THE CHRONOLOGY OF A DISASTER

A review and assessment of the value of acting early on household welfare

Ruth Hill, Emmanuel Skoufias, and Barry Maher

January 2019

WORLD BANK GROUP

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Abbreviations

CAT DDO	Catastrophe Deferred Drawdown Option
DHS	Demographic and Health Surveys
FAO	Food and Agriculture Organization of the United Nations
HAZ	height-for-age z-score
LAZ	length-for-age z-score
mVAM	mobile Vulnerability Analysis and Mapping
PDNA	post-disaster needs assessment (PDNA)
PMFBY	Pradhan Mantri Fasal Bima Yojana
pp	percentage point
sd	standard deviation
SPI	Standardized Precipitation Index
SSA	Sub-Saharan Africa
WFP	World Food Programme

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KEY FINDINGS

1. On average, lost incomes account for 43 percent of the cost of fast-onset disasters (such as earthquakes, floods, or hurricanes) in Asia and small island states, as estimated in post-disaster needs assessments (PDNAs). Private asset losses are typically estimated to be more than public asset losses.
2. A review of emergency assessments that collected household survey data after a fast-onset disaster shows that the proportion of households reporting a reduction in consumption or consumption of less-preferred foods is high in the immediate aftermath and then improves after a few months. Importantly, (i) effects are larger for poor households, and (ii) women tend to be impacted worse than men.
3. High-frequency data collected during six droughts in eastern and southern Africa shows that (on average) nutrition decelerates more rapidly than at other times from 5 months after the start of harvest until 11 months after the start of harvest than at other times. In the one conflict setting for which data was available, the reduction in nutrition was immediate.
4. The cost of not getting a response in place in time to meet the consumption needs of those suffering from drought is 3.9 percent lower income (GDP) per capita in the long-run. The gain from an emergency response that is one month quicker is 0.8 percent of income per capita in the long run.
5. The proportion of households reporting borrowing to meet household needs increases with time after both rapid-onset and slow-onset disasters. Poor households, which lack access to finance from formal banking institutions, are more likely to resort to informal borrowing with higher interest on loans.
6. The sale of productive assets also increases with time, although this is reported less often.
7. Connecting markets appears important for mitigating the price impacts of shocks. Analysis from Ethiopia suggests that if markets are not well connected, drought will have an impact on prices in local markets as early as two months after the start of harvest. However, prices are minimally impacted in well-integrated markets.

1. Introduction

When shocks strike they have an immediate and direct impact on life, income, and assets. This review does not aim to quantify these losses but rather to quantify the welfare gain to households of intervening early to replace lost income and assets. The impact of a shock on household welfare is the cumulative effect of the initial income or asset loss and the impact of a series of entitlement failures in the local economy that is triggered by this initial loss (Sen 1981; Devereux 2007). Much of the literature on the impact of shocks has focused on the cumulative welfare impact, and little attention has been given to the progression of entitlement failures and the timing of their impact. As a result, it has been difficult to quantify the welfare benefit of intervening earlier rather than later to mitigate the impact of the shock.

Two strands of literature can be usefully brought together to generate some initial indicative estimates of the timing of a shock's impacts, and thus the likely benefit of acting early to mitigate these impacts:

1. Post-disaster and vulnerability assessments that explain how the impact of different disasters unfolds, that estimate losses from assets and income, or that present data on coping mechanisms used
2. Micro econometric studies that assess the cost imposed by coping strategies on income and growth

An initial assessment of this literature was undertaken in Clarke and Hill (2013) for drought in Africa. This paper extends and updates this review by (i) adding new studies published in the last five years; and (ii) including studies outside of Africa and considering other types of disaster in addition to drought—specifically floods and earthquakes in Asia, and earthquakes, cyclones, or hurricanes in small island states (Pacific, Caribbean).

We find that across settings and types of shock considered by this paper, the most prevalent coping mechanism used by households was to reduce food consumption. This finding is consistent with a well-published literature showing that variability of income over time impacts child nutrition and can be linked to stunting, a condition that causes irrevocable harm by impairing brain development, leading to lower cognitive and socioemotional skills, lower levels of educational attainment, and hence lower incomes. We use data on consumption losses and nutrition outcomes collected in the months after a disaster to detail the timing of this impact to the extent possible. The data on which to draw is limited, but clear patterns do emerge. The timing of the impact is quite different for rapid-onset shocks like earthquakes, floods, and hurricanes, which destroy both income and assets, than it is for drought, a slow-onset shock primarily impacting income. **In the case of earthquakes, floods, and hurricanes, nutrition is impacted immediately and improves after a few months. High-frequency data collected during six droughts in eastern and southern Africa shows that after drought, nutrition (on average) decelerates more rapidly than at other times, from 5 months after the start of harvest until 11 months after the start of harvest. The reduction in nutrition was immediate, however, in the one conflict setting for which data was available (Somalia).**

We estimate that the cost of not getting a response in place in time to meet the consumption needs of those suffering from drought is 3.9 percent lower income (GDP) per capita in the long-run. The gain from an emergency response that is one month quicker is 0.8 percent of income per capita in the long run.

The paper proceeds as follows. Section 2 sets out the framework and approach used. Section 3 presents evidence on rapid-onset events, section 4 on slow-onset events, and section 5 on prices. Section 6 offers some conclusions and recommendations for future data collection.

2. Framework and approach

2.1. FRAMEWORK

In looking at the economic costs of disasters, it is useful to separate those that arise from the loss of assets (such as loss of a family home in an earthquake) from the loss of income (such as the loss of family farm income due to drought-induced crop damage). This distinction is a bit stylized, as some asset losses result in income losses. Each of these costs has an immediate impact on welfare, but the cost of the loss can escalate if additional income-earning opportunities are lost, or if costly coping strategies are undertaken.

The possible channels of a welfare impact from the loss of private assets are depicted in figure 2.1. It is possible for asset losses to have little impact on welfare or income growth if households are able to deplete savings to replace assets, or if they can increase income from other sources with little cost (such as by working additional hours or receiving transfers from family members). These are shown as light circles in the diagram. However, many of the other strategies used by households can be costly and can impact a household's present welfare or its ability to improve its welfare in the long run; these are represented by the shaded circles. Families may take loans to replace assets, and for poorer households with little access to formal banking channels, these loans often come with high interest. Household members sometimes increase income by taking on additional work that carries a high cost, including risky work such as prostitution. Households can also divert resources from productive investments, such as investments in their child's schooling or inputs for the next crop. Or they may sell productive assets such as livestock to replace the asset lost.

Sometimes households reduce consumption to replace a lost asset. This approach has immediate impacts on welfare; for children, pregnant women, or lactating mothers, it can also have long-run effects on physical and cognitive development. The direct and indirect impacts of disasters may have a greater effect on women and girls than on men and boys, and there is evidence that females are more likely

to die, reduce their consumption, and be taken out of school than males (Baez, de la Fuente, and Santos 2010).

Another important channel through which earthquakes, floods, and hurricanes can influence welfare is the alteration of the disease environment net of any parental response to child illness. These events may cause damage to water and sanitation facilities, thus increasing their association with higher contemporaneous incidence of diarrheal disease, and even typhoid and cholera (WHO 2002). Disasters can also reduce access to health facilities, and standing water indirectly leads to an increase in vector-borne diseases (such as malaria and dengue) by increasing the number of vector habitats and expanding their range. Such illnesses lower the capacity to take in and retain essential nutrients from food. Insofar as parents cannot entirely prevent or perfectly ameliorate these effects of illness on their children, disaster shocks will have a negative impact on nutritional status through the disease channel.

Private asset loss can also have an immediate and long-run impact on welfare when productive assets are damaged and income is lost as a result. For example, loss of electricity or workspace, or loss of agricultural land to salinity in coastal flooding, can have an immediate impact on income that lasts until the lost asset can be replaced.

FIGURE 2.1: POSSIBLE WELFARE IMPACTS OF LOSS OF ASSETS

Note: WASH = water, sanitation, and hygiene. Circles with teal outline indicate outcomes with little negative impact on welfare. Red arrows indicate coping strategies that have knock on impacts on prices and thus an indirect impact on welfare (good or bad for different households).

Disasters can also cause income losses through other means. When public assets such as bridges and roads are damaged, market access can be limited. The loss of standing crops in the field due to disaster not only has an immediate impact on welfare, but can also have knock-on impacts that cause additional and sustained impacts on welfare. These mechanisms, shown in figure 2.2, are the same as those highlighted in figure 2.1, but they are no longer being undertaken in order to replace an asset; they are being undertaken in order to compensate for losses in income.

FIGURE 2.2: POSSIBLE WELFARE IMPACTS OF LOSS OF INCOME

Note: Circles with yellow outline indicate outcomes with little negative impact on welfare. Red arrows indicate coping strategies that have knock on impacts on prices and thus an indirect impact on welfare (good or bad for different households).

Insofar as households are spatially dispersed and transport infrastructure is weak, markets in food staples may not be well integrated. Localized rainfall shocks may consequently influence food prices. These price effects can compound the the loss of income and cause others who did not lose income to suffer. If the income shock is large enough relative to the size of the market to meaningfully impact local supply or demand, it has an immediate effect on prices and wages. Coping strategies can also have a knock-on impact on prices, as indicated by the red arrows in figure 2.2. If supply of labor increases, wages can fall. Similarly, if there is oversupply of assets (e.g., livestock) or other goods (e.g., charcoal and wild products) that are sold to make up lost income, prices for these assets can fall.

There are three broad mechanisms by which early action brings economic benefits to households:

One mechanism is the benefit that arises from replacing assets more quickly. This allows income losses resulting from productive asset losses to be minimized. Estimating this benefit requires an estimate of the economic return to the asset lost within a given time frame.

A second mechanism is the benefit from avoiding costly coping strategies associated with lost income and assets. Estimating the gains from avoiding costly coping strategies requires an estimate of the probability that each strategy is used in each month post-disaster and an estimate of the economic cost of engaging in the coping strategy. The key questions in this case are (i) how likely is it that the costly coping strategies will be undertaken; (ii) at what point (i.e., how many months) after a shock do households start to engage in the costly coping strategies; and (iii) what is the economic impact of engaging in these coping strategies?

A third mechanism is the benefit from ameliorating any price impacts of a disaster. Estimating the effect of acting early on reducing the negative price effects requires an assessment of when knock-on price impacts occur and how large they are.

2.2. APPROACH: ASSESSING THE TIMING OF IMPACTS

This paper reviews humanitarian and post-disaster needs assessments to answer the following questions:

1. What is the relative importance of asset and income losses following a disaster? What types of assets are lost, and what do we know about the timing of their return relative to when they were lost?
2. What is the prevalence of different coping strategies? For the most common coping strategies, what do we know about the timing of their use?
3. What do we know about the timing of price impacts?

Question 1 is considered with respect to floods and earthquakes in South Asia, and with respect to earthquakes, hurricanes, and cyclones in small island states. Question 2 is considered with respect to these same disasters as well as drought in Africa. The geographical bounds for the work were chosen to make the search and analysis of humanitarian reports possible with the resources available, and based on the focus of World Bank operational work in these regions. . As Baez, Fuchs, and Castelan (2017) show, the regions focused on here are not the only ones affected by these shocks. In addition to its regional focus, the analysis for question 2 focused exclusively on assessments from 2012 to 2017. This was for two reasons: (i) we wished to expand on the review in Hill and Clarke (2013), which covers a number of reports up to 2012; and (ii) the number of humanitarian reports

BOX 1: TYPES OF REPORTS REVIEWED

Post-disaster needs assessments. These are cross-sectoral needs assessments often conducted by governments with support from the World Bank in the aftermath of a sudden-onset disaster. Their goal is to quantify the value of assets lost and to estimate the income losses that are likely to accrue from the loss of these assets. PDNAs are based on sector expert assessments and take into account any available data. They often focus on the physical losses rather than the household response, but they do include a discussion of how livelihoods and service delivery are affected.

Food security assessments. These are often conducted by the World Food Programme and sometimes by other United Nations agencies as well, such as the Food and Agriculture Organization of the United Nations (FAO), which carries out Crop and Food Security Assessments and UNICEF. They focus on assessing whether households are reducing consumption to cope with a shock and what other types of coping mechanisms are being used. There is often some primary data collection that supports the assessment.

Vulnerability analysis and mapping reports. These are regular assessments of food security undertaken by the World Food Programme. The ones reviewed here are the monthly bulletins on the mobile Vulnerability Analysis and Mapping (mVAM) survey results. These often focus only on consumption coping mechanisms utilized by households, given that the surveys are conducted over the phone.

In addition, Food Security and Nutrition Analysis Unit (FSNAU) data on admissions to feeding programs is used.

available online is greater for this period. The full list of assessments reviewed is presented in annex 1, and the broad assessment categories considered are listed in box 1. Question 3 is answered using data for Ethiopia that has been used to answer this question in Hill and Fuje (2018).

This is the first time data of this kind has been compiled from humanitarian and food security assessments across countries. The literature review highlights that there is considerable data available in humanitarian and post-disaster needs assessments. It is important to remember, however, that these assessments were undertaken quickly in data-constrained environments. While many of them are based on an impressive amount of information, there are a number of data limitations that are worth noting as caveats:

- **Lack of quantification:** Coping mechanisms are often discussed in reports in qualitative terms; there is no survey data to draw on to quantify the number of households using a given mechanism. It is not clear how the sites that inform the qualitative analysis have been selected, and it is also not obvious how to assess the analysis bias. It could be that places that are easier to reach and with a better emergency response are more likely to be visited; alternatively, it could be that places that are hardest hit are visited.

- **Lack of standard definitions:** Different agencies use different lists of coping mechanisms in their reports. It is not always clear what type of response falls into a given category. It is sometimes hard to tell whether data on a given mechanism has not collected, or whether it has been collected but was not prevalent. As much as possible, we try to make the distinction clear in the data that is reported. The coping strategy for which data is the most consistently and reliably collected is reduced consumption. In some cases, data on worsening nutrition outcomes is also collected. Given the value of this data to others beyond the agency compiling the report, it would be very useful to develop more standard definitions and lists that could be used for various coping strategies.

- **Lack of information on sampling:** In all cases, it is not clear how representative the reported data is. Assessments often fail to describe the types of communities and respondents they include, or how the communities and respondents were selected. Again, it is not clear what type of biases will be present. It would be very helpful for assessments to provide more information on how sampling was done. Without this, comparisons across space or time can be difficult. Many of the studies rely on mobile phone surveys conducted monthly with the same set of households and using standard definitions of consumption coping that do not change across settings. In these surveys, the sample is often defined before the onset of a disaster. However, little information is available on how the sample was selected or on attrition rates over time.

2.3. APPROACH: QUANTIFYING THE COST OF A SLOW RESPONSE

PDNAs include a financial assessment of the value of asset and income losses. However, the food security assessments and the mobile Vulnerability Analysis and Mapping (mVAM) reports focus on the percentage of households engaged in negative coping mechanisms. The second part of our approach is to calculate the financial cost of engaging in negative coping mechanisms. Negative coping mechanisms can be expensive—for the state, the community, and the household. They increase the incidence of stunting (an irrevocable impact), hence reducing income for a lifetime. They lead the poorest to sell their productive assets , thus reducing their ability to earn income moving forward. They lead to borrowing that can leave the poorest burdened with crippling debt, which consumes future earnings of the household with interest repayments. All these impacts ultimately reduce income growth and increase poverty.

The majority of the impacts on which we have data are reductions in consumption and the increases in malnutrition that result. Below, we review the literature on the economic costs of malnutrition in order to value the increased malnutrition in financial terms.

When children in the early stages of life do not consume adequate food and lack access to health, water and sanitation, and other needed services, they are more likely to suffer delayed growth, with serious costs that are eventually borne by the rest of society. Lack of access to *the underlying determinants* of good nutrition and long-term well-being are associated with immediate costs in child welfare: no access or inadequate access to the drivers of nutrition is associated with undernutrition and diarrheal disease. But there are also important long-term consequences, both for the individual and society, associated with the chronic undernutrition of children: a high risk of stunting and impaired cognitive development, as well as lower school attendance rates, reduced human capital attainment, and a higher risk of chronic disease and health problems in adulthood than better-nourished peer (Black et al. 2013; Hoddinott et al. 2013). Thus lack of access to services early in a child's life also contributes to an increased probability that he or she will be poor as an adult.

In later life, the negative outcomes of inadequate childhood nutrition are numerous, and some can even be quantified in economic terms. Those who are stunted have 1.6 fewer years of education on average, are 6 cm shorter, and have 0.625 standard deviations lower outcomes on cognitive tests. As a result of childhood stunting, individual income and economic growth is reduced. Galasso and Wagstaff (2018) estimate the cost of childhood stunting to be 9–10 percent of GDP per capita for countries in Africa and Asia. We use the framework and parameters in Galasso and Wagstaff (2018) to calculate the cost of increases in malnutrition that are likely to result from a delay in response.

3. Rapid-onset events

3.1. A REVIEW OF POST-DISASTER NEEDS ASSESSMENTS

When floods, earthquakes, and cyclones occur, they damage both public and private assets. A review of PDNAs for floods, earthquakes, and cyclones that occurred in the last five years in the geographic regions considered in this report show that on average, 14 percent of the cost of the disaster is loss of public assets, while 25 percent is the loss of private assets. The primary private asset loss is housing. However, rapid-onset disasters also cause income losses, because the disaster-related asset losses result in lost income. The damage to assets is immediate and not affected by the timing of response, but the income losses accrue in the period one to three years after the disaster, and they can be reduced by quicker reconstruction of public and private buildings, infrastructure, and productive assets such as seed stocks and production equipment. The income losses can be substantial, ranging from 14 percent for floods in Pakistan to 64 percent for a cyclone in the Seychelles.

The review of PDNAs for fast-onset disasters in small island states and South Asia shows that on average, 43 percent of the estimated cost of the disaster results from income lost (figure 3.1). The per capita value of these losses is indicated in figure 3.2 and ranges from $3 to $503 per capita. The costs are higher for smaller states, as a larger share of the country is usually affected by a disaster. When the cost of the disaster is divided by the number of people affected, this pattern is unlikely to be present. Reducing the recovery time would yield significant economic gains for most countries. Post-disaster needs assessments do not provide information on the time period considered for calculating income losses, nor information on the assumptions that go into the calculations. Without this information, it is not possible to assess how much would be saved by reducing response time by a month.

The loss of income is 80–90 percent private income, and a large part of the income loss is in agriculture. The losses in agriculture arise from a loss of future harvests (from tools and inputs lost) or from income lost due to the death of livestock (see table 3.1 for select details compiled from different reports). This loss of income is thus similar to the loss of income that results from drought in Africa.

FIGURE 3.1: DISTRIBUTION OF DAMAGES AND LOSSES DUE TO FAST-ONSET DISASTERS (SMALL ISLAND STATES AND ASIA)

Source: Analysis of PDNAs for events occurring in the countries included.

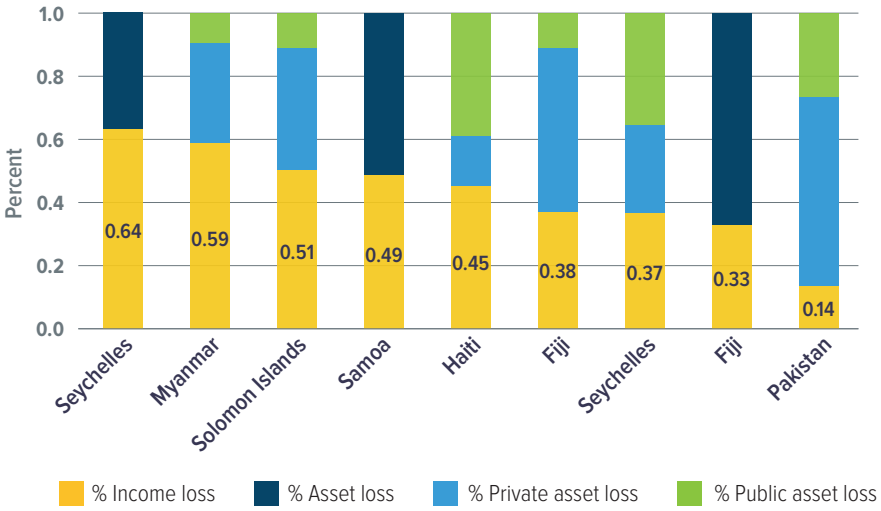
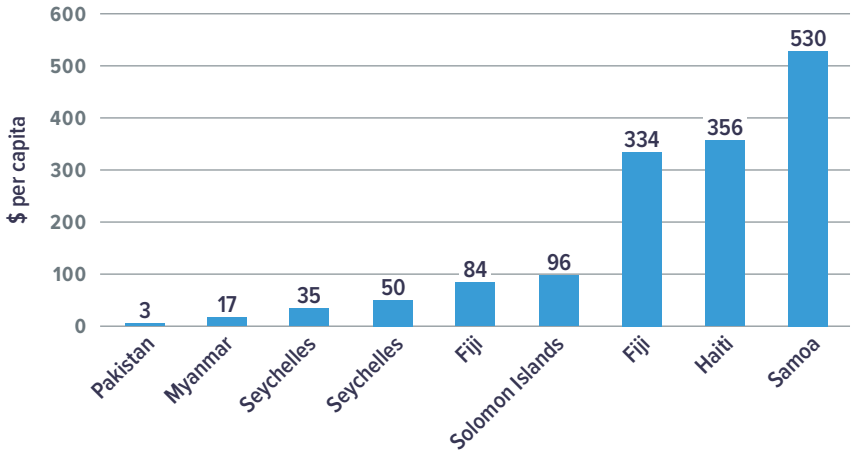


FIGURE 3.2: INCOME LOSSES PER CAPITA DUE TO FAST-ONSET DISASTERS (SMALL ISLAND STATES AND ASIA)

Source: Analysis of PDNAs for events occurring in the countries included.



Droughts always result in crop income losses and can lead to livestock losses, but they do not otherwise bring direct asset losses. A second source of income lost from earthquakes, hurricanes, cyclones, and floods is loss of jobs, damage to industry and service sectors, or disrupted access to power and markets. This loss can be quite large when a tourist season is lost.

When incomes are seasonal (either because of crop production or tourist seasons), the timing of floods, earthquakes, and cyclones determines the level of income losses they bring. If the asset or income lost is not replaced in advance of the next season, income losses are compounded, as shown in table 3.1. The response needs to occur sooner than the start of the next season to avoid these additional losses. The speed of response required thus depends on the timing of the disaster. Figure 3.3, taken from a report produced by the Food Security Cluster after the Nepal earthquake, shows the earthquake's very different impact on rice and wheat harvests, given their different timing in relation to the earthquake.

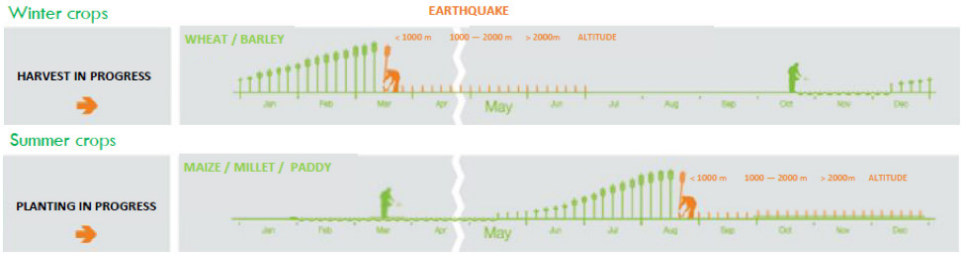
In addition to causing loss of household assets, disasters cause damage to public assets and infrastructure that results in reduced access to markets and basic services. These losses lead to increased health risks, which are often documented in emergency assessments. Although the PDNAs we reviewed often reported substantial damage to educational facilities, few PDNAs recorded substantial impacts on educational attainment as a result. Schools or students were relocated and school years lengthened to make up for the lost time, which was usually not more than a week or two. The one exception was in Pakistan, where 733,000 students were reported to be out of school. The PDNA did not detail how long they were out of school, however, so it is difficult to assess the impact on educational outcomes.

TABLE 3.1: INCOME AND ASSET LOSSES IN DISASTERS

Event	Loss of food stocks	Percent of those affected who lost productive assets	Loss of income	Was future cropping season affected?
Nepal flood 2017	30–60% of food stocks were lost; in the most-affected districts, 80% of households lost their entire food stock			
Nepal earthquake 2015	38% of food stocks were not recoverable among earthquake-affected households	70.5% (agricultural tools/ inputs) 50% (seeds)	75% of agricultural laborer reported losing income in first month: two-thirds report more than 30% income loss, one-third report total income loss. Income losses of traders were reported to be 30% on average. 22% of farmers reported standing crop losses of 50%.	Yes, but not clear by how much
Haiti hurricane 2016	Two-thirds of households lost 75% of food stocks	39% (plot damage)		Overall reduced by a third
Cambodia floods		The most common household assets destroyed were fishing nets (33 percent), boats (21 percent), rice mills (19 percent), bicycles (19 percent), and water pumps (14 percent).	90% of farmers reported lost income and most fishermen.	
Philippines typhoon 2009		50% lost seeds, 25% inputs	40% of surveyed households lost their entire crop	
Pakistan floods 2010		40% livestock, 55% seeds	88% of expected harvest was lost	2% reduction in expenditure on inputs
Haiti earthquake 2010		Yes, some	42% of those affected lost income	8% reduction in spending on inputs
Lao PDR typhoon 2009		1–14% livestock, 45% fish ponds	70% of expected harvest was lost	

FIGURE 3.3: IMPACTS OF DISASTER'S TIMING RELATIVE TO SEASON ON THE BENEFIT OF ACTING EARLY

Source: Nepal Food Security Cluster 2015.

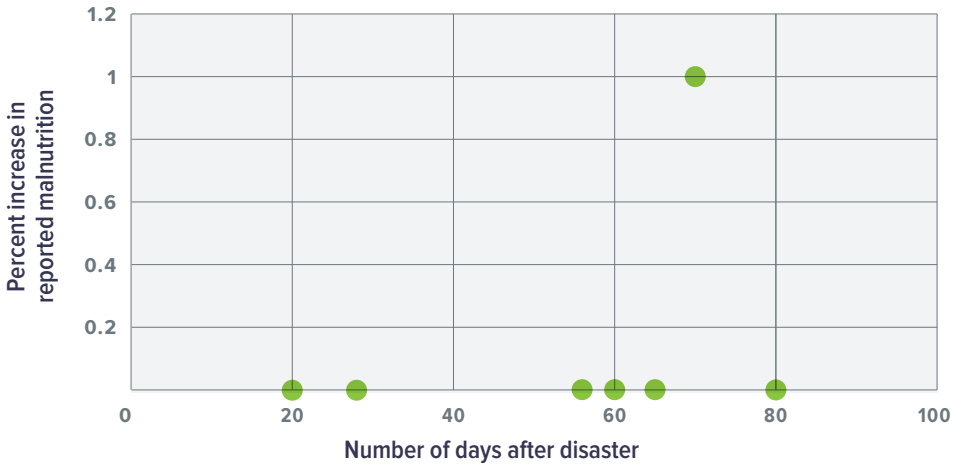


3.2. A REVIEW OF EMERGENCY ASSESSMENTS THAT INCLUDE HOUSEHOLD SURVEY DATA COLLECTION

PDNAs have very limited information on the coping strategies that households use, and few report worsening nutrition outcomes in the first weeks of a disaster (see figure 3.4). Some PDNAs are perhaps conducted too early to record poor food security outcomes, but some do state that food security may become more of an issue as time passes. For example, according to the Samoan needs assessment conducted four weeks after a cyclone, respondents reported no significant changes in consumption for the first few weeks following the cyclone, as they could salvage the bananas, coconuts, and breadfruit that had fallen during the storm. However, the PDNA noted that even as it was conducting its assessment, these supplies were starting to dwindle, and some households indicated that they were eating less or eating fewer types of foods.

FIGURE 3.4: FEW PDNAS CONDUCTED IN THE IMMEDIATE AFTERMATH OF A DISASTER REPORT NUTRITION IMPACTS

Source: Analysis of PDNAs for events occurring in the countries included.



However, as discussed below, other assessments conducted similarly quickly after a disaster do record larger effects on consumption immediately after a disaster, which suggests that PDNAs should routinely collect data on coping strategies and reductions in consumption. Given the strong link between disasters, negative coping and the twin goals of the World Bank, this report recommends that questions on coping strategies be added to the standardized template of questions asked of community members during PDNAs.

Table 3.2 summarizes the use of coping mechanisms in the aftermath of earthquakes, hurricanes, floods, and typhoons, as reported in assessments other than PDNAs conducted in the aftermath of these disasters. These assessments report on quantitative surveys, which limits the number of events considered and biases the assessments toward larger countries than is the case for PDNAs. Table 3.2 includes the number of days after the disaster that the assessment was conducted and the percentage of households in affected areas that reported using various coping mechanisms during the assessment. It summarizes 10 reports for seven events. Not all reports provided information on all shocks. The cells are blank when this data was not collected. From these 10 assessments, some clear patterns start to emerge: borrowing and reducing consumption are frequently used coping mechanisms, whereas other coping mechanisms—selling livestock or other productive assets, taking children out of school, reducing health expenses, begging, and migrating—are used much less frequently.

For all coping mechanisms that were reported more than five times, we graphed the prevalence of the mechanism against the number of days after the disaster that the assessment was conducted (figure 3.5). These graphs pool disasters, rather than examining how the same disaster has progressed over time, so the findings should be interpreted with caution. However, the key findings presented here also hold for the two disasters where data was collected at multiple points in time post-disaster (figure 3.6). There are two key findings that emerge.

First, the proportion of households reporting a reduction in consumption or consumption of less-preferred foods is high in the immediate aftermath of a

TABLE 3.2: USE OF COPING MECHANISMS IN THE AFTERMATH OF EARTHQUAKES, HURRICANES, FLOODS, AND TYPHOONS

Event	Days after shock	Proportion of households reporting											
		Borrow	Borrow food	Sell livestock	Eat seed stock	Sell land	Eat less	Eat less-preferred food	Take children out of school	Decrease health expenses	Beg	Migrate	Reduce area cultivated
Nepal earthquake 2015	20	50% (mountains) 25% (elsewhere)	44%				39%	55%					
	150	46%	16%	3%	3%	0%	7%	9%	0[a]				Yes, not clear how much
Haiti hurricane 2016[b]	7	(1%)		(15%)		(1%)			(0%)		(2%)		
	70	33% (40%)		11% (20%)	16%	3% (2%)	74%	77%	4% (9%)		7%[c] (7%)		
	300	60%	48%	42% (includes house)			33%	33%			30%	40%	Overall reduced by a third
Cambodia flood 2011	120	40%[d]					15%	37%	15% increase in child labor				
Philippines typhoon and flood 2009	40	51%	37%	5%			25% infants 12% children 39% adults	79%	6%			9%	
Pakistan floods 2010	30	34%	33%	8%	3%	0%	26%	36%	4%	6%		1%	2% reduction in spending on inputs
Haiti earthquake 2010	25	65%		7%	12%				--	16%	--		8% reduction in spending on inputs
Lao PDR flood 2009	25	61%					65%	42%	20% of displaced			19%	

Source: Based on 10 non-PDNA report for seven events.

Note: Cells are left blank when no data was collected.

a. The highest share reported was 4 percent in one district, but there was no overall difference after the earthquake as attendance increased in some districts.

b. Numbers in brackets refer to the three departments of Grand-Anse, Nippes, and Sud. Numbers not in brackets refer to all affected areas..

c. An increase in charcoal selling was reported.

d. This figure reflects 50 percent for poorest and 22 percent for the richest.

disaster and falls over time. In contrast to figure 3.4, which suggested little initial impact of a disaster on nutrition outcomes, figure 3.5 suggests that households adjust adult consumption immediately after disaster. Data on the Philippines for nursing infants and children also showed reduced consumption within two months of the flood (table 3.2). Figure 3.5 also shows that the proportion of households reporting food reductions falls over time. Given that the data is self-reported, it is not clear whether this reflects households becoming accustomed to the new type and quantity of food produced, the arrival of food aid, or the fact that this coping strategy is not sustained over the long run. Data collected on food consumption suggests that there are improvements in food consumption over time after an initial large spike in reduced consumption (figure 3.6).

The studies note important differences in the impact of the disaster on consumption, with poorer households reporting bigger impacts. In Nepal, households engaged in agricultural daily labor had the highest rates of adopting food-based coping strategies. Elevation also proved to be a strong predictor of whether a household adopted food-based coping strategies (elevation was also an important predictor of poverty prior to the disaster). A quarter of households residing in the high hills resorted to borrowing food at least once in the week prior to a survey, compared to only 11 percent of households in the low hills.

There can also be important gender differences in malnutrition impacts. These differences are often present within households, not just between female-headed and male-headed households. After the floods in 2010, 11 percent of households in Pakistan reported that one of the coping strategies engaged in was for women to eat less food than men.

The second key finding to emerge is that the proportion of households reporting borrowing to meet household needs increases across time. The case of Nepal after the earthquake is typical. After the earthquake, household debt levels rose high, with a quarter of all outstanding debt accumulated in the six months following the earthquake. A similar increase over time was observed for the less prevalent strategies of selling productive assets (in this case livestock) and withdrawing children from school (figure 3.7). Again, the initial poverty of a household increases the likelihood that these coping strategies are undertaken. In Haiti, poorer households relied more than less poor households on negative coping strategies such as the sale of assets and begging. In Nepal, poorer households were more likely to incur higher interest rates on loans than less poor households (Walker, Khadka, and Pandey 2017).

FIGURE 3.5: SHARE OF HOUSEHOLDS REPORTING EATING LESS OR EATING LESS PREFERRED FOODS IN THE DAYS AFTER A FAST-ONSET DISASTER

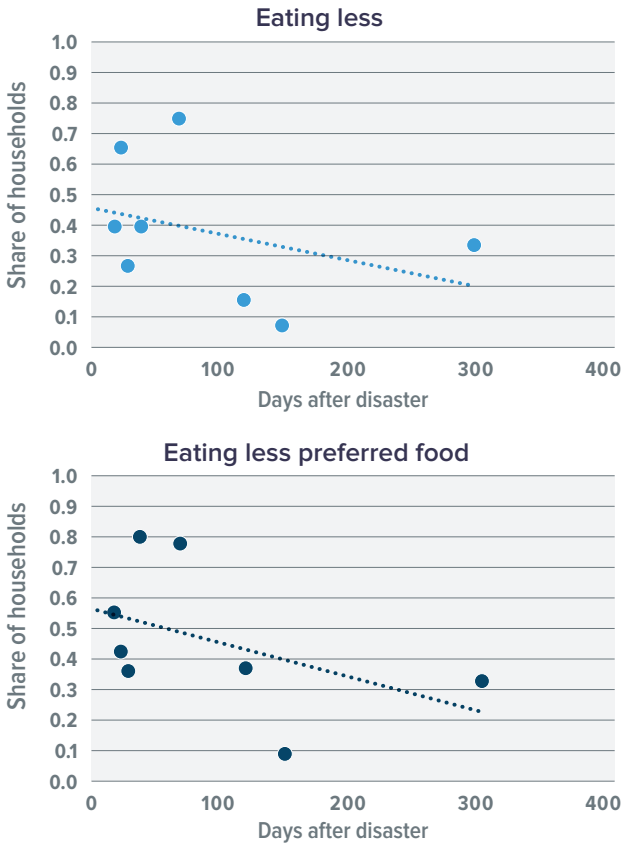


FIGURE 3.6: CONSUMPTION TRENDS IN REPEATED ASSESSMENTS FOLLOWING EARTHQUAKE IN NEPAL AND HURRICANE IN HAITI

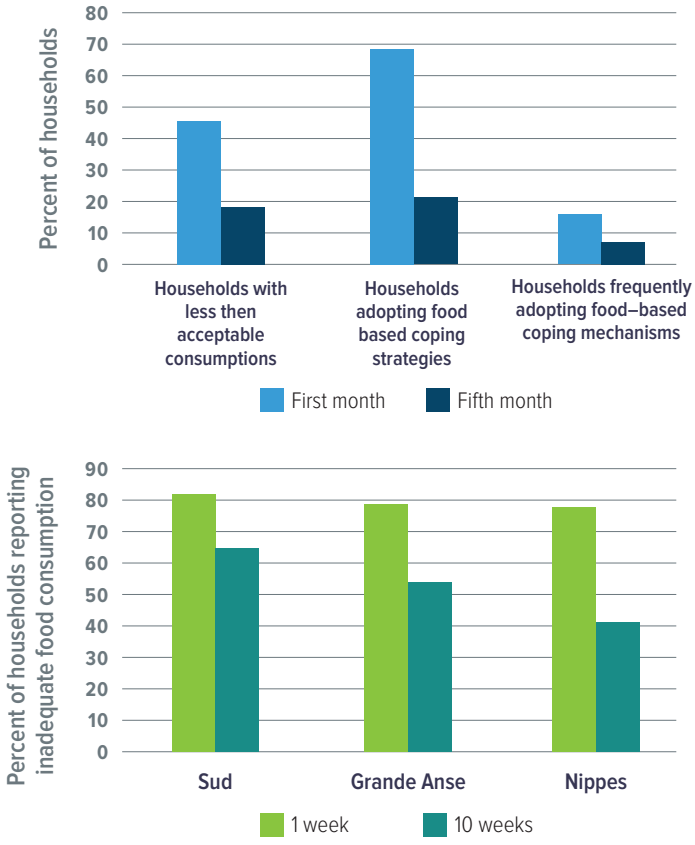
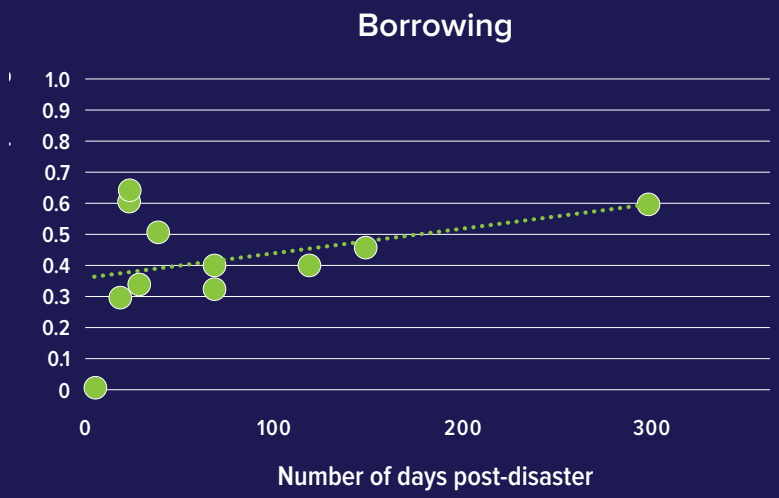
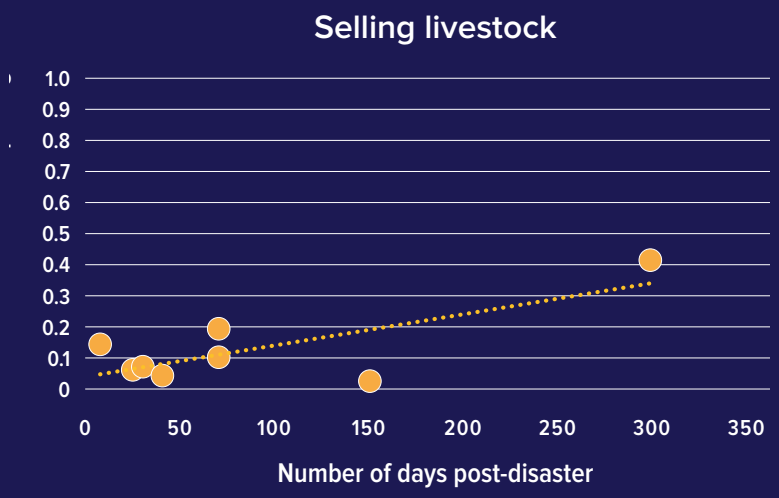
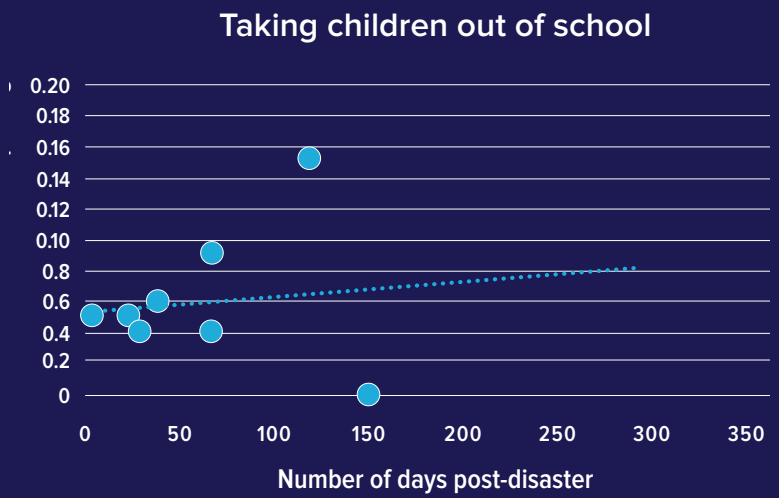


FIGURE 3.7: SHARE OF HOUSEHOLDS REPORTING BORROWING, ASSET SALES AND TAKING CHILDREN OUT OF SCHOOL IN THE DAYS AFTER A FAST-ONSET DISASTER







4. Slow-onset events

4.1. A REVIEW OF EMERGENCY ASSESSMENTS THAT INCLUDE HOUSEHOLD SURVEY DATA COLLECTION

Comparatively few post-disaster assessments for African countries contain information on the relative importance of different coping strategies after rain failure. Assessments for Africa tend to include more quantitative data on consumption impacts of rain failure. We reviewed the available data in both cases and describe it below.

A pattern similar to that for rapid-onset events seems to emerge: reduced consumption and higher rates of borrowing are the main means by which households cope following the failure of rains in Africa. Sales of productive assets and withdrawal of children from school are also reported, but much less often (table 4.1). This finding is consistent with the review of academic literature on coping mechanisms and the review of Household Economy Analyses on coping mechanisms that was reported in Clarke and Hill (2013) and is summarized in figure 4.1. Dercon (2004) provides a description of the coping strategies households used during the famine in Ethiopia in the mid-1980s. He finds that 85 percent

FIGURE 4.1: PREVALENCE OF COPING STRATEGIES TO MANAGE DROUGHTS: REVIEW OF ACADEMIC LITERATURE AND THE HOUSEHOLD ECONOMY ANALYSES

Source: Calculated using data presented in Clarke and Hill (2013).

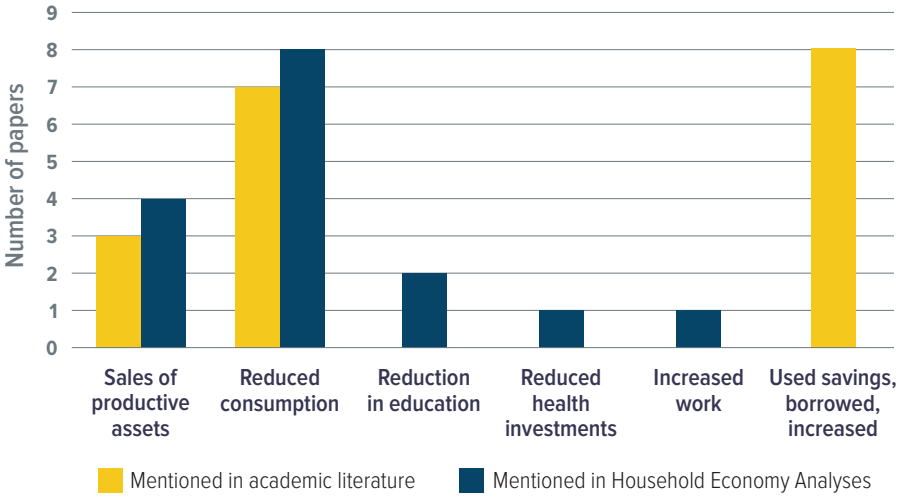


TABLE 4.1: PREVALENCE OF COPING STRATEGIES TO MANAGE DROUGHTS

Event	Borrow	Sell livestock	Sell other productive assets	Eat less	Eat less-preferred food	Take children out of school	Beg/ engage in prostitution	Migrate
Chad	59%	19% (breeding animals) 37% (destocking)	10%	Combined data suggests a high proportion of households engaging in these strategies		8%	2%	23%
Uganda (Karamoja)	56%			78%	81%			

of households reduced food consumption, 39 percent sold valuables (on average 29 percent of livestock holdings were liquidated), 7 percent migrated in distress, and 11 percent had at least one member go to a feeding camp. This ordering of the prevalence of coping strategies (reduced consumption, liquidation of assets, and distress migration in some form) was constant in every village, even though the severity of harvest failure varied across villages.

Sales of productive assets are usually in the form of livestock sales. Land sales are rare throughout Sub-Saharan Africa (SSA), partly because of legal restrictions or limited certification of property rights, and partly because land is relatively abundant (Platteau 1992). There is a considerable literature on the degree to which livestock is sold in times of famine, and it is worth spending some time discussing the evidence on this point. In Burkina Faso in 1984, combined livestock sales offset 15 to 30 percent of the income losses resulting from drought during this period (Fafchamps, Udry, and Czukas 1998), while more than half of the drought-induced crop losses during this period were passed on to reduced consumption (Kazianga and Udry 2006). In southern Ethiopia, drought did not trigger sales of livestock (Lybbert et al. 2004); and in northern Kenya, instead of liquidating assets to finance consumption in drought, households chose to protect the assets they had by reducing food intake and energy levels (McPeak and Barrett 2001). These

studies conclude that although considerable anthropological and anecdotal work shows how sales of productive assets are used to smooth consumption, there is little econometric evidence suggesting that this strategy is the main way households cope with droughts. Rahmato (1991) found that during the 1984–85 famine in Ethiopia, households cut their consumption to dangerously low levels rather than sell off assets, once the assets' terms of trade had collapsed. This is not to say that productive assets are not sold. Rather, they appear to be sold by households with more assets to begin with. This has been shown for Zimbabwe (Hoddinott 2006) and Ethiopia (Little et al. 2006).

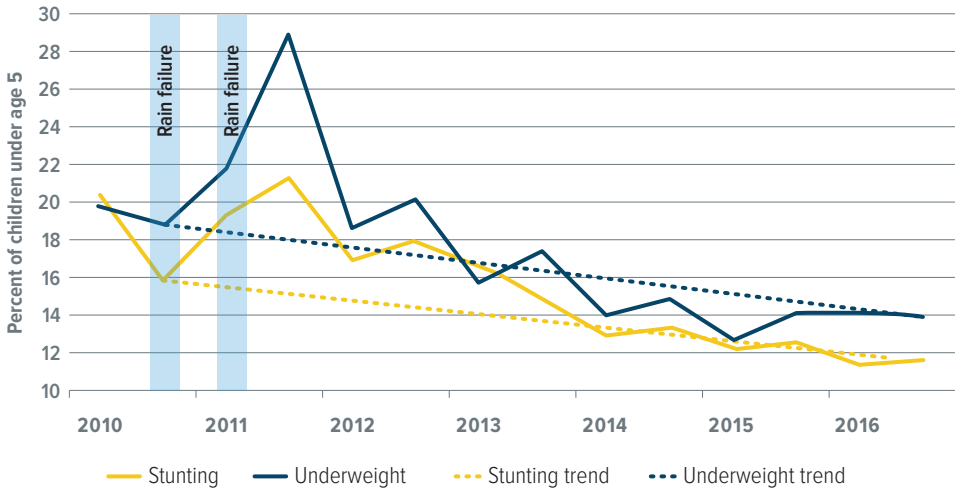
There are a few countries with frequently collected data on the most commonly reported coping strategy—that is, reductions in consumption over time—and this data is the focus of the analysis below. The analysis draws on data from six droughts in four countries in eastern and southern Africa, including monthly or bimonthly data on coping strategies collected in mVAM surveys conducted by the World Food Programme (WFP). It also makes use of the frequent data on nutrition outcomes and enrollment in nutrition programs available for Malawi, Somalia, and Uganda.

The impact of drought on frequently reported food security measures or measures of underweight and stunting is presented for countries in the graphs below. Each graph also indicates when the rainfall deficiency occurred and, for cropping seasons, the timing of the crop harvest. It is important to note that even in the absence of rainfall shortfalls, there is a natural increase in food insecurity and undernutrition during the lean season (the months in the run-up to the harvest). The effect of a drought is to add to this pattern of seasonality, and the graphs try to indicate this where possible by including available data from the season before the drought. In many cases, drought appears to lengthen and deepen the lean season following the harvest that was affected by drought.

SOMALIA

There was very little humanitarian response in Somalia following the early warning reports that indicated the Deyr 2010 and Gu 2011 rains had failed. It was not until July of 2011 that a famine was declared and fundraising for the response started. Rates of stunting and underweight had been high in 2009, but were falling prior to the rain failure. However, both started increasing immediately after the first rain failure, and underweight increased by 32 percent in the **six months from the second rain failure** (figure 4.2). The incidence of underweight fell rapidly as aid and good rains ensued, but the rate of stunting was persistently 14–50 percent higher than the trend average throughout 2012 to 2013.

FIGURE 4.2: THE 2010–11 DROUGHT IN SOMALIA



MALAWI

The maize harvest from April to July in Malawi is still the main source of income for most of Malawi's rural households. Thus the period running up to the harvest, when the rains fall, is a lean season (figure 4.3) in which, even in a good year, households deplete assets, borrow, and reduce consumption. In every year, nutrition outcomes worsen during this period for poor and near-poor households. Nutrition outcomes start to improve as harvesting starts, and can even improve when green maize can be consumed.

The maize production in Malawi in 2015 was below normal as a result of floods in parts of the country and erratic rains during the main cropping season. El Niño conditions led to further losses in 2016. Figure 4.4 shows that rates of moderate and severe malnutrition started to increase after September in 2015 (**10 months after the start of the rainy season in November, and 5 months after the start of the harvest in April**). In 2016, after the second successive year of poor rains, rates of malnutrition started to increase from August (**nine months after the start of the rains and four months after the start of the harvest**), peaking in January and not starting to fall until the green harvest in March 2017. Data on coping strategies collected during the second rain failure showed the household coping strategy index increasing during the lean season as expected, but not falling even when harvesting started, as households adjusted given the poorer harvest. Reduced adult consumption was recorded from July.

ZIMBABWE AND LESOTHO

El Niño conditions in 2016 resulted in the failure of rains in Zimbabwe and Lesotho. Mobile phone data collected through WFP's mVAM in these countries shows how the lack of rains impacted households (figure 4.5). Data from Zimbabwe (figure 4.5a) shows that rain failure from December 2016 to March 2017 was reflected in increasing resort to risky coping strategies in October, **11 months after the start of the rainy season and 7 months after the start of harvest**. Coping strategies peaked before the start of the following harvest. However, different households

FIGURE 4.3: SEASONAL CALENDAR IN MALAWI

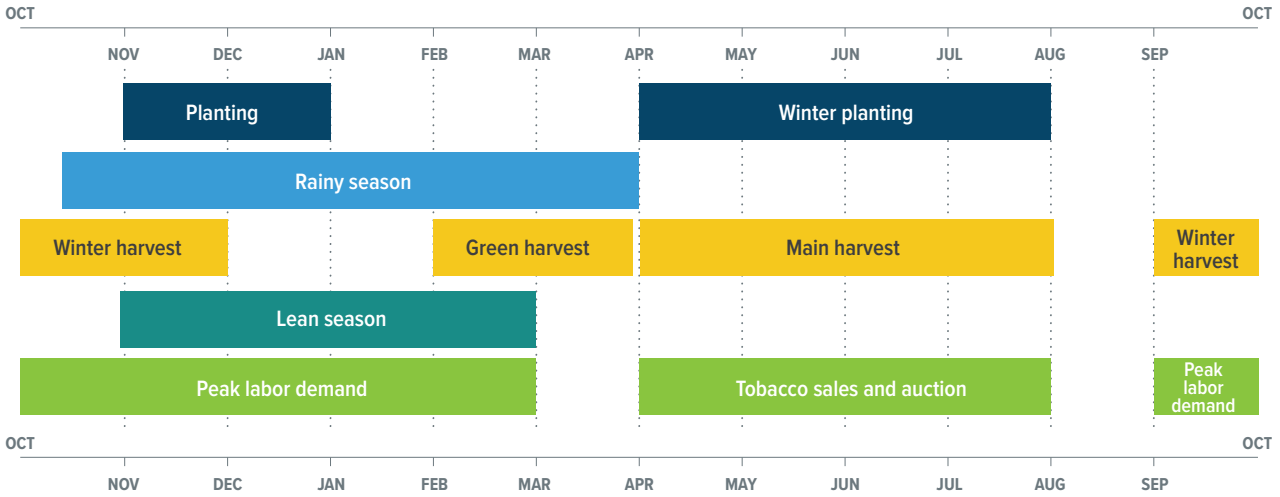
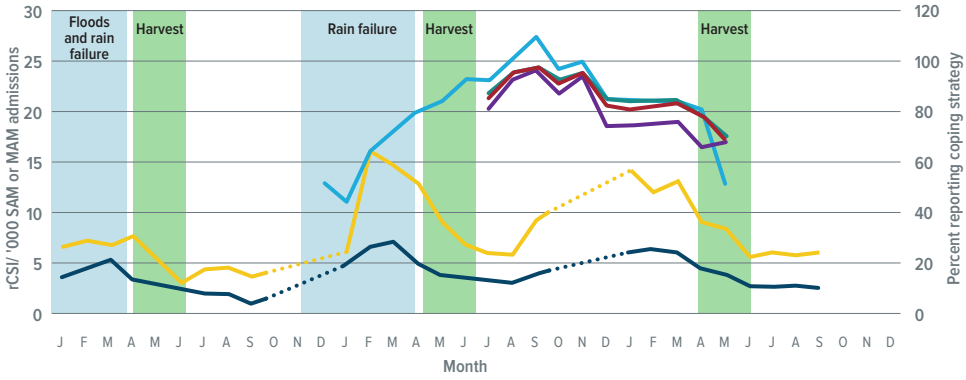


FIGURE 4.4: FLOODS AND DROUGHT IN MALAWI, 2015–17

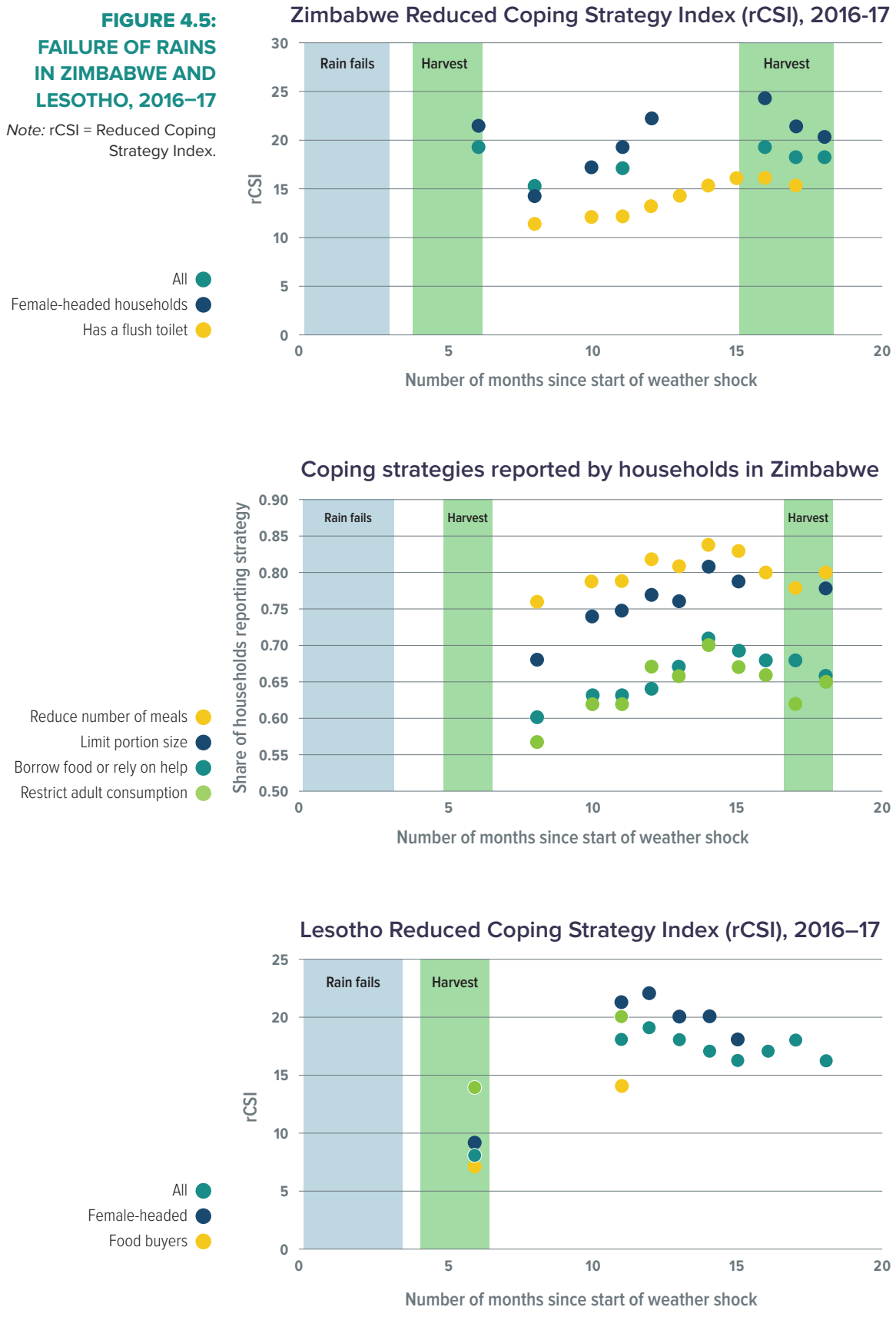


- Admissions-Severe Acute Malnutrition (SAM)
- Admissions-Moderate Acute Malnutrition (MAM)
- rCSI
- SAM (Interpolated)
- MAM (Interpolated)
- Limit portion size
- Reduce number of meals
- Restrict adult consumption

Note: rCSI = Reduced Coping Strategy Index.

FIGURE 4.5: FAILURE OF RAINS IN ZIMBABWE AND LESOTHO, 2016–17

Note: rCSI = Reduced Coping Strategy Index.



fared differently. Better-off households (those with a flush toilet) did not increase their coping strategies as quickly as the average. The pattern for female-headed households was similar to the average. Less data is observed for the same years in Lesotho, but there are some similarities in the patterns. Coping strategies peak in December, and are higher for female-headed households and subsistence farmers (figure 4.5c).

UGANDA

In northern Uganda, data on admissions to a supplemental feeding program is available for three years. Women and children are admitted into the supplemental feeding program when they are severely malnourished. At the end of 2014, harvests were good, and the increase in program numbers in 2015 was marginal (figure 4.6). The harvests at the end of 2015 and 2016 were poor; hence a large increase in the number of admissions into the feeding program was observed in the following years. Admissions started to increase in January 2016, **six months after harvesting began in the previous July, and peaked in June in 2016 and May in 2017**. At its peak the number of admissions was almost twice (1.8 times) what it was before the increase began. The data collected on use of coping strategies and the food consumption score does not fully align with this picture (figure 4.7), but we do see reported use of coping strategies increasing in May 2016 and reported food consumption security dropping in May 2017, as expected.

SUMMARY

The data for the countries discussed above is summarized in table 4.2. **For five of the six droughts considered, reductions in consumption occur gradually, increasing over time from 5 months (on average) after the harvest and peaking 10–11 months after the initial loss. In Somalia, the one fragile context considered, increased malnutrition appeared more immediate; once households have used the means they have to satisfy food needs, increases in malnutrition are quite large.** The measure of malnutrition most often reported is being moderately or severely underweight (or wasted).

TABLE 4.2: SUMMARY OF TIMING AND MAGNITUDE OF NUTRITION SHOCKS

	Start of increase in malnutrition (no. of months post-harvest)	Peak of increase in malnutrition (no. of months post-harvest	Average monthly increase in malnutrition (percent)
Somalia	Immediately	6 months	8
Malawi 2015	5 months	11 months	20–28
Malawi 2016	4 months	11 months	20–28
Zimbabwe	7 months	11 months	No data on malnutrition rate
Uganda 2016	6 months	11 months	30
Uganda 2017	6 months	10 months	30
Average	5 months	10 months	21

Note: The start of harvest is assumed to be the point at which the full impact of the weather shock is known.

FIGURE 4.6: ADMISSIONS TO A SUPPLEMENTAL FEEDING PROGRAM IN NORTHERN UGANDA, 2015–17

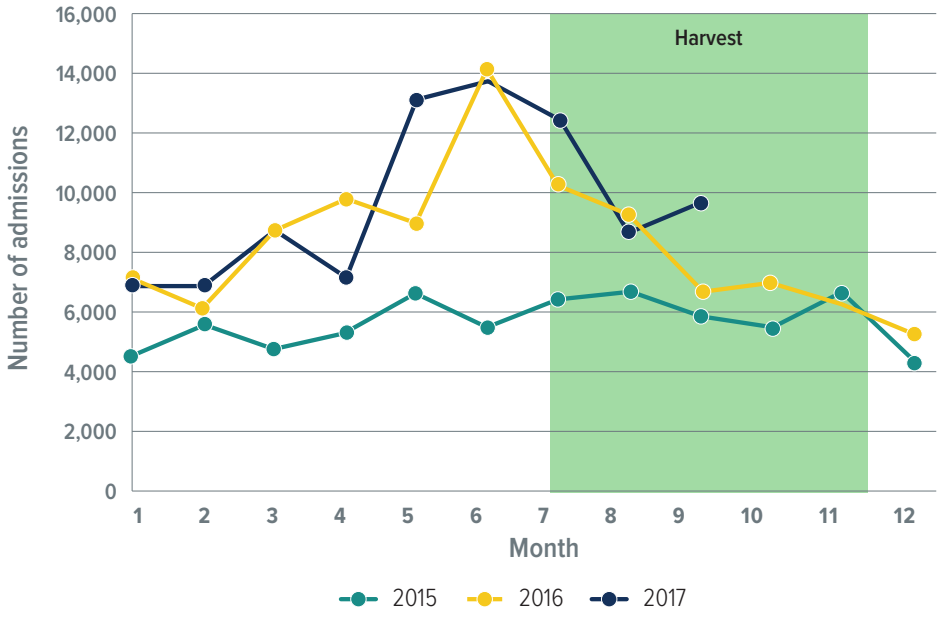


FIGURE 4.7: FOOD CONSUMPTION SCORE AND COPING STRATEGY INDEX IN UGANDA, 2016–17

Note: FCS = food consumption score; rCSI = Reduced Coping Strategy Index.

The data available for drought in Africa is much richer than for the sudden-onset shocks in Asia and small island states (described in section 3), and the pattern it points to is very different. **In sudden-onset shocks, consumption is reduced immediately and then improves within a few months of the shock; this can be seen in figure 3.6 for Nepal and Haiti**. The difference in speed of impact is consistent with the data available on the impact of earthquakes, floods, and hurricanes on food stocks table 3.1 summarizes how in many cases these disasters wipe out existing food stocks as well as future harvests. When they occur at the wrong time the effect can have particularly severe impacts on consumption.

The estimates of the impact of drought on consumption are consistent with estimates of the impact of rainfall shortfalls during the growing season on stunting prevalence in select countries (as measured by Demographic and

Health Surveys, DHS); see table 4.3. Observations on children and their anthropometric measurements from the DHS are merged at the cluster level with grid-level data on the beginning and end date of the growing season[1] and data on the value of the Standardized Precipitation Index (SPI) during the last completed growing season prior to the date of interview with the household and its members. The SPI is a standardized measure analogous to a z-score that can be interpreted in terms of standard deviation (sd) units from the normal mean precipitation.[2] A deficit in rainfall of 1 standard deviation from the normal mean precipitation in the cluster during the most recently completed growing season is associated with the probability of stunting across all children age 0–60 months, as follows: there is a 3.2 percentage point (pp) increase in Benin, a 3.31 pp increase in Democratic Republic of Congo, no significant increase in Mozambique, a 2.42 pp increase in Nigeria, and a 2.21 pp increase in Rwanda.

Increased wasting has an immediate impact on morbidity and mortality, but it also has an impact on long-run outcomes. Richard et al. (2012) use data from eight countries to show that wasting during 6–17 months impacts stunting measured at 18–24 months. **On average, length-for-age (LAZ) z-scores are reduced by 0.88 when stunting is experienced at some point from months 6 to 17**. Wasting during the first six months does not have an impact on stunting measured at 18–24 months (annex 2). The impact of delayed response on stunting rates is estimated using this relationship and the mean and variance of the height-for-age z-score (HAZ) distribution for each country. The data for Somalia is taken directly from the data on stunting in figure 4.2, which shows that the prevalence of stunting increases less than the prevalence of wasting but stays elevated for longer.

1. General information and some data on growing seasons is in HarvestChoice (2010).

2. The SPI data set is available for a grid with 0.25° resolution, which equals a square of 25 km by 25 km in the equator (getting smaller away from the equator), with geocoordinates for each point in the grid; see the African Flood and Drought Monitor (AFDM) online platform developed by Princeton University and UNESCO's International Hydrological Program (IHP) at https://platform.princetonclimate.com/PCA_Platform.

TABLE 4.3: RELATIONSHIP BETWEEN RAINFALL SHORTFALLS DURING THE GROWING SEASON AND THE PREVALENCE OF STUNTING AMONG CHILDREN LESS THAN 60 MONTHS OF AGE IN SELECTED COUNTRIES IN SSA

VARIABLES	Benin 2011–12	Congo, Dem. Rep. 2007, 2013–14	Mozambique 2014	Nigeria	Rwanda
Rainfall shortfall in sd units during the last growing season	0.0320*	0.0331*	0.0155	0.0242**	0.0221*
	(0.0167)	(0.0178)	(0.0107)	(0.00945)	(0.0124)
Year of interview dummies	Yes	Yes	Yes	Yes	Yes
Other controls	Yes	Yes	Yes	Yes	Yes
Observations	4,142	1,845	5,021	13,073	1,970
R-squared	0.040	0.056	0.042	0.090	0.077

Source: World Bank staff estimates.

Note: Robust standard errors in parentheses. * p < 0.1, ** p < 0.05. Grid-level information on growing period is from HarvestChoice (2010). The coefficients reported are obtained using (-1) * SPI as a right-hand-side variable in the regression. SPI for the last growing season is the Standardized Precipitation Index for the DHS cluster where the child resides. The SPI data set is accessible at https://platform.princetonclimate.com/PCA_Platform/. Other controls include dummy variables for child's age, gender, and birth order; mother's age, marital status, education level, preceding birth intervals, and height; number of household members; and number of children under five.

To put this in the context of the regional figures on stunting, figure 4.8 presents a series of graphs on stunting rates for children of different ages across Sub-Saharan Africa. Figure 4.8a shows the stunting rates of younger children (0–24 months) and older children (24–59 months) for 33 SSA countries (Skoufias et al. 2018). This figure shows quite clearly that the stunting rates are higher for the older children than for the younger children. This pattern is a consequence of growth faltering, the rapid decline in height- and weight-for-age of children in the first two years of life that is common in many developing countries. Growth faltering among children was first documented in a study by Shrimpton et al. (2001), and it is largely in response to this finding that several global health policy and information campaigns now emphasize the first 1,000 days of life (Prentice et al. 2013).

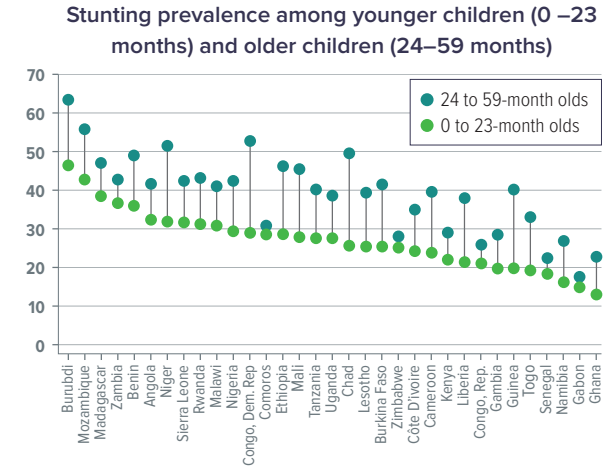
HAZ decreases rapidly in the first 21 months of life, continues decreasing at a slower pace after 21 months, bottoms out at around 33 months, and increases at a very slow rate afterward with only minor fluctuations.[3] This is shown in figure 4.8b, which presents the cross-sectional age profile of HAZ scores for children between 0 and 59 months of age in the 33 countries from SSA analyzed in Skoufias et al. (2018).

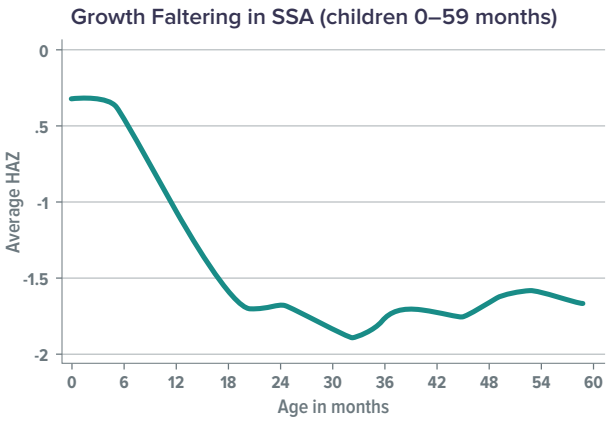
Growth faltering is faster in countries in the Sahel region, in rural areas, and among poorer households. Growth faltering curves for the Sahel versus other regions is shown in figure 4.8c, for urban versus rural areas within countries in figure 4.8d, for boys versus girls in figure 4.8e, and for different socioeconomic groups within countries (specifically, the bottom 20 percent compared to the top 20 percent of the wealth distribution) in figure 4.8f. The reductions in consumption and worsening of child nutrition outcomes documented in this section are one of many causes for this growth faltering (Skoufias et al. 2018).

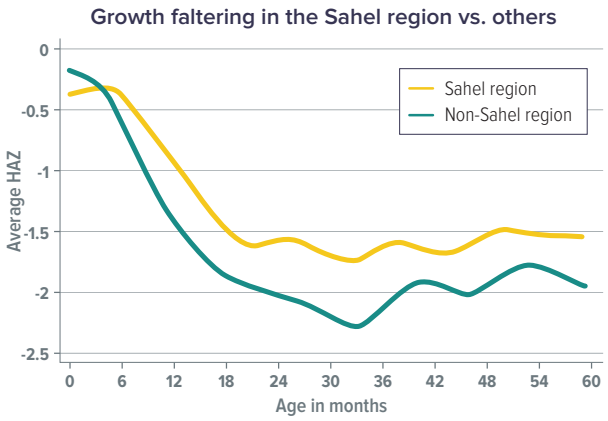
In the following section, we derive the economic cost of this shock-induced increase in malnutrition and associated growth faltering using estimates of the economic costs of stunting in the long run.

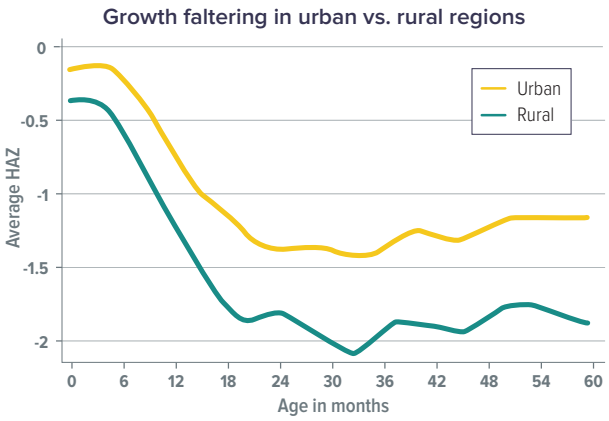
3. For a recent cross-country study on the determinants of growth faltering, see Rieger and Trommlevora (2016). The growth faltering curves are derived in Skoufias et al (2018) using a local polynomial smooth of HAZ with the Stata command "lpoly."

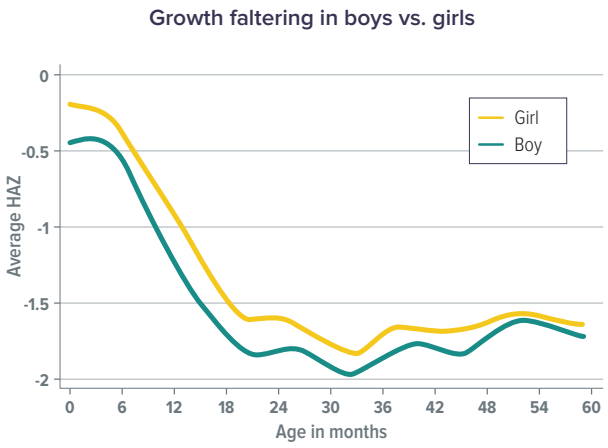
FIGURE 4.8:
STUNTING RATES FOR CHILDREN UNDER FIVE YEAR OLDS IN SUB-SAHARAN AFRICA

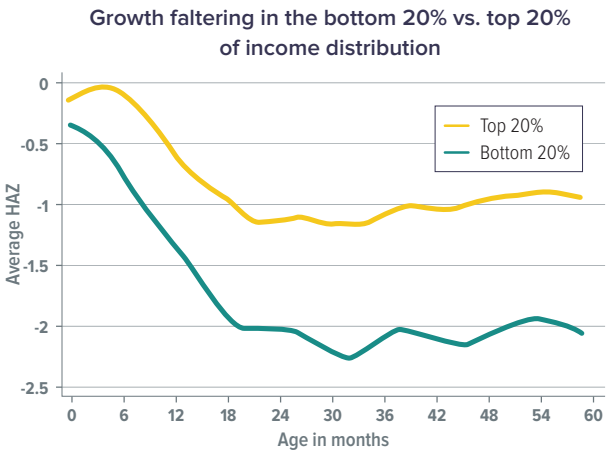












4.2. THE ECONOMIC COSTS OF REDUCED CONSUMPTION

Using the parameters and estimation methods in Galasso and Wagstaff (2018) detailed in annex 2, we estimate the long-run economic cost of increased stunting that occurs during a drought. This could be considered the cost of the drought under the current humanitarian response—or conversely, the potential benefit of a faster and more complete humanitarian response that prevents malnutrition from increasing post-disaster. Data collected on reduced consumption during earthquakes, floods, cyclones, and hurricanes suggests that the impacts of these disasters on nutrition may be much faster than for drought, but we have no data showing what the size of the impact on stunting is a month or two after the disaster.

Figure 4.9 shows how the drought is modeled to impact stunting rates among children under five and among the proportion of the workforce (aged 15 to 55) that experienced stunting as a child. Fifteen years after the shock, some of those that were stunted in childhood as a result of the drought enter the workforce. These workers have fewer years of education, lower cognition, and shorter stature than they would have without the drought.

The cost to the economy from this increase in stunting is depicted in figure 4.10. The cost arises as a result of lower incomes from lower height, education, and cognitive development each year (top panel). The income per capita lost is compounded each year, leading to diverging income levels (bottom panel). **The discounted value of this divergence for 70 years is 3.9 percent lower income (GDP) per capita in the long-run.**

FIGURE 4.9: IMPACT OF DROUGHT ON RATES OF STUNTING AMONG CHILDREN AND WORKFORCE

Note: Workforce is population aged 15–55.

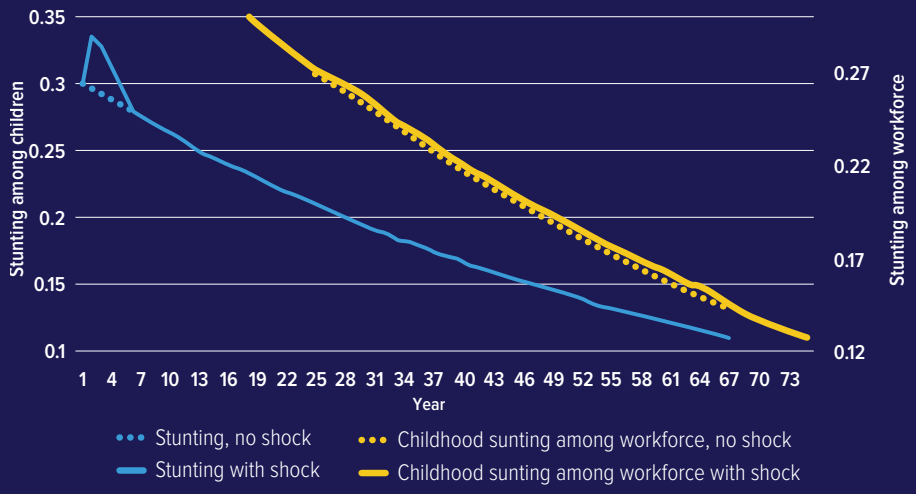


FIGURE 4.10: THE ECONOMIC COST OF DROUGHT-INDUCED STUNTING

5. The impacts of disasters on prices

This section draws on a study by Hill and Fuje (2018), which seeks to quantify the timing and size of the impact of drought on local prices by combining data on monthly grain prices and wages in 82 retail markets over 17 years with data on district-level weather shocks. In an agrarian economy like Ethiopia's, weather shocks not only affect grain supply, but by reducing household income they also affect grain demand. The results show that the supply effect tends to be larger than the demand effect and hence that weather shocks increase grain prices, but there is seasonality in these impacts. Grain prices in the months following harvest increase, but this effect dissipates until no significant effect on grain prices is observed six months after the shock.

A small but significant deflationary impact on prices is observed in the months prior to the new harvest (figure 5.1). A moderate drought can be thought of as corresponding to a 30 percent loss in yields, and a severe drought can be thought of as corresponding to a 50 percent loss in yields. Thus these estimates suggest an impact of drought on prices of 4.0–6.5 percent starting in the second month after harvest begins.

However, Hill and Fuje (2018) also present evidence to show that the impact of weather shocks on prices in Ethiopia has been minimal in the latter half of the 17-year period considered (i.e., since 2004), most likely because of the improvement in roads (figure 5.2). The attenuation of the impact of drought on local prices was more pronounced in districts where improvements in access to markets were the strongest, where a safety net was introduced, and where food aid was better coordinated with weather shocks.

In summary, this analysis points to relatively minimal impacts of shocks on food prices in settings where markets are well integrated, but inflationary effects of 4.0–6.5 percent from months 2 to 6 post-harvest where markets are less well integrated.

FIGURE 5.1: AVERAGE IMPACT OF WEATHER SHOCKS ON GRAIN PRICES IN ETHIOPIA, 1997–2013

Source: Hill and Fuje 2018.

Note: Prices are the log of the nominal price in Ethiopian birr per kilogram, and yield loss is the percentage of crop yield lost due to rainfall shortage.

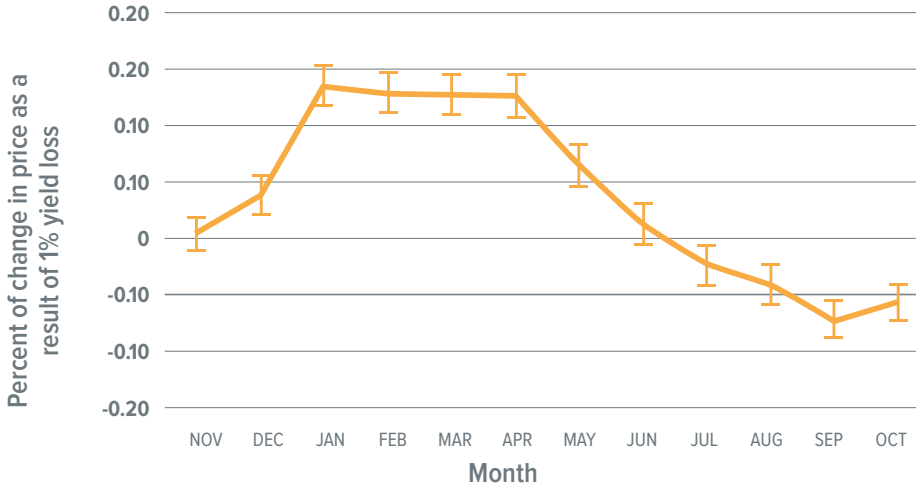
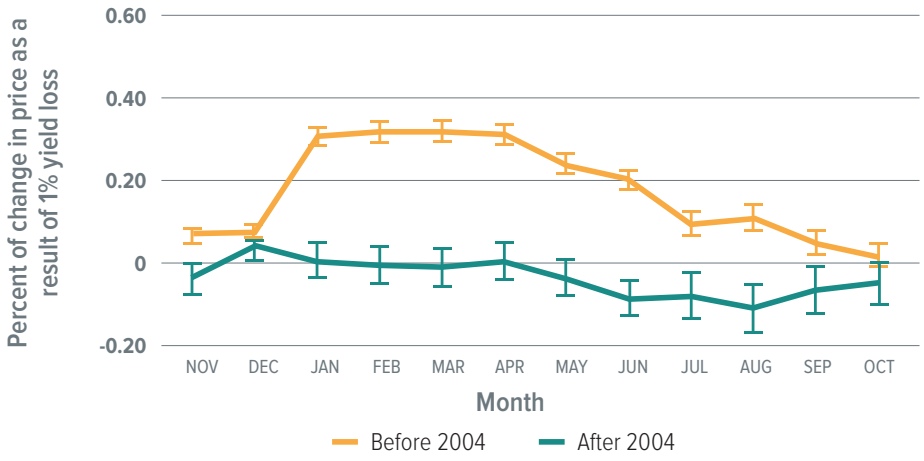


FIGURE 5.2: IMPACT OF WEATHER SHOCKS ON GRAIN PRICES IN ETHIOPIA, BEFORE AND AFTER 2004

Source: Hill and Fuje 2018.

Note: Prices are the log of the nominal price in Ethiopian birr per kilogram, and yield loss is the percentage of crop yield lost due to rainfall shortage.



6. Conclusion and implications for future data collection, analysis, and policy

The analysis in this paper adds to the growing literature showing that disasters have costly, long-run development impacts for households. A growing body of evidence demonstrates that disasters drive people into poverty, that poor households often resort to negative coping strategies when faced with disaster impacts, and that these strategies have long-term, irreversible, and sometimes intergenerational effects. Across settings, the most prevalent method of coping with a shock was to reduce food consumption. This finding is consistent with a well-published literature showing that variability of income over time impacts child nutrition.

The analysis provides information on the timing of household impacts. It considers two different types of disasters: slow-onset disasters in eastern and southern Africa, and fast onset-disasters in Asia and small-island states. Separating the analysis in this regard allows recommendations to be tailored to the salient perils faced.

Earthquakes, floods, and hurricanes in Asia have an immediate impact on nutrition, but nutrition gets better after a few months. The impact of droughts in eastern and southern Africa on nutrition starts to escalate 5 months after the start of harvest (on average, in nonconflict settings), increasing until 11 months after the start of harvest. Using estimates of the long-run costs of lack of nutrition, we estimate that the cost of not getting a response in place in time to meet the consumption needs of drought-affected populations is 3.9 percent lower income (GDP) per capita in the long-run. A response time that is one month quicker has a benefit of 0.8 percent of income per capita in the long run.

After reducing consumption, the most often cited response to shocks is borrowing, and then sales of productive assets; both of these add further to the economic costs of not offering households help in the aftermath of a disaster. Where data is available, it suggests these strategies are implemented after reducing consumption. The cost of credit post-disaster is not part of the data collected, so it is not possible to provide an estimate of the cost to welfare of borrowing. The cost of selling productive assets to cope with a disaster has been estimated in Dercon (2004) and Elbers, Gunning and Kinsey (2002) and has been discussed in Clarke and Hill (2013), so it is not recalculated here; but the failure to respond early enough to prevent a household from having to engage in this costly coping mechanism creates an additional cost.

6.1. COMMENTS ON DATA AND EVIDENCE

Before discussing the implications of our findings for policy, it is important to underscore that the data used for the review is limited.The following are recommendations for improving the evidence base:

- A review of PDNAs undertaken in Asia and small island states over the last five years indicates that although PDNAs consider the income losses arising from shocks, few of them document the coping strategies used by households to manage shocks and the costs that these may bring. A recommendation of this study is to **include an assessment of households' food security and coping strategies in PDNAs, drawing on other emergency assessments as needed.**

- When quantitative data is collected post-disaster, there tends to be very little information provided about how representative it is, and the raw data is rarely made available. As a result the data can be hard to interpret. **Improving the documentation of and access to data collected after a disaster would help ensure that more could be learned from the data**. It would also allow best practices to be developed and shared among partners engaged in gathering evidence on needs in emergency situations.

- High-frequency data collection conducted before, during, and after a disaster is invaluable to help identify how many households need support, and when they need it. This information can be gleaned from the mVAM surveys, which have already provided many insights as a result. **When data users are told what area the data is representative of, what sampling method was used in collecting it, and what the attrition rates were, they can use the data more effectively and produce more accurate results.** They can also provide feedback to help the producers of data develop best-practice methods for ensuring that data is representative and that attrition in the panel is kept to a minimum.

In addition to collecting better data before, during, and after a disaster, practitioners should do more to analyze the timing of a disaster's impacts. Data

collection for most nationally representative household surveys in Africa and South Asia now spans 12 months. When disasters occur during this period (for example, the 2015 drought in Ethiopia), the survey can be used to look not just at the impact of the shock on average, but also at the timing of the impact across months. Also, as support is provided to households in more responsive humanitarian systems and adaptive social protection programs, it will be important to use these efforts to learn more about the benefits of timely assistance. Programs can help in this effort by embedding impact evaluations in their design and rollout. A good example in this regard is the Ethiopian Productive Safety Net Program (Berhane, Abay, and Hoddinott 2016).

6.2. RAPID-ONSET DISASTERS

The results suggest that for rapid-onset disasters, rapid disbursement of a risk financing instrument is crucial. If governments and ministries of finance wish to mobilize a response with the objective of defending the welfare of affected households and preventing them from resorting to negative coping, financing instruments to fund the response must disburse rapidly. Examples of fast-disbursing risk financing instruments include the following:

- **Contingent lines of credit** (such as the World Bank's Catastrophe Deferred Drawdown Option, or CAT DDO). These have a clear disbursement trigger (in the case of the World Bank instrument, a declaration of disaster according to national laws) as well as a demonstrated track record of rapidly disbursing

after the onset of a disaster.

- **Parametric risk transfer instruments,** such as the risk pools in the Pacific, Caribbean, and Africa. These make insurance payouts based on parametric risk models rather than on estimates of actual loss, so they can disburse funds rapidly (less than two weeks).

- **Contingency funds with clear rules of disbursement.** These can be effective, low-cost financing instruments for disaster response, assuming that the conditions for disbursement of funds are clearly articulated. If they are not, negotiations motivated by political considerations can manifest after the onset of a disaster, which can lead to delays in response.

Financing instruments that may be slow to mobilize should be deprioritized for financing disaster response. These include (i) budget reallocations, which can be subject to negotiations that may delay disbursement of funds; (ii) contingency funds without clear rules for disbursement, as explained above, and (iii) loans from development banks, which disburse in five months at earliest, with average time for disbursement much longer.

In addition to speed, delivery mechanisms for post-disaster assistance need to have clear rules and systems in place to facilitate rapid disbursement of emergency support. The mechanisms for targeting recipients of emergency assistance should be established in advance of a disaster, or at least have the ability to be deployed rapidly, such as by piggybacking on existing safety net mechanisms to enable rapid identification of households in need of assistance. In some cases existing payment systems can also be used. If agriculture insurance programs exist, they could explore a rapid disbursement trigger such as a declaration of emergency at the subnational level. Such an approach is being tried in India under the national agriculture insurance program (Pradhan Mantri Fasal Bima Yojana, PMFGY). Pubic financial management systems could explore the addition of emergency protocols to facilitate rapid procurement and delivery of emergency assistance. Governments could explore waiving time-consuming procurement conditions (such as requiring receipt of three tenders) under emergency scenarios, or could consider creating lists of high-priority goods and services that could be procured rapidly during an emergency, to enable faster response.

6.3. SLOW-ONSET DISASTERS

For slow-onset disasters, the results indicate that although speed is important, it should be combined with accuracy in non-fragile settings. Previously, advocates for fast-disbursing insurance mechanisms, such as weather and satellite index insurance, cited their speed of payout as a key advantage. Experience is showing the downside of such insurance instruments, however: when non-insured losses occur, there is no payout to farmers who experience crop loss.[4] Better data could help

4. A non-insured loss is an event in which the farmer experiences a loss and the insurance does not make a payout. This occurs when the peril causing the loss is not insured (for example, the loss is due to a disease outbreak and the insurance provides coverage for drought), or when the index on which the insurance is based does not capture the impact of the loss.

address this problem. While expensive and time-consuming to collect, area yield data based on crop-cutting experiments can lower the basis risk—that is, the risk of a mismatch between index measurements and actual losses—more effectively than weather and satellite data (Clarke et al. 2013). The findings from the above analysis suggest that while speed is important for slow-onset events, taking the time to verify the data on the disaster impacts is important as well. This enables decision makers to collect further information that can greatly increase the accuracy and targeting of disaster response, as well as reduce the incidence of non-insured losses. This information could come from rapid post-disaster needs assessments, rapid field surveys (using tablets or smart phones, for example), and rapid assessments by field officers.

For slow-onset events, the required speed of response is often less urgent than for rapid-onset events; thus a wider range of financing instruments is available for them. In addition to the rapid-financing instruments listed above, slow-onset events could make use of the following:

- **Emergency loans from development bank:** When done efficiently, these can disburse within five months.

- **Budget reallocations:** These are an option when government processes can facilitate them within five months. A note of caution is warranted here, however, as most low-income countries can face challenges when executing budget reallocations; thus this instrument should be considered only if the government has a strong track record of doing so successfully.

The need for clear disbursement rules and timely delivery of disaster response applies to slow-onset as well as rapid-onset events. Even responding in five months requires ex ante investments in disaster response mechanisms. Although five months does give more time than in a rapid-onset shock, humanitarian responses arrive at the earliest eight to nine months after harvest losses, which from the evidence above is too late. A household may not be sure that the government will respond until it receives assistance. This underscores the importance of continuing to invest in decision rules and mechanisms to provide cash transfers to households in advance of disasters, though the goal should be to use less costly forms of financing and more accurate triggers.

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Annex 1.
Assessments of fast-onset shocks

	Country	Assessment title
1	Seychelles	Seychelles Post Disaster Needs Assessment—Tropical Cyclone Fantala April 2016 http://documents.worldbank.org/curated/en/802481498125766383/Seychelles-post-disaster-needs-assessment-tropical-cyclone-Fantala-April-2016
2	Fiji	Fiji, Post-Disaster Needs Assessment, Tropical Cyclone Winston, February 20, 2016 https://www.gfdrr.org/sites/default/files/publication/Post%20Disaster%20Needs%20Assessments%20CYCLONE%20WINSTON%20Fiji%202016%20(Online%20Version).pdf
3	Myanmar	Post-Disaster Needs Assessment of Floods and Landslides: July–September 2015 http://earlyrecovery.global/sites/default/files/myanmar000post0uly000september02015_1_0.pd
4	Solomon Islands	Rapid Assessment of the Macro and Sectoral Impacts of Flash Floods in the Solomon Islands, April 2014 http://documents.worldbank.org/curated/en/428071468296671081/Solomon-Islands-Rapid-assessment-of-the-macro-and-sectoral-impacts-of-flash-floods-in-the-Solomon-Islands
5	Seychelles	Seychelles Damage, Loss, and Needs Assessment (DaLA) 2013 Floods http://documents.worldbank.org/curated/en/689161468106741988/Seychelles-Damage-Loss-and-Needs-Assessment-DaLA-2013-floods-a-report-by-the-Government-of-Seychelles
6	Fiji	Post-Disaster Needs Assessment, Tropical Cyclone Evan, 17th December 2012 https://www.gfdrr.org/en/publication/fiji-post-disaster-needs-assessment-tropical-cyclone-evan-december-17th-2012
7	Samoa	Samoa Post-disaster Needs Assessment Cyclone Evan 2012 http://documents.worldbank.org/curated/en/450361468335701492/Samoa-Post-disaster-needs-assessment-cyclone-Evan-2012
8	Pakistan	2011 Pakistan Floods, Preliminary Damage and Needs Assessment http://documents.worldbank.org/curated/en/655781468058769881/2011-Pakistan-floods-preliminary-damage-and-needs-assessment
9	Haiti	Haiti Earthquake PDNA: Assessment of Damage, Losses, General and Sectoral Needs [2010] http://documents.worldbank.org/curated/en/355571468251125062/Haiti-earthquake-PDNA-Post-Disaster-Needs-Assessment-assessment-of-damage-losses-general-and-sectoral-need
10	Haiti	Le Rapport d'Évaluation des Besoins Après Désastres Cyclones Fay, Gustav, Hanna et Ike https://www.recoveryplatform.org/outfile.php?id=88&href=/assets/publication/pdna/pdna%20haiti.pdf
11	India	Bihar Kosi Flood (2008) Needs Assessment Report https://www.gfdrr.org/sites/gfdrr/files/publication/GFDRR_India_PDNA_2010_EN.pdf
12	Nepal	A Report on the Food Security Impact of the 2017 Flood in the Terai https://reliefweb.int/report/nepal/nepal-report-food-security-impact-2017-flood-terai-august-2017
13	Bangladesh	Bangladesh: Torrential Monsoon Flood, August 2017 https://www1.wfp.org/publications/bangladesh-torrential-monsoon-flood-august-2017
14	Haiti	Post- "Matthew" Emergency Food Security Assessment (EFSA) - Phase 1 [2016] https://documents.wfp.org/stellent/groups/public/documents/ena/wfp290561.pdf

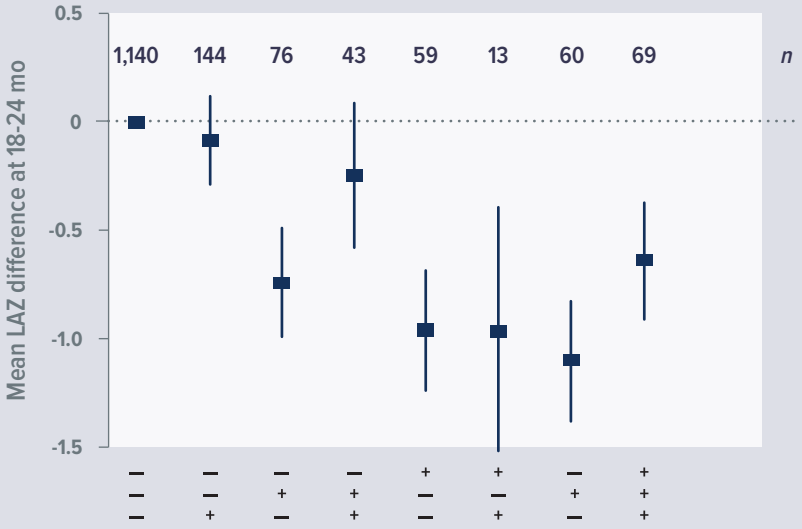
	Country	Assessment title
15	Nepal	Joint Assessment of Food Security, Livelihoods and Early Recovery [2016] https://www.wfp.org/content/nepal-joint-assessment-food-security-livelihoods-and-early-recovery-november-2015
16	Nepal	A Report on the Food Security Impact of the 2015 Earthquake, May 2015 [Food Security Cluster] https://www.wfp.org/content/nepal-report-food-security-impact-2015-earthquake-may-2015
17	Vanuatu	Vanuatu: The Impact of Cyclone Pam [2015]
18	Philippines	Philippines Typhoon Hagupit (local name: Ruby)
19	Philippines	Multi-Cluster/Sector Initial Rapid Assessment, Philippines Typhoon Haiyan [2013] https://www.wfp.org/content/philippines-typhoon-haiyan-multi-cluster-sector-initial-rapid-assessment-november-2013
20	Lao PDR	Mapping of Flood Affected Villages in Lao PDR [2013] https://www.wfp.org/content/mapping-flood-affected-villages-lao-pdr-summary-report
21	Haiti	Rapport d'Evaluation d'urgence des impacts du cyclone Sandy sur la sécurité alimentaire [2012] https://documents.wfp.org/stellent/groups/public/documents/ena/wfp254368.pdf?iframe
22	Cambodia	Cambodia 2012 Post-Flood Relief and Recovery Survey https://www.wfp.org/content/cambodia-post-flood-relief-and-recovery-survey-may-2012
23	Bangladesh	Bangladesh—Rapid Food Security Assessment at Satkhira in the Context of Recent Flood and Water Logging, August 2011 https://www.wfp.org/content/bangladesh-rapid-food-security-assessment-satkhira-august-2011
24	Myanmar	Myanmar—Food Security Assessment in Four Townships Affected by Cyclone Gir, February 2011 https://www.wfp.org/content/myanmar-food-security-assessment-four-townships-affected-cyclone-giri-february-2011
25	Sri Lanka	Monsoon Floods Rapid Assessment [2011] https://www.wfp.org/content/sri-lanka-monsoon-floods-rapid-assessment-january-2011
26	Philippines	Philippines Luzon Typhoons and Floods: Emergency Food Security Assessment—November 2009 https://documents.wfp.org/stellent/groups/public/documents/newsroom/wfp229085.pdf?_ga=2.6782263.429039661.1550233467-80453004.1549542326
27	Pakistan	Pakistan Flood Impact Assessment [2010] http://www.finance.gov.pk/survey/chapter_11/Special%20Section_2.pdf
28	Lao PDR	Post-Typhoon Ketsana Rapid Assessment, Southern Laos—May 2010 https://www.wfp.org/content/lao-pdr-post-typhoon-ketsana-rapid-assessment-southern-laos-may-2010
29	Haiti	Rapid Post-Earthquake Emergency Food Security Assessment—March 2010 https://www.wfp.org/content/haiti-rapid-post-earthquake-emergency-food-security-assessment-march-2010
30	Lao PDR	Joint Assessment of Impact and Needs Arising from the September 2009 Ketsana Typhoon https://www.wfp.org/content/lao-pdr-joint-assessment-impact-and-needs-arising-sep-2009-ketsana-typhoon-october-2009
31	Korea, Dem. People's Rep.	August 2007 Floods Rapid Assessment Report https://www.wfp.org/content/democratic-peoples-republic-korea-floods-rapid-assessment-report-august-2007

Annex 2. Stunting data and analysis

Estimating the impact of increased malnutrition on stunting

Data from Richard et al. (2012) is presented in figure A1 and shows that the average impact of wasting experienced in months 0 to 17 on stunting in months 18 to 24 is a reduction in mean LAZ of 0.68.

FIGURE A1: IMPACT OF WASTING ON STUNTING



Source: Richard et al. 2012.

Note: Effect of wasting in in different age groups (+ = wasting was experienced during that period; - = no wasting during that period) on mean LAZ at 18-24 months in a combined dataset including anthropometry data collected in children <24 months of age. Number of participants (n) contributing data to each category is at the top of the figure. LAZ, length for age Z-score.

ESTIMATING THE ECONOMIC COST OF REDUCED STUNTING

The income lost τ years after a shock at time $t, lny(t+\tau)/\ D_N(t)$ is calculated using the following equation presented in Galasso and Wagstaff (2018):

$$\frac{dlny(t+\tau)}{dD_N(t)} = \alpha\left\{\left[r\frac{\delta E_w(t+\tau)}{\delta S_W(t+\tau)} + \gamma\frac{\delta H_W(t+\tau)}{\delta S_W(t+\tau)} + \theta\frac{\delta C_W(t+\tau)}{\delta S_W(t+\tau)}\right]\frac{\delta S_W(t+\tau)}{\delta S_C(t)}\frac{\delta S_C(t)}{\delta D_N(t)}\right\}$$

Table A1 details the definition of the terms in the equation and parameters used to calculate the cost from the increase in stunting.

TABLE A1: PARAMETERS FOR ESTIMATING THE ECONOMIC COSTS OF REDUCED STUNTING

Term	Definition	Value used in calculations
α	Elasticity of income with respect to human capital	0.67
r	Return to education (% more income per year of education)	0.124
γ	Return to adult height (% more income per cm)	0.017
θ	Return to cognition (% more income per standard deviation)	0.043
$\frac{\delta E_w(t+\tau)}{\delta S_W(t+\tau)}$	Education lost from an increase in childhood stunting of the workforce at	1.594 years of schooling
$\frac{\delta H_W(t+\tau)}{\delta S_W(t+\tau)}$	Height lost from an increase in childhood stunting of the workforce at	5.981cm
$\frac{\delta C_W(t+\tau)}{\delta S_W(t+\tau)}$	Cognitive development lost from an increase in childhood stunting of the workforce at	0.625 standard deviations
$\frac{\delta S_W(t+\tau)}{\delta S_C(t)}$	Increase in childhood stunting of the workforce at from an increase in childhood stunting at	Estimated assuming working years from 15 to 55
$\frac{\delta S_C(t)}{\delta D_N(t)}$	Increase in childhood stunting as a result of the shock	Wasting doubles on average, which results in a reduced average HAZ of 0.68. For a HAZ distribution like Uganda's, this corresponds to a 57 percent increase in stunting for the affected population. We assume a quarter of the population is affected by the drought, so the shock increases stunting by 14 percent.
y_t	Income per capita	GDP per capita, with projected growth rates from IMF World Economic Outlook for available years, and after that with growth rates slowing such that the growth rate in 2025 is half the growth rate in 2015.
	Discount rate	0.05

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