CLIMATE SHOCKS, FOOD AND NUTRITION SECURITY

Evidence from the Young Lives cohort study

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Many people living in poor communities in Ethiopia, Andhra Pradesh (India), Peru and Vietnam experience climatic shocks such as droughts and floods, and many face episodes of food insecurity. To understand better the links between the two types of shocks, Oxfam commissioned research from the Young Lives international cohort study of childhood poverty. Experience of floods is strongly associated with worsening food security in Peru and Vietnam. Previous episodes of food insecurity are also strong predictors of future food insecurity. The linkages between climatic shocks and childhood stunting are less clear cut.

Young Lives

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EXECUTIVE SUMMARY

Drawing on survey data from Young Lives, an international study of childhood poverty involving 12,000 children in four countries, this paper examines the effects of environmental shocks on food insecurity and children's development. The data, from children and their families living in rural and urban locations in Ethiopia, the Indian state of Andhra Pradesh, Peru, and Vietnam, provide information on the same individuals over time, allowing consideration of how earlier incidences of food insecurity and exposures to environmental shocks shape later outcomes. Regression analysis is used to estimate the relationships between these and other relevant factors.

After introducing the data and methods, this report first considers the reported incidence of environmental shocks in the studied communities, and, second, the reported incidence of household food insecurity. Following a review of previous Young Lives evidence on how households cope with these events we then analyse the effects of environmental shocks on households' food security and on children's nutritional outcomes, measured in terms of their height-for-age, or stunting.

Environmental shocks are commonly reported, with droughts common in Ethiopia and Andhra Pradesh, and flooding common in Peru and Vietnam. Restricting analysis to reporting of these respective types of shocks in 2009 it is shown that residing in a rural location, living in poverty, and being engaged in agricultural work all increase the likelihood of reporting an environmental shock. The disparities in risks within any given location appear to be larger in urban areas; in rural locations there is more community-wide, covariate, reporting of shocks. The report then moves from descriptive analysis to multivariate regression techniques, which highlight underlying associations by controlling for other explanatory risk factors. Evidence from Ethiopia shows that within communities, greater wealth and greater shares of income from non-farm sources reduce the chances of reporting drought, but that household wealth levels have less impact on reporting environmental shocks in the other countries. By and large, though, much of the variation in the reporting of shocks is down to where people live. In terms of the frequency of shocks, those households which experience recurrent shocks tend to be in rural areas, be more agricultural, and have lower wealth and maternal education levels than either those experiencing one-off shocks or those who never report a shock.

Analysis of food insecurity is based on households' own reports about their situation over the 12 months prior to the Young Lives surveys. The reports of food insecurity over the collective 2006 and 2009 research rounds are higher than at just one point in time. Recurrent reports of food insecurity are relatively common, one in six households in the Ethiopian sample but lower in the other countries. Descriptively in three of the four countries, those households that never report food insecurity are more likely to have urban bases, be less dependent on agricultural incomes, have higher wealth, and higher levels of maternal education; the converse is true of chronically food insecure households. In Peru the pattern is similar but those households reporting chronic or one-off food insecurity also have these characteristics. Using an index constructed to gauge the severity of food insecurities reported in 2009 we find the greatest depth of food insecurity in Ethiopia, with three-fifths of households reporting moderate food insecurity. Only one in ten Ethiopian households were measured as food secure; a status shared by less than a third of households in Andhra Pradesh, Peru, and Vietnam.

Analysing the interaction between environmental shocks in 2006–2009 and reported 2009 household food insecurity and controlling for all other factors, we do not see effects associated with drought in Ethiopia and Andhra Pradesh. In both Peru and Vietnam, however, across the whole sample and in rural areas only, there is a significant relationship between experiencing floods and worsening food security.[1] The magnitude of the impact associated with a flood is approximately one-fifth of the difference in food insecurity between the 25th to the 75th food security percentile. Holding all other factors constant (including environmental shocks) and

considering only the impact of experiencing prior episodes of food insecurity, we find that previous food insecurity is associated with increased reporting of food insecurity in 2009 in all countries. The effects are more consistent and larger than with environmental shocks. In *addition* to environmental shocks, therefore, prior experience of food insecurity is important in determining current episodes of insecurity. Living in an urban area is also somewhat associated with higher food insecurity in all countries other than Andhra Pradesh in India. This (having controlled for other factors) reverses the relationship suggested by simple descriptive analysis, which show food insecurity levels are lower in urban areas. This reflects the different household composition in urban and rural areas but also suggests that living in an urban area is not necessarily protective (rather it may be a risk). Conversely higher levels of parental (both mothers' and fathers') education, higher wealth levels, and male-headed households are all negatively associated with household food insecurity.

Finally, considering the linkages between environmental shocks and children's physical development in terms of their height-for-age, an association is found between droughts and stunting among 15-year-old Ethiopians (but not eight-year-olds), and a less significant link between experiencing droughts and *reduced* stunting among eight-year-olds in Andhra Pradesh. A stronger and more significant finding in all four countries is that previous height-for-age scores are a strong predictor of subsequent height among children, suggesting the critical importance of early life circumstances.

Households' resilience to the effects of droughts, floods, or other environmental events may be supported by anti-poverty and area-based development policies. Social protection is an important response to concerns over climate shocks.

1 INTRODUCTION

The implications of a changing climate for good nutrition and food security are a critical concern. Food security relates to the vulnerability of rural livelihoods, the effectiveness of food production systems, and price volatility (see the Rio + 20 sustainable development outcomes document UN 2012: 22–23). Sufficient and nutritious food is fundamental to human life. Therefore, food security is a universal concern but particularly acute for children, given the impact early malnutrition has on long-term development (see Grantham-McGregor et al. 2007). Nutrition and food security vary both between and within countries and so are an issue of inequality. Price volatility has clear, damaging effects for the poorest households (Hossain, King, and Kelbert 2013). And since early malnutrition undermines children's longer-term development, malnutrition is one way in which childhood circumstances affect later life chances and transmit disadvantage (UNICEF and UN Women 2012).

This paper uses cohort data for Ethiopia, The Indian state of Andhra Pradesh, Peru, and Vietnam. This cohort study provides data on the same children and households over time, allowing us to consider:

- The incidence of environmental and food security shocks affecting households, and whether such shocks are one off events or recurrent;
- How shocks at an earlier point in time are associated with later physical development of children or household circumstances.

This section provides a brief overview of data and methods, section 2 the incidence of environmental shocks, and section 3 the incidence of food insecurity. Section 4 reviews previous analysis of consequences associated with environmental crises, together with household responses. Section 5 then illustrates model estimates of the effects associated with environmental shocks on children's physical development; and on household food security. Section 6 concludes.

Data and methods

This paper uses data from the Young Lives cohort study[2] of childhood poverty. The study collects panel data in four countries, Ethiopia, India, Peru, and Vietnam. Two cohorts of children have been followed in each country (first data collection was in 2002), with data available on an Older Cohort, at ages 8, 12, and 15 years; and a Younger Cohort at ages 1, 5, and 8 years. In each country there are approximately 1,000 Older Cohort children (fewer in Peru), and 2,000 Younger Cohort children. Detailed data have been collected on these children, and the households in which they are growing up.

As a general principle where analysis is at a household level (for example the incidence of shocks) the two cohorts are combined (maximising numbers). When analysis is at child level (and age-specific), it is separated by cohort. When interpreting the results it is worth bearing in mind that the extent of environmental shocks varies according to differences in climatic conditions over time. It is important to recognize that some one-off patterns may emerge by considering only one period of data.

Data are collected using a sentinel site method,[3] with information collected on children growing up in specific geographic communities selected to be broadly, though not nationally representative. Since poor areas are over-sampled this produces a 'pro-poor' sample, poorer than the population as a whole but reflecting a broad range of circumstances. Therefore, when referring to the extent of shocks, this is within the sample, not necessarily the country. Sampling structure varies across countries and consequently countries are not directly compared. However, similarities or differences in patterns are noted. Technical details, including comparing

Young Lives respondents with nationally representative data are available on the study website.[4] Appendix F contains summary statistics on the variables used in the analysis.

Panel data, common in higher-income countries, are comparatively rare in low- and middle-income countries. The particular advantage of panels is to be able to connect earlier and later circumstances. In this research panel data are used to explore the pattern of chronic risk, how earlier circumstances affect whether households report a shock, and to test the associations between earlier shocks and later outcomes for children or households. We use both descriptive and analytic regression techniques. Regression analysis is a powerful technique but, as with all such analyses, has some drawbacks. The estimates are as good as the models, and the models depend on the data available. It is possible that unobserved characteristics, on which there are no data, might affect these results. In other words, we are testing associations rather than causes, after having accounted for multiple possible explanations. Second, we test significance of results. This is a check for robustness, with the test reliant on both the size of the effect and the sample (on the basis that a large effect on a small number of individuals might arise from chance). While relying on significant results, it is worth considering the direction of the other, non-significant, results for consistency.

2 INCIDENCE OF ENVIRONMENTAL SHOCKS

To explore incidence of environmental shocks and food insecurity we use data collected in 2002, 2006, and 2009. 'Shocks' are defined in the survey instrument as an important event which negatively affected the household economy in the period before the interview. Typically the period asked about was since the last interview (so for data reported in 2009, between 2006 and 2009). However, recall issues mean it is likely that many reported shocks occurred close to the interview. Environmental shocks subsequent to 2009 are not included in this analysis, but will have been reported in the 2013 Young Lives Round 4 survey. Table 1 presents data for each country to show what percentage of households reported experiencing disasters, drought, flooding or heavy rain and frosts or hailstorms. The same table provides evidence of the extent to which adverse circumstances are recurrent.

Table 1: Incidence of environmental shocks (percentage of households reporting)

Ethiopia (sample in 2002=2,999 households)					
	2002	2006	2009	Reported in either 2006, 2009 or both	Reported in both 2006 and 2009
Disaster	32.3	N/A	N/A	N/A	N/A
Drought	N/A	29.1	35.2	45.5	18.9
Flood or heavy rain	N/A	13.9	13.2	23.6	3.6
Frost or hailstorm	N/A	9.9	11.2	17.3	3.7
Andhra Pradesh (sample in 2002=3,019 households)					
Disaster	47.9	N/A	N/A	N/A	N/A
Drought	N/A	28.1	7.7	31.3	4.7
Flood or heavy rain	N/A	5.8	2.8	8.2	0.6
Frost or hailstorm	N/A	0.4	0.4	0.8	0.0
Peru (sample in 2002=2,766 households in 2002)					
Disaster	1.5	N/A	N/A	N/A	N/A
Drought	N/A	6.9	4.4	10.7	0.6
Flood or heavy rain	N/A	4.4	11.4	15	0.8
Frost or hailstorm	N/A	11.0	13.0	18.3	5.8
Vietnam (sample in 2002=3,000 households)					
Disaster	21.1	N/A	N/A	N/A	N/A
Drought	N/A	6.5	8.4	13	1.6
Flood or heavy rain	N/A	11.3	15.2	25.1	1.8
Frost or hailstorm	N/A	2.4	6.0	7.7	0.6
Storm	N/A	N/A	21.5	N/A	N/A

Notes: both cohorts included. Quoted samples are for 2002. Samples in some of these cells will be slightly smaller than this (for instance where there is missing data over the whole period). N/A = question not asked. Sample differences mean countries were not compared directly, but rather the patterns between/across years examined.

Environmental shocks are commonly reported, with droughts common in Ethiopia and Andhra Pradesh; floods or heavy rain in Peru; and flooding or storms in Vietnam. The table suggests that the incidence of environmental shocks varies across both time and type, presumably driven by local climatic variation. The rest of this section explores aspects of these patterns as follows:

- Which groups report experiencing environmental shocks?
- What predicts households reporting shocks?
- What are the differences between households reporting one-off or recurrent shocks?

Which groups experience environmental shocks?

This section refers to data reported in 2009[5] and restricts analysis to the most commonly reported shock in each country (Peru is an exception, where reports are on floods not frosts[6]). Figures 1–4 show variation within groups as well as between them. As previously noted, it varies over time which households are most affected by the different patterns of shocks. The subsequent section accounts for this somewhat by considering the profile of chronically affected households.

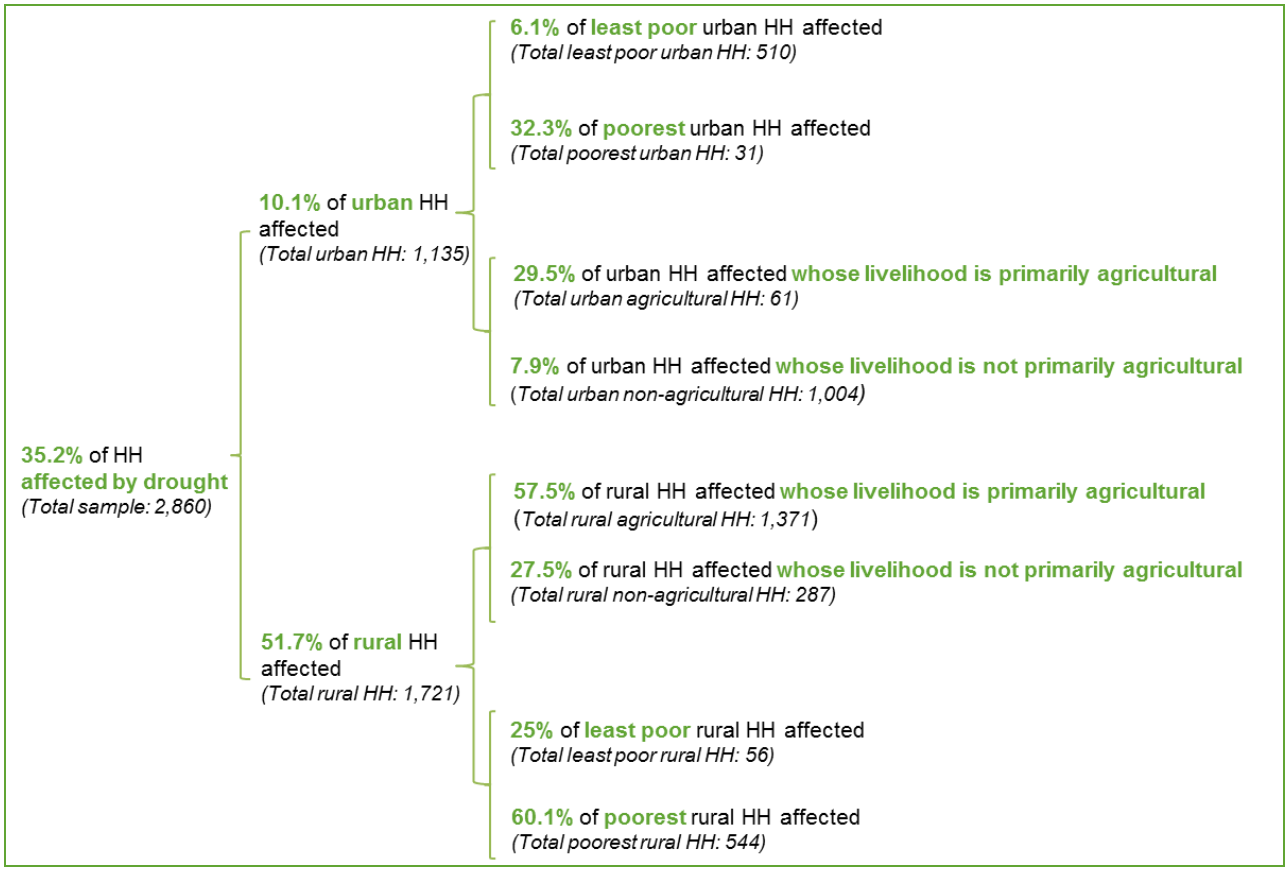
In general terms, for these environmental shocks, being in a rural area, being poorer and being engaged in agricultural work each increase the chances of reporting the shock. The data also suggest that urban areas tend to have a greater disparity of risk than rural areas where shocks may have more community-wide (covariate) effects (though small numbers of poorer people in urban areas mean we are cautious about this finding in some countries). We present both analyses on a country-by-country basis, for 2009 data, supported by qualitative analysis drawn from in-depth semi-structured interviews conducted with a sub-sample of around 50 children and their caregivers in each country in 2007, 2008, and 2010/11.

Drought in Ethiopia

Figure 1 and Appendix A show differences in the shocks experienced by different groups. Reported shocks are structured by location, livelihood, and resources.

- Households in rural areas were five times more likely to report droughts than households in urban areas;
- Comparatively small differences were found by ethnicity;
- Male-headed households are slightly more likely to report a drought than female-headed households (likely to reflect the fact that female-headed households are less likely to live in rural areas where the risk of drought is greater);
- Agricultural households[7] were at about five times the risk of experiencing drought. In rural areas they reported twice the number while urban agricultural households reported three times the number of droughts as non-agricultural households;
- Poorer[8] households are seven times more likely to report drought shocks. The poorest households in urban areas are five times more likely to report a drought than the least poor households.

Figure 1: Which households report drought? (Ethiopia, 2009)



Note: totals reported in parenthesis may not equal totals per category due to missing values. Refer to Appendix A for definitions of groups. HH=household.

Separate analysis in Appendix B (discussed below), reinforces the conclusion that location is fundamental to the experience of drought but that within communities, disadvantage also matters. Less poor households may be able to draw on assets or savings to compensate for the effects of environmental shocks (Deaton 1989). The example in box 2.1 shows the case of a household which sold their livestock in times of drought.

Box 2.1: Livestock sales in times of drought

Louam[9] is 9 and lives with her parents and three of her siblings in rural Ethiopia. Louam said that her family is not poor and not rich, but medium. She thinks that poverty means wearing ragged clothes and going hungry. Louam knows what this is like. Her family have suffered from repeated environmental shocks. There was a period when Louam was little when the family did not have enough to eat because bad weather led to decreased agricultural production. For a time the whole family, including Louam, lived on tea and bread. Louam's mother said that her daughter: 'lost weight and became thin' which affected her physical growth. More recently, there has not been enough rain and the harvest was not good. Louam's mother said: 'We sold our animals and had to buy grain. We sold nine sheep and also our eucalyptus trees.'

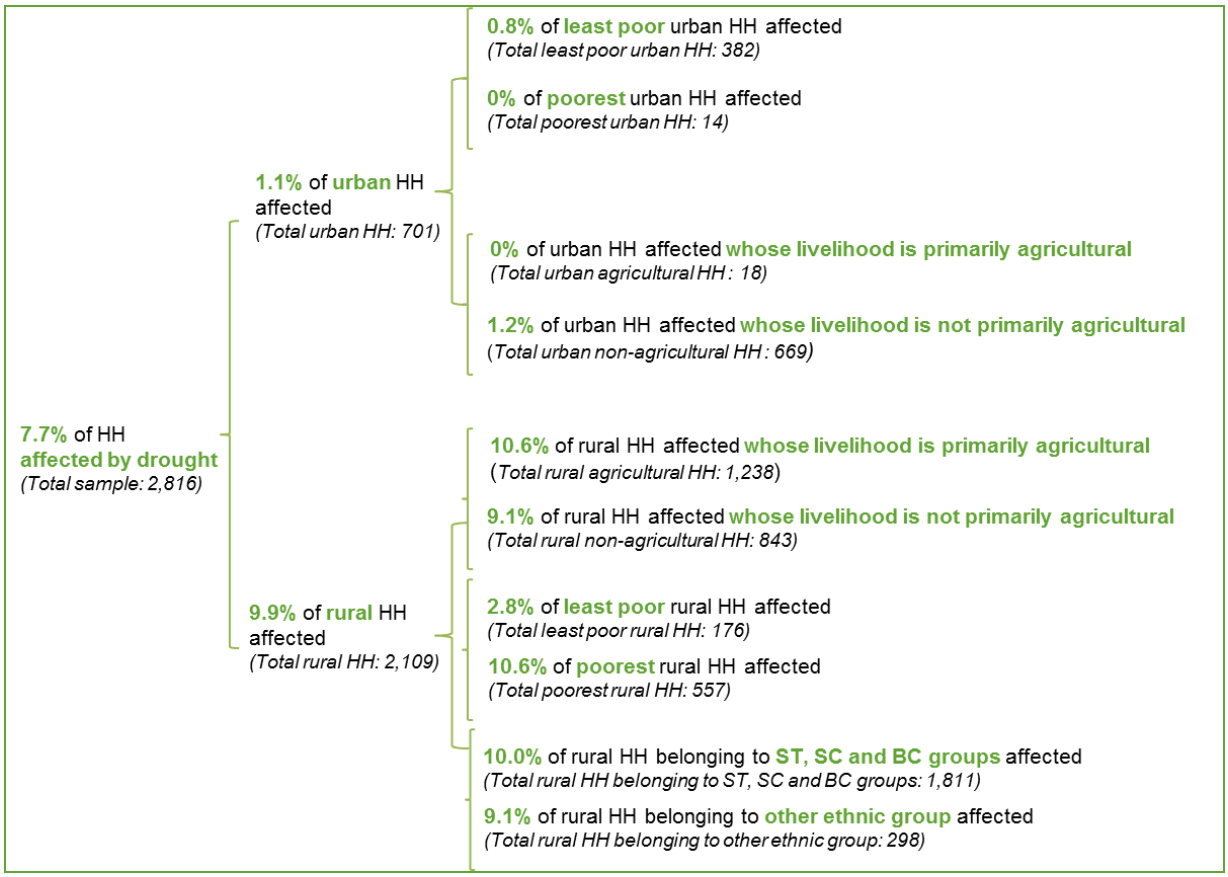
(Van der Gaag and Knowles 2009: 13–15; Woodhead et al. 2013: 20)

Drought in Andhra Pradesh

There are clear differences in the risks experienced by the groups shown in Figure 2 and Appendix A:

- Rural households are approximately nine times more likely to report drought than urban households;
- The scheduled tribe (ST), scheduled caste (SC), and backward classes (BC) group combined reported slightly more shocks than the other group – in this case the other group includes households which tend to be slightly more affluent (either because they are higher caste, or Muslim households which in this sample tend to live in the capital, Hyderabad). The ST, SC, and BC group tend to be poorer;
- Male-headed households were slightly more likely to report droughts, as they were also within rural areas;
- Poorer households reported about seven times more droughts than less poor households. Less poor households within rural areas report one-third of the drought shocks reported by poor rural households;
- Agricultural households faced double the risk of drought as non-agricultural households. There is little difference by means of livelihood within rural or urban communities.

Figure 2: Which households report drought? (Andhra Pradesh, 2009)



Note: totals reported in parenthesis may not equal totals per category due to missing values. Refer to Appendix A for definitions of groups. ST=scheduled tribe, SC=scheduled caste; BC=backward classes. HH=household.

Differences within urban and rural areas may still reflect an underlying locational explanation since the poorest households are concentrated in particular rural sites. However, differences within communities are discussed in Appendix B (third and fourth columns) below with analysis suggesting that households with more educated mothers[10] are less likely to report the experience of a drought. Also, households who owned livestock before the drought are around

4 percentage points more likely to report the shock (perhaps reflecting the loss of assets due to drought).

The same regression analysis on the full sample (first and second columns) shows a link between the National Rural Guarantee scheme[11] and drought reporting which is further explored in the subsequent section. The case study in box 2.2 describes Latha's experience of using this social protection programme during droughts.

Box 2.2: India's Mahatma Gandhi National Rural Guarantee scheme during drought

Latha is 18 years old and lives in a poor, drought-prone community in rural Andhra Pradesh, India. Her family own two acres, situated far from the canal, which is used locally as a source of irrigation. Latha's family used to struggle to survive when their annual crop of groundnuts failed. As her mother explained: 'There was no work before, except farm work no other work was there.' Latha stated that the family managed 'by taking loans from here and there.'

In the last three years the rainy season has not come on time and the crops suffered with drought. However, the same period has seen the expansion of the social protection Mahatma Gandhi National Rural Guarantee Scheme (MGNREGS). This has provided another source of income for Latha's family and unlike previously, no-one has been forced to migrate. Her mother described how:

'The drought work [MGNREGS] has been good for us, we need not leave the village, all parents and children are in one place, rather than one here and another one there. Now mothers and children can work together and spend time. Now every week if four members go to work, we get Rs.1200 per pair; that means about Rs.2000. Even if Rs.1000 is spent, another Rs.1000 can to be saved.'

Latha left school after seventh class, when she was 10 years old. She had wanted to continue to secondary school, but that would have meant travelling to another village. Latha participates in MGNREGS and earns Rs. 100 a day, which she uses to buy clothes and other necessities. She enjoys the work: 'It is good… all people do happily… the work is not very difficult… no hard work… easy to undertake… all of us do the work by mingling with one another… we don't feel the difficulty.'

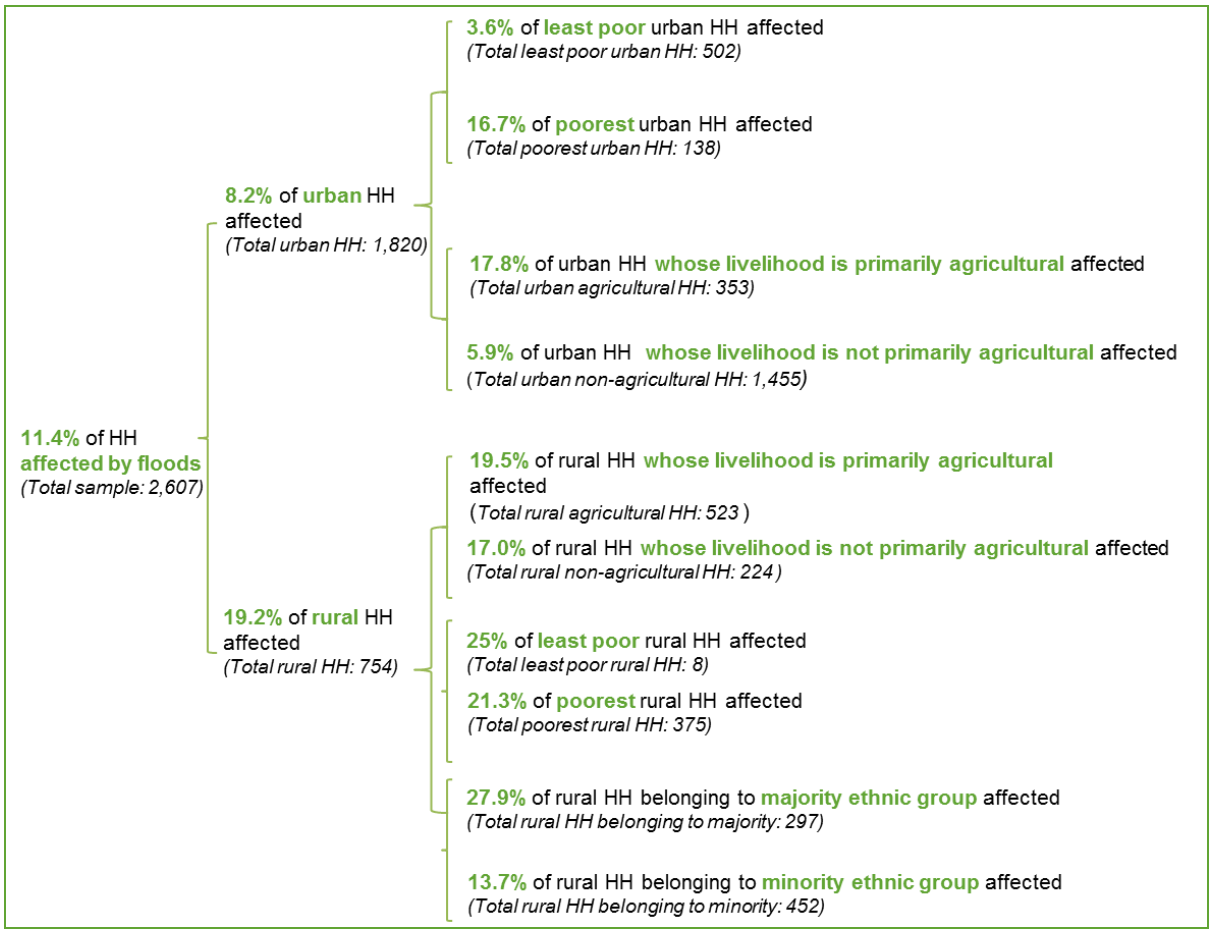
(Morrow 2013)

Floods in Peru

Figure 3 and appendix A presents an analysis of floods in Peru:

- Rural households reported twice the level of floods as urban households;
- Majority households were twice as likely to report a flood as ethnic minority households. That is a striking result since majority groups tend to be more advantaged in Peru. This seems to reflect differences in location (communities tend to be fairly homogeneous by ethnic group);
- Male-headed households consistently report more shocks in urban and rural areas;
- Agricultural households report more than twice the shocks as non-agricultural households. While there is little difference within rural areas, agricultural households in urban areas were three times more likely than non-agricultural households to be affected;
- Poorer households were about five times more likely to be affected though there was little difference within rural areas. However, within urban areas the poorest households reported five times the level of floods as the least poor households.

Figure 3: Which households report floods? (Peru, 2009)



Note: totals reported in parenthesis may not equal totals per category due to missing values. Refer to Appendix A for definitions of groups. HH= household.

The case study in box 2.3 shows the effects of flooding on a rural community.

Box 2.3: Flooding in rural Peru

Andahuaylas is a rural Quechua community located in the Southern highlands of Peru. The community is mainly reliant on agriculture, predominantly potato and corn production. It is characterised by high levels of out-migration, particularly during the months of November and February. The community has grown in size in recent years, and is now considered to be a 'minor settlement' and entitled to elect a local mayor and council. It has three schools (kindergarten, primary, and secondary) and a health post attended by a doctor and a nurse. In the period of January to March 2011 the community experienced heavy rains, which destroyed the crops of many families, and damaged houses, causing them to collapse. The family of nine-year-old Fabricio was particularly adversely affected. His mother explains:

'this year there was a lot of rain, we have suffered a lot in the water and in the mud, and this year all our produce was not good…the water was stagnant, our maize [turned out] small…'

As a result the family has had less produce to sell in local markets and for home consumption, forcing them to restrict their food intake and eat rice only once a week. His mother describes how this affects Fabricio, 'it affects him, he also gets sad, [asking], "what will we eat, are we going be alright? How will you buy things for me?..."'

Fabricio's mother also describes how there is less money to buy clothes for her children and how she's unable to afford to go to the doctor when she's ill. Due to the bad harvest this year she has also fallen behind on existing loan repayments:

'We borrowed 5000 for a hectare of potato, then the potato didn't grow well, it's been a failure, and so we still need to pay that, and they [the bank] are asking for it, and so we're sad, my children are also sad, asking me "with what money are we going to pay it?"'

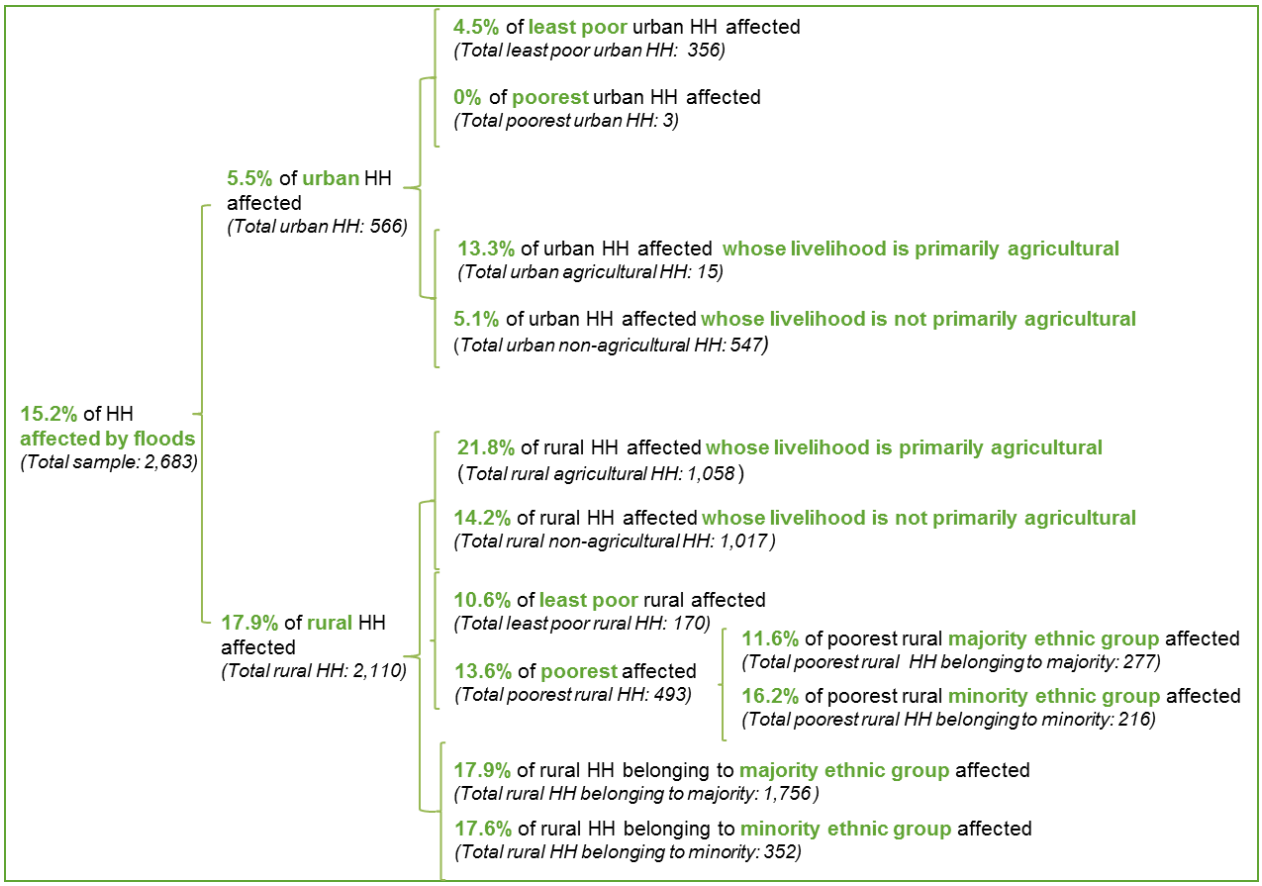
Fabricio's mother participated in community meetings, where she was promised food items as a means of support, but this never materialised. However other members of the community received donations of food sent by individuals from the nearby town.

Floods in Vietnam

There are considerable differences by location, ethnicity, livelihood, and wealth level shown in Figure 4 and in Appendix A:

- Households in rural areas were three times more likely to report a flood than urban households;
- Minority groups were slightly more likely to report floods than the majority ethnic group and there is little difference within rural areas overall. Further disaggregation of the poorest quintile shows that within that group in rural areas, minority households were slightly more affected by floods than majority households. In Vietnam, ethnicity is geographically concentrated, and so this is likely to reflect experiences in specific sites;
- Male-headed households report more floods in rural areas and overall. Female-headed households reported a higher rate of flooding in urban areas though in each case differences are small;
- Agricultural households reported twice the number of floods as non-agricultural households overall. This difference was also found within urban areas, though actual numbers were small;
- Poorer households were twice as likely to report floods as less poor households. However, only very small numbers of the poorest households were in urban areas and the poorest rural households report the most floods. The difference within rural areas is smaller than overall (suggesting the greater difference is by location).

Figure 4: Which households report floods? (Vietnam, 2009)



Note: totals reported in parenthesis may not equal totals per category due to missing values. Refer to Appendix A for definitions of groups. HH= household.

Analysis discussed below and shown in Appendix B shows that, having taken account of other factors such as location, households whose livelihood was primarily agricultural in 2006 were 7 percentage points more likely to report experiencing a flood in 2009 than non-agricultural

households. The case study in box 2.4 describes the experiences of Hung, a 17-year-old who lives in the Red River Delta in Vietnam.

Box 2.4: Hail and floods in Vietnam

Hung lives in the Red River Delta in Vietnam. His family have suffered a series of environmental shocks. First, a severe hailstorm in 2006 damaged 500 ornamental kumquat trees, costing the family an estimated 14m Vietnamese dong (VND) (equivalent to approximately $875 in 2006)[12]. This was followed by floods in 2008, which damaged the crop of oranges the family were growing, at a loss of 40m VND. Hung's mother explains:

'Some people told me the government would help us, so I tried to register for support. Then, [the district leaders] said they would help in the following year. In addition, they told me that they subsidised vegetables, not oranges. They tried to pass the buck to each other. Poor me! My family only grew oranges, not vegetables. All of the oranges were damaged because of the flood. When they refused to help me, I had to come back home without receiving anything.'

His mother explains: 'My children told me that we didn't have to worry any more. They also told me that when they are strong and healthy, they could earn money. Unless they are weak, everything can be solved. They made me understand that I didn't need to worry about anything because if they are healthy, they could earn even 50m VND. Thanks to their encouragement, I could get over all difficulties despite of the financial loss, which is too hard for a farmer to suffer.

(Pells/Save the Children 2012)

What predicts households reporting a shock?

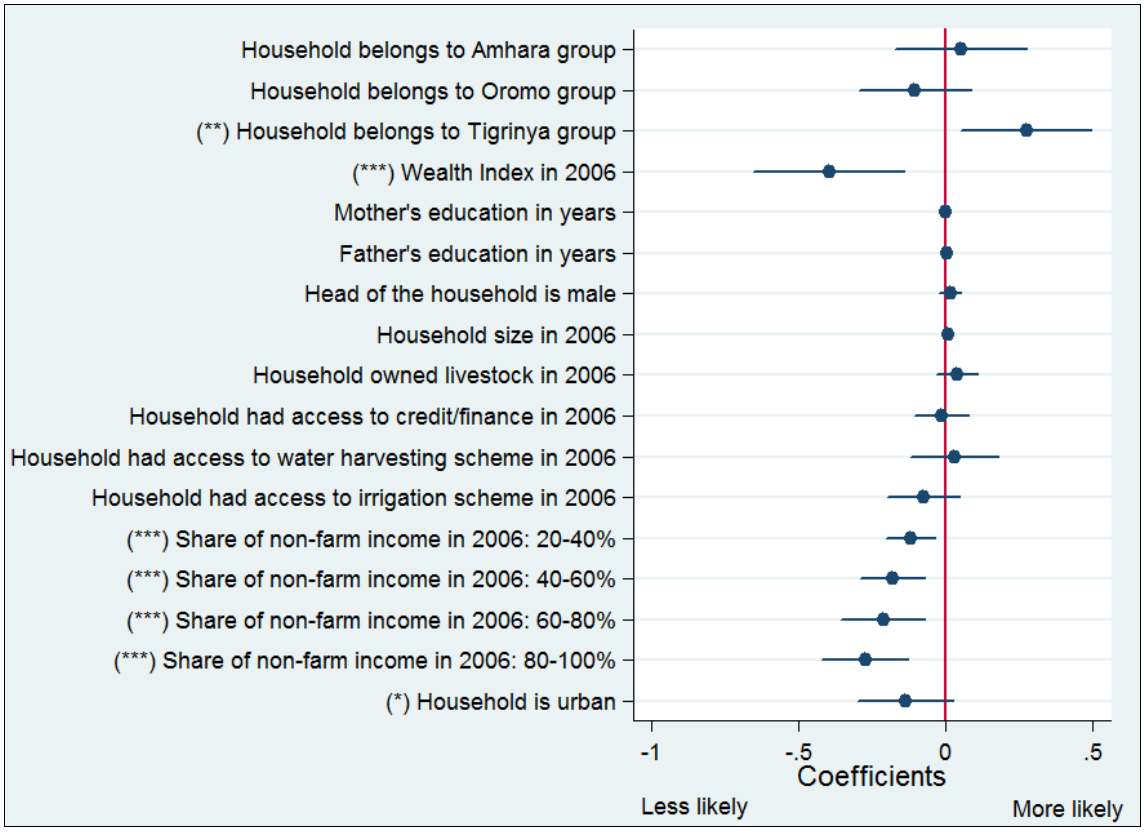
So far the analysis has been descriptive, simple associations between different characteristics and whether households report an environmental shock. In the previous section a number of household characteristics display differences within groups. However, such descriptive analysis does not necessarily show underlying associations – poor households may experience the most shocks, but location might be a more important risk factor if most of those poor households live in rural areas. Disaggregation accounts for this somewhat (by showing where the greater disparities are) but multivariate regression techniques improve on this. Regression allows us to model the relative effects on a dependent variable (e.g. the likelihood of reporting a drought) associated with a series of potential determinants (e.g. location, education levels, assets, etc.). The particular value is to consider whether potential factors are shown to be associated with an effect on the likelihood of reporting a drought *after* having accounted for other explanatory variables. By modelling the effects associated with multiple factors simultaneously this may generate different conclusions to simple descriptive analysis since these identify underlying associations, rather than the observed associations reported earlier.

Characteristics in 2006 are used to predict the probability of households reporting the shock in 2009[13]. Fuller results are provided in Appendix B. Figure 5 shows reports from Ethiopia and one model ('the full sample linear probability model (LPM)' in Appendix B). The appendix includes subsequent models that restrict the scope of the analysis to rural areas (second column), and to results *within* communities, rather than between them (fixed effects models in third and fourth column). The coefficients can be interpreted in terms of the effect (in percentage points) associated with a change in each variable on the likelihood of a household reporting a drought in 2009 (0.5 is equivalent to 50 percentage points).[14]

Figure 5 uses results for all Ethiopian households. Holding other variables within the model constant this suggests:

- Households belonging to a Tigrinya group were more likely to report a drought compared with households belonging to 'other' ethnic groups, e.g. Gurage, Hadiya, Sidama, Wolaita groups whose homeland is the Southern Nations, Nationalities, and People's (SNNP) region (likely to reflect location);
- Higher levels of wealth and income, and less reliance on agriculture were both associated with a reduction in the chances of reporting a drought;
- Living in an urban area was associated with a reduction in drought reports, but this is only marginally significant. The significance increases only when reliance on agricultural income is dropped from the models (so some of the urban effect relates to livelihood);
- **Households with a share of non-farm income between 40 and 60 per cent before a drought were 18.2 percentage points less likely to report a drought, compared with households very reliant on agriculture**. The larger the share of the household income coming from non-farm sources, the less vulnerable the household was to reporting a drought.
- **Higher household wealth is associated with a very large reduction in drought reports** (40 percentage points) but this is the modelled effect of moving from the bottom of the wealth index to the top (a very large increase).

Figure 5: Determinants of reporting drought (Ethiopia, 2009)



*Note: Linear probability model with robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1. Coefficients and 95 per cent confidence intervals for the coefficients are shown in the graph. Full regression coefficients of this model are available in Appendix B. Household characteristics are based on 2006 reports in order to reduce the risk of reverse causation affecting these results (where droughts affect concurrent wealth levels).*

In the second column in Appendix B1 the analysis of the LPM is rerun for rural households. Two differences emerge, though both are only marginally significant. First that having a male head of household is now shown to increase the chances of reporting a shock slightly (4 percentage points). Second, that having access to irrigation schemes in 2006 reduced the chances of reporting a drought (by 10 percentage points).

Columns 3 and 4 in Appendix B1 present 'community fixed effects' models. These models repeat the analysis but reference the specific community in which children live, and therefore, 'soak up' differences *between* communities, and consider only differences *within* communities affected by the same overall circumstances. This highlights two additional points.

First, the extent of the variation (the R-squared statistic[15]) in drought reports which is explained by models concerned only by *within* community differences is smaller (for Ethiopia about 1 per cent) compared to models concerned with both *between* and *within* community variation (in the first model 31 per cent). This finding is marked for Ethiopia; whilst (broadly) the same pattern is seen in the other countries the extent of the variation explained by models is smaller (Appendices B2–B4). The main variations, therefore, seem to be location dependent. Second, *within* communities these models suggest that higher wealth and a greater household share of non-farm income reduce the chances of reporting a shock. Additionally, being from the Oromo group increases the chances of reporting a shock but the effect is slight.

Though the example used here is Ethiopia, Appendices B2–B4 provide similar models for the other countries. Caution is needed when examining multi-country evidence due to differences in policies, the overall levels and spatial distribution of shocks, as well as differences in the samples and questions asked.

However, these additional models suggest further points, again holding other variables constant:

- In Andhra Pradesh, on the LPM (first and second columns in Appendix B2), there is evidence that each additional day of work on the Mahatma Gandhi National Rural Employment Scheme (MGNREGS) increases the chance of reporting a drought. The effect each day is small, but given that the average for households is 32 days, the true effect is larger). This finding is consistent with the scheme aim of reaching drought-affected households;
- In two of the models owning livestock increases the chance of reporting an environmental shock (for example in rural Vietnam by 7 percentage points approximately on both the LPM and fixed effects – *within* communities – model). This may suggest a link between the ownership of assets vulnerable to environmental shocks and the reported impact of such shocks;
- **In Peru, on the LPM access to credit or finance in 2006 is associated with slightly lower shock-report numbers.** That is an important (positive) finding but is worth thinking through in policy terms. Borrowing followed by an environmental shock might either leave households more resilient, or in debt which was difficult to pay back if assets were bought, and then lost due to flood or drought;
- Household wealth levels are less substantive and significant in the models from Andhra Pradesh, Peru, and Vietnam. In some ways this is surprising considering the Ethiopia results, but is consistent with the idea that location is more important than individual or household characteristics.

What are the differences between households reporting one-off or recurrent shocks?

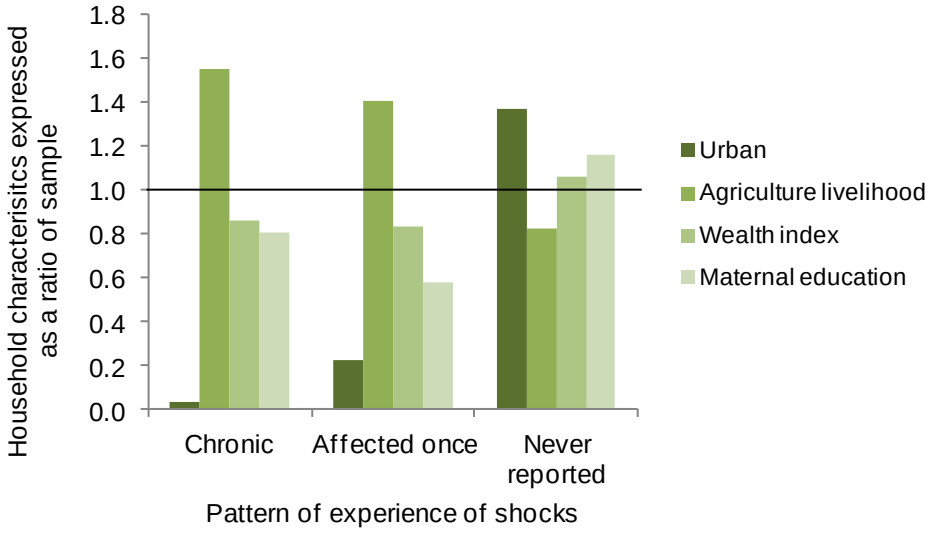
The data in Table 1 demonstrate that for some households shocks were recurrent. Data collected solely at one point underestimates who actually experiences a shock over time, and masks differences between those experiencing recurrent and one-off shocks. Given that recurrent (or chronic) experience of shocks may be particularly devastating we next examine households by the pattern of shocks they report.

Figure 6 uses data from Andhra Pradesh. Having categorised the households into 'chronic' (affected in 2006 and 2009), 'affected once', and 'never affected' groups, the profile of each of these groups is expressed as a ratio of the profile of the overall sample. This method allows us to consider differences in the sorts of households by pattern of shock. If the characteristics of the sub-sample match the wider sample, the figure would be 1 (the line is marked on the chart). If the figure is lower than 1 this suggests that the characteristic is less common or smaller in the sub-sample. For example, Figure 6 shows households reporting recurrent droughts were 1.5 times more likely than the whole sample to have an agricultural livelihood. This analysis suggests that:

- **Households reporting chronic shocks were least likely to live in urban areas and more likely to be reliant on agricultural sources (compared with the overall sample).** Such households have lower average wealth levels and lower maternal education levels than the overall sample and the never-affected group;
- Comparing households reporting chronic shocks with once-affected households, those affected chronically were less likely to live in urban areas and more likely to be involved in agricultural livelihoods. Wealth levels are similar and, perhaps surprisingly, the average maternal education levels in the chronic group are slightly higher (by about 0.8 years of formal schooling, against a sample average of 3.4 years).
- Comparing those who never report shocks with the chronically or once-affected groups suggests those who never report shocks were more likely to live in urban areas, less likely to be involved in agriculture and had higher wealth levels and maternal education levels.

Results from Ethiopia echo these findings from Andhra Pradesh. Analysis for Ethiopia suggests those affected by chronic droughts were broadly similar to those reporting one-off droughts but were more dependent on agriculture and less urban. However, households facing chronic shocks have lower levels of maternal education and very slightly lower wealth levels than households facing one-off shocks.

Figure 6: Profile of households affected by droughts in Andhra Pradesh, by pattern of shocks reported



Note: group categories use 2009 data but shock reporting relies on data reported in 2006 and 2009.

In summary:

- Environmental shocks, such as drought and flooding, were commonly experienced, though incidence varies over time and between country samples;
- Households in rural areas, who are poorer and engaged in agricultural work are most likely to report experiencing a shock. Some of the differences within countries are large;
- Analysis of underlying predictors of shock reporting demonstrates much of the variation is dependent on location. However, within areas there is evidence that households with higher wealth levels and less reliance on agricultural income reported fewer shocks in some countries;
- Data shows that those who experience recurrent shocks tend to live in rural areas, be more agricultural, have lower wealth levels and lower maternal education levels than those experiencing either one-off shocks or who never report a shock.

3 THE INCIDENCE OF FOOD INSECURITY

Food security is a complex and multidimensional phenomenon (including access, availability, utilisation, and stability) that can be measured through a variety of indicators. This paper focuses mainly on the access dimension of food security which is measured in two ways.

First, Table 2 uses a simple measure on which there is closely related data in 2006 and 2009. This allows consideration of the extent to which the experience of food insecurity was chronic. In this document this simple indicator is known as the food insecurity measure. Second, a more detailed index is used. This measure separates out degrees of severity. However, as this was added in 2009, there is only data from one year. In this document this measure is referred to as the food insecurity index.

In this section, therefore, the pattern over time is considered using the food insecurity measure. Then the patterns of severity are examined using the food insecurity index for 2009. Finally we consider associations other factors using analytic techniques.

How chronic is food insecurity?

In order to compare the concept of food insecurity across rounds, the answers to the following questions are used to construct the food insecurity measure:

- 2006: 'Has the household had any food shortages in the last 12 months?' (possible answers of 'yes' or 'no');
- 2009: 'Which of the following statements best describes the food situation at your home in the last 12 months?' (four possible answers in the following order: 'we always eat enough of what we want', 'we eat enough but not always what we would like', 'we sometimes do not eat enough' and 'we frequently do not eat enough').

Both questions are household self-reports about the last 12 months. Since there are differences in the answer codes, to make the 2009 question reasonably comparable to the 2006 food shortage question, the categories of 'we frequently do not eat enough' 'we sometimes do not eat enough' combine to be defined as food insecure. Breakdowns of these questions are shown in Table 2.

Table 2: Households reporting food insecurity, percent (food insecurity measure)

	2006	2009	Reported in either 2006, 2009, or both	Reported in both 2006 and 2009
Ethiopia	33.9	36.7	53.1	17.6
Andhra Pradesh	9.2	9.4	16.7	1.8
Peru	24.4	10.1	29.8	4.4
Vietnam	9.6	30.3	33.2	6.6

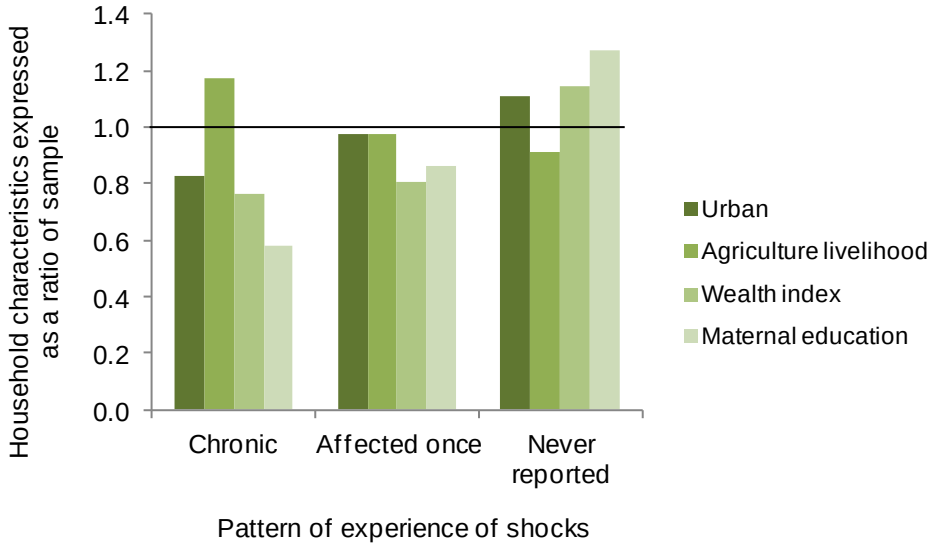
Notes: both cohorts included. Sample differences mean it is important to look at the pattern of change between the years rather than compare countries.

As with the experience of droughts and floods, looked at over a period of time the households which reported food insecurity at any point, are higher than at any one point. Again some households report recurrent food insecurity, up to 17 percent of the households (one in six) in Ethiopia but lower in the other countries. There is also some variability over time – in Peru the level of food insecurity on this measure changed from one in four (2006) to one in ten (2009) and in Vietnam from one in ten (2006) to one in three (2009).[16]

The panel nature of the data allows consideration of whether the characteristics of those reporting food insecurity once are likely to be different from those reporting food insecurity recurrently. Figure 7 uses data from Ethiopia to present some simple analysis of the profile of households reporting different patterns of food insecurity. As with Figure 6 (above) these are ratios of the whole sample, and so if chronically food insecure households were as likely to be in urban areas as the whole sample the bar would be at 1. Instead the bar is at 0.8, showing that chronically food insecure households are more likely to be in rural areas. The figure demonstrates that

- those who never report food insecurity were more likely to live in urban areas, less likely to have an agricultural livelihood, have higher wealth levels and higher maternal education levels;
- those who report chronic food insecurity were less likely to live in urban areas, more likely to have agricultural livelihoods (1.2 times the overall sample, or 20 percent more likely), likely to have lower wealth (0.8 times the overall sample) and maternal education levels (0.6 times). In 'real' terms, chronically food insecure households had mothers who had an average of 1.8 years of formal education, compared with 2.6 years for those affected once, and 3.8 years for those never affected.

Figure 7: Profile of households affected by food insecurity in Ethiopia, by pattern of shocks reported



Note: group categories use 2009 data but food insecurity reporting relies on data reported in 2006 and 2009.

The pattern in Figure 7 is similar or more pronounced in Andhra Pradesh and Vietnam. In Peru those reporting one-off or chronic food insecurity have similar characteristics, but both groups are less urban, more agricultural, poorer and with lower levels of maternal education than those who never report food insecurity.

How severe is reported food insecurity?

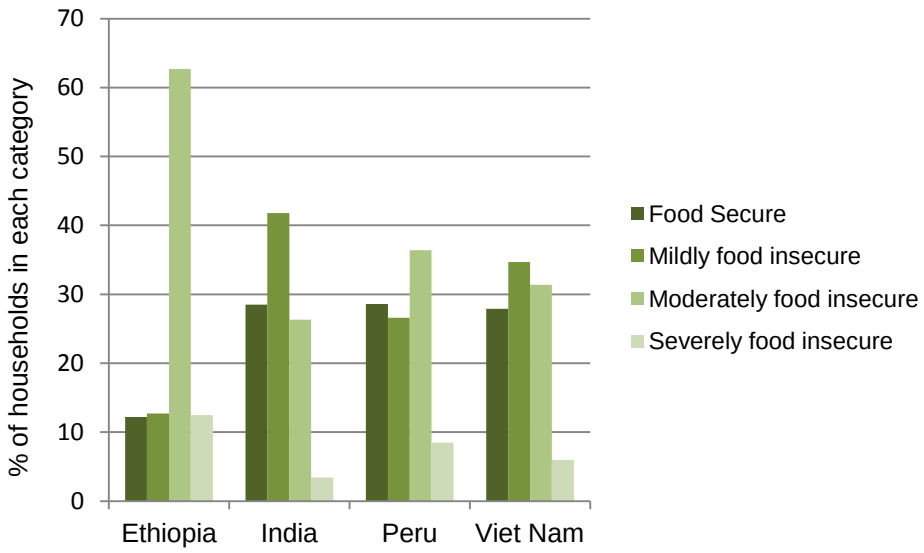
This section moves on to more detailed analysis of food insecurity using data collected in 2009 which allows indexing of food security, defined by access and prevalence. The index consists of nine questions measuring occurrence and frequency of food insecurity during the previous 12 months to the survey. The sum of the frequencies of occurrences for the nine food insecurity-related questions results in a scale that spans from 0 (where no conditions of food insecurity are experienced) to 27 (where all conditions of food insecurity are often experienced).[17]

These nine occurrence questions and the four categories they fit into are listed in the table in Appendix C as follows:

- *Food secure households* include those which always have enough to eat of what they want, and/or which rarely experience uncertainty about the food supply (but still always eat what they want);
- *Mildly food insecure households* experience anxiety about the food supply – either sometimes or often – and/or do not eat the foods they want, and/or eat limited or unwanted kinds of food rarely;
- *Moderately food insecure households* eat limited or unwanted kinds of food – either sometimes or often – and/or experience insufficient food intake such as limiting portion sizes and reducing the number of meals in a day – either rarely or sometimes;
- *Severely food insecure households* often limit portion sizes or reduce the number of meals in a day and/or experience insufficient food intake.

Figure 8 profiles the distribution of food insecurity in each country in 2009. There are striking differences in the experiences between the samples. In Ethiopia food insecurity levels are generally more severe with three-fifths of households reporting moderate food insecurity. In Andhra Pradesh two-in-five households report mild food insecurity. Using this indicator, food insecurity levels are high, with less than one-third of households in Andhra Pradesh, Peru, and Vietnam and about one-in-ten in Ethiopia, measured as food secure.

Figure 8: Food insecurity index by severity, 2009



This index gives a finer sense of both the severity of food insecurity and who is at (differential) exposure to food insecurity than does the 2009 single question used in Table 2. In doing so the index suggests a higher level of food insecurity than the single question because it captures a broader definition. Comparing the measures using data from Andhra Pradesh (broadly typical of the pattern seen in the other countries) suggests that

- Of the 9.4 per cent of households who reported being food insecure in Andhra Pradesh on the single question measure in 2009 (see Table 2); all are consistently food insecure on the 2009 index, with 7 per cent of this group being mildly food insecure, 63 per cent being moderately food insecure, and 30 per cent being severely food insecure;
- Of the 90.6 per cent who reported being food secure on the single question in 2009 (again in Table 2) only 31 per cent of these were classed as food secure while the remainder were mildly food insecure (45 per cent), moderately food insecure (23 per cent), or, for a very small number of households, severely food insecure.

Therefore, in 2009 the single measure is able to capture situations of higher food insecurity, but the index demonstrates that many of those who do not report food insecurity on the single question do experience a limitation on food security, measured in terms of access and choice of food. We explore determinants of food insecurity on this index in section 5.

In summary:

- Levels of food insecurity are high in the samples and, in Ethiopia particularly, are frequently chronic with one in six households reporting food insecurity in both 2006 and 2009;
- As with environmental shocks, measured over time food insecurity rates are higher than at any one point;
- Those who were chronically food insecure were typically more rural, reliant on agriculture, had lower wealth levels and lower maternal education levels than other groups.

4 PREVIOUS EVIDENCE FROM YOUNG LIVES: FOOD INSECURITY, ENVIRONMENTAL RISK, AND HOW HOUSEHOLDS COPE

In this section we draw on previous analysis of data on Young Lives children and their families to examine typical responses to environmental shocks. Environmental shocks and food insecurity have profound impacts on children's development and well-being. In rural Ethiopia, reduction in the availability of food during pregnancy had a significant impact on children's growth and development, for example low height-for-age at five years old. Drought occurring after birth had a similar impact (Woldehanna 2010). Stunting, or low height-for-age, is associated with poorer cognitive and psychosocial development (Le 2009; Sanchez 2009; Dercon and Sanchez 2011). Thus food insecurity and poor nutrition in the early years is generally associated with educational, social, and economic disadvantages that reduce children's capabilities as they develop (Woodhead et al. 2013).

Food insecurity continues to impact on children's development beyond the early years. Experience of food shortages at age 12 was associated with children having poorer outcomes at age 15 (after controlling for a range of factors, including ethnicity, location, and household wealth) (Pells 2011). Children with a past experience of household food shortage:

- were 60 per cent less likely to have a healthy body mass index (BMI)-for-age in Peru;
- scored lower in cognitive achievement tests in Andhra Pradesh and Ethiopia;
- reported lower self-rated health in Vietnam and Andhra Pradesh;
- reported lower subjective well-being in Ethiopia and Peru.

In the event of crop shocks in Vietnam, children from poor households with limited opportunities for borrowing were 15.8 per cent more likely to have dropped out of school than children who did not experience the shock. The study time out of school for these children was reduced by 31 per cent compared with poor children who did not experience a shock (Nguyen 2013).

Households draw on a range of strategies to cope with different shocks. Coping strategies may include reducing consumption, selling assets or using savings (consumption smoothing), labour substitution (by children or others), borrowing, seeking assistance from relatives, neighbours, or NGOs, and/or use of social protection schemes. Families often employ several strategies simultaneously. Typically households will first use any savings, then seek loans or support in-kind from relatives, before turning to informal credit from money-lenders or low-interest loans from semi-informal groups, such as self-help groups and, if accessible, seek credit from formal institutions (Pells 2011).

A range of factors shape which coping strategies are open to households. First, the nature of the shock experienced and the extent to which others within the community are affected. As environmental shocks tend to be covariant (affecting a large number of households within a given site) this can limit the ability of households to turn to others within the community for support. Conversely, widespread shocks such as flooding and drought may trigger outside support from either the government or NGOs (Ogando Portela and Pells forthcoming).

Second, the economic status of the household and the extent of social connectedness within the community shape the options available. Membership of self-help groups or access to credit is dependent on families being assessed as having the capacity to re-pay loans, such as possessing assets or the number of men of working age (seen as a proxy for the economic capacity of the household) in the household (Pells 2011). The social and economic support provided by self-help groups may enable households to mitigate the impact of shocks and is associated with better outcomes for children, after controlling for household characteristics. In families which have little or no access to social support groups, children are 40 per cent less likely to have a healthy BMI-for-age in Andhra Pradesh and 40 per cent less likely to have a healthy height-for-age in Ethiopia and Peru. In Ethiopia, children who live in households which belong to self-help groups are more than twice as likely to be enrolled in school and in Andhra Pradesh, children who live in households with low group membership are half as likely to be enrolled. However, families worry about their ability to pay back loans and falling into debt: 'I don't take *Iqqub.*[18] You know why? A person can take *Iqqub* if he can pay back. You need to have a business or good income. It needs good income to participate in *Iqqub*' (caregiver, rural Ethiopia) (Pells 2011).

Third, children play a key role in managing risks and responding to shocks faced by households, through their work and care activities, as illustrated by the Box 4.1 (Boyden 2009; Heissler and Porter 2010; Vennam et al. 2010). In Andhra Pradesh, the amount of time that children had to work (whether paid or unpaid) increased by two hours if the household suffered a loss of income as a result of drought, with girls being more affected than boys (Krutikova 2009). At the same time, work can have longer-term consequences for children's life chances.

Box 4.1 Children's responses to environmental shocks

At the age of 14, Haymanot attended school in the afternoon and worked on the Ethiopian Productive Safety Net Programme (PSNP) in the morning with her sister, as her mother was too sick to work. She was also responsible for household chores and doing some embroidery work. However, Haymanot's sister also became ill. A combination of famine, drought, and sickness ran down the household assets, with the result that Haymanot left school soon after. She described her sadness, as she was winning awards at school, but said it was her decision to stay at home and care for her mother: 'I feel very bad because I am not going to school and my mother is sick. … I will be happy if I continue going to school and my mother gets better.' At this time Haymanot was also suffering from repeated malaria, diarrhoea, vomiting, and fever, exacerbated by her work in the stone-crushing factory. Three years later Haymanot married. She feels that 'it has benefited me because I have got rest from going to work'. She says her health is much better and 'we have enough farm products' so she is not suffering from food shortage like when she was with her mother.

On the one hand stopping school and caring for her mother has restricted Haymanot's opportunities and affected her physical health for a time. On the other hand, Haymanot's mother explains that if 'she leaves any job and continues with her education, people will make fun of her, saying "Look Haymanot is idle"'. Working and supporting her mother enhanced Haymanot's reputation in the community: 'Some people who saw her always working admired her and asked how she managed to work and withstand the hardship at this age.' Haymanot does not feel that her previous experiences have impacted her life negatively. She hopes to delay having children and return to school next year.

(Ogando Portela and Pells forthcoming)

Finally, the recent expansion of social protection schemes has provided new opportunities for households to manage risks. In Ethiopia, households who had a household member registered under the PSNP were less likely to report being affected by drought (Ogando Portela and Pells forthcoming). The PSNP is a public-works scheme, with direct support provided to households

where no-one is able to work. In India, the MGNREGS provides 100 days of employment a year at a minimum wage rate to every adult in a rural household willing to undertake unskilled manual work. MGNREGS provides households with an alternative source of income. Households that were prone to seasonal shocks, lean agricultural periods, drought, and food price inflation were more likely to register (10.7 per cent) and use the scheme (Uppal 2009; Dornan 2010). This finding is consistent with the analysis presented in section 2 (Appendix B2), where we highlight that households who participate in the MGNREGS are more likely to report the experience of a drought (the scheme aims to reach drought-affected households). Registration and take-up of the scheme is also associated with positive impacts on children's nutritional outcomes (Uppal 2009).

Similarly, also in Andhra Pradesh, the government's Midday Meal Scheme provides children from first (age five) to eighth grade with a hot, nutritious meal. Many children who were born between 2000 and 2001 were affected by the severe 2002–2003 drought and so had a lower height-for-age and weight-for-age than their peers who were not affected by the drought. However, there was no difference if the child participated in the Midday Meal Scheme, suggesting that the scheme protected children from the impact of drought (Singh et al. 2012).

5 ANALYSING THE EFFECTS OF ENVIRONMENTAL SHOCKS ON CHILDREN'S NUTRITIONAL STATUS AND HOUSEHOLDS' FOOD SECURITY

This section estimates the effects associated with environmental shocks on two types of outcome – reported household food insecurity and children's physical development. We use multivariate regression to model the key determinants of physical development and household food insecurity. Summary tables are reproduced within this section, with the full models in appendices D and E. Appendix F contains descriptive statistics on the variables employed in the models.

Regression techniques model the effects associated with multiple determinants in the same models and by doing so the models test underlying associations[19] and provide estimates of the relative importance of determinants. This section first examines determinants of household food insecurity; before considering evidence on children's physical development (measured through their height-for-age) using data collected in 2009.

Determinants of food insecurity

To examine what determines household food insecurity we include various potential factors, including whether households have experienced environmental shocks, and use these to explain reported food insecurity levels. Food insecurity is measured using the index discussed earlier and explained in Appendix C. Food insecurity is experienced at the household level and so we pool the Younger and Older Cohort.

Full models are in Appendices D1 and D2 but to keep reporting simple here, Table 3 reproduces results only reporting the effects associated with previously experienced food insecurity in 2006 or a recent environmental shock. The food insecurity index provides a range of food insecurity from 0 to 27. The averages vary by country. The average for Ethiopian households sampled was 6.5, in Andhra Pradesh 3.1, in Peru 4.5, and in Vietnam 4.2 (these results are in Appendix F). Using the same categories as Figure 8, to give a sense of the variation:[20]

- 'food secure' households averaged from 0 to 0.2;
- 'mildly food insecure' households averaged from 2.3 (Andhra Pradesh) to 3 (Peru);
- 'moderately food insecure' averaged from 6.3 (AP) to 7.7 (Vietnam);
- 'severely food insecure' households ranged from 12.7 (Vietnam) to 14.3 (India) on average.

The figures in Table 3 show the effects (coefficients) on food security that were associated with either environmental shocks, or with prior food insecurity. The table has two models for each country. The first model is all households (urban and rural), the second is rural only (no urban-only models are created as the lower level of shocks mean they would not be robust). The coefficients can be interpreted as the change in the food security index which, holding other variables constant, was associated with a one unit change in the explanatory variables (experience of an environmental shock and food insecurity in this case). As an example, the full sample model for Peru predicts that experiencing a drought worsens the level of food insecurity by 1.3 points on the index.

Table 3: Effects of environmental shock on reported food insecurity in 2009

	Ethiopia		**India**		**Peru**		**Vietnam**	
	Full sample	Rural sample	Full sample	Rural sample	Full sample	Rural sample	Full sample	Rural sample
	Coeff. (St.E.)	Coeff. (St.E.)	Coeff. (St.E.)	Coeff. (St.E.)	Coeff. (St.E.)	Coeff. (St.E.)	Coeff. (St.E.)	Coeff. (St.E.)
Disaster	0.602	0.515	0.363	0.195	1.372**	0.769**	1.058***	1.031***
	(0.380)	(0.416)	(0.259)	(0.231)	(0.521)	(0.311)	(0.157)	(0.144)
Lagged food insecurity	1.788***	1.763***	1.102***	1.026***	1.781***	0.510	1.799***	1.662***
	(0.161)	(0.164)	(0.248)	(0.296)	(0.332)	(0.307)	(0.319)	(0.329)
Observations	2,382	1,590	2,651	2,016	2,098	595	2,425	1,959
R-squared	0.203	0.211	0.134	0.095	0.155	0.087	0.213	0.213

*Note: Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1. Environment shock refers to droughts in Ethiopia and Andhra Pradesh and floods in Peru and Vietnam. Refer to Appendix D for full regression coefficients.*

For environmental shocks (controlling for other factors), the results in Table 3 suggest that:

- in Ethiopia, in this model we do not find evidence that experiencing a drought was associated with increased food insecurity on the index (however it is worth noting in a separate regression, using slightly different controls there was found to be a marginally significant association);
- in Andhra Pradesh, experiencing a drought did not have significant effects on increased food insecurity, though the direction of the effect is consistent with Ethiopia;
- in Peru in the full sample and the rural-only sample, experiencing a flood increased food insecurity by 1.3 points and 0.7 points respectively;
- in Vietnam, as with Peru, in the full sample and in the rural sample, experiencing a flood worsened food security by about 1 point on the scale.

One way to think about how big these effects are is to consider the average level of food security households report as noted in Figure 8. To give a sense of distribution the range between the 25th and 75th percentiles[21] is as follows:

- Ethiopia (3–10);
- India (0–4);
- Peru (1–7);
- Vietnam (1–6).

So in both Vietnam and Peru, holding other factors constant, the effect associated with a flood was about one-fifth of the movement of a household from the 25th percentile to the 75th percentile on the distribution of the food insecurity index.

As a comparison the table also shows the effect associated with food insecurity reported in 2006 on the index in 2009. Previous food insecurity was associated with an increased reporting of food insecurity in 2009 in all samples except rural Peru. The effects are more consistent than with environmental shocks, and are also larger (between 1.1 points in Andhra Pradesh and 1.8 points in Vietnam, in the full sample). A second conclusion from Table 3, therefore, is the importance of recurrent food insecurity.

Appendix D contains the full list of variables used in the Table 3 model (the data is from 2009[22]), plus the effect sizes and significance. Table 4 reproduces the direction of these findings on key variables to consider the similarity of patterns between countries. Further patterns emerge:

- higher parental education level (both mothers and fathers) was associated with a consistently positive impact on food security;
- having a male head of household and a higher wealth level were both associated with lower food insecurity;
- living in an urban area was associated with higher food insecurity in three out of four countries. This is an important finding, and a different one to that suggested in Figure 7. Whereas Figure 7 is purely descriptive (and shows the chronically food insecure are least likely to be in urban areas), Table 4 controls for multiple possible factors. In other words whilst those living in an urban area generally report lower food insecurity, the reason for this is that those in urban areas have other characteristics (for example higher wealth levels) likely to protect them from food insecurity. It is notable, for example, that whilst rural households may be able to grow some food themselves, to improve household consumption, that option is less likely to be open to urban households who will be more dependent on buying food.

Table 4: Determinants of food insecurity, (full sample only, all countries)

	Ethiopia	**Andhra Pradesh**	**Peru**	**Vietnam**
Higher level of maternal education	-	-	-	-
Higher level of paternal education	-	-	-	-
Larger household	n/s	n/s	+	n/s
Head of household is older	+	n/s	n/s	n/s
Head of the household is a man	-	-	-	-
Increase in wealth index in 2006	-	-	-	-
Household is in an urban area	+	n/s	+	+
Household experienced a drought in period 2006-2009	n/s	n/s	+	+
Experience of food shortage in 2006	+	+	+	+

Note: - = reduced chances of food insecurity; + = increased chances of food insecurity; n/s= not significant. This table excludes country-specific variables such as region or ethnicity shown in Appendix D. Results significant at p<0.1 or greater level.

In summary:

- the experience of flooding was independently associated with worse food insecurity in Peru and Vietnam.
- there is no evidence of significant effects of drought on food insecurity in Ethiopia or Andhra Pradesh;
- higher parental education level, higher wealth level, and having a male head of household were associated with lower food insecurity levels;
- in three out of four countries, having controlled for other factors, living in an urban area was associated with greater food insecurity;
- having previously experienced food insecurity increases the severity of current food insecurity.

Determinants of children's physical development

Previous analysis has found effects of food shortage on children's BMI in Peru (see Section 4). Two points of data, 8 and 15 years,[23] are used to examine these correlations but using height-for-age and additionally consider environmental shocks: drought in Ethiopia and Andhra Pradesh, floods in Peru and Vietnam.

Height-for-age is calculated by comparing the child's actual height with the expected height (using a healthy population of the same age and gender). Height is expressed in z-scores.[24] If the average height of children in the sample matched the average height of the reference population the average z-score would be 0. Appendix F shows the average height-for-age to be consistently negative. This is not surprising given the samples are from developing countries and the samples are pro-poor but it demonstrates that these children are shorter than they should be. Height development reflects growth over a child's whole life (not just in the period prior to data collection) and so we include reference to earlier height-for-age which controls for initial level of height reached at Round 2 (as is seen in the models below previous height is a consistent and clear predictor of current height), so focusing attention on what affected change between 2006 and 2009. To examine what determines children's height, we present a series of regression models predicting child height, and estimate the relative effect associated with various potential drivers of height. Full models are in Appendix E, but a summary is reproduced in this section in Tables 5 and 6. Models are presented for both 8 year olds and 15 year olds, with models for the whole sample (urban and rural areas) and rural areas only.

The coefficients can be understood as the effect on height-for-age scores (expressed as standard deviations, or 'z-scores') of a one unit increase in one of the independent variables (experience of a drought or flood between 2006–2009, or an increase in 2006 height-for-age in Table 5 and 6). Negative results suggest the independent variable was associated with a reduction in the child's height-for-age score; positive results an increase.

Table 5: Effects of drought on z-scores of height-for-age, (Ethiopia and Andhra Pradesh, 2009)

	Ethiopia				**India**			
	At age 8		At age 15		At age 8		At age 15	
	Full sample	Rural sample	Full sample	Rural sample	Full sample	Rural sample	Full sample	Rural sample
	Coeff. (St.E.)	Coeff. (St.E.)	Coeff. (St.E.)	Coeff. (St.E.)	Coeff. (St.E.)	Coeff. (St.E.)	Coeff. (St.E.)	Coeff. (St.E.)
Drought	-0.056	-0.017	0.196***	-0.179***	0.112*	0.084	-0.033	-0.034
	(0.059)	(0.050)	(0.052)	(0.051)	(0.056)	(0.060)	(0.072)	(0.073)
Height-for-age z-score in 2006	0.669***	0.725***	0.768***	0.794***	0.760***	0.775***	0.657***	0.678***
	(0.032)	(0.025)	(0.036)	(0.048)	(0.035)	(0.046)	(0.039)	(0.029)
Observations	1,566	1,048	795	531	1,732	1,311	881	676
R-squared	0.477	0.514	0.649	0.698	0.624	0.619	0.524	0.531

*Note: Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1.*

Table 6: Effects of floods on z-scores of height-for-age, (Peru and Vietnam, 2009)

	Peru				Vietnam			
	At age 8		At age 15		At age 8		At age 15	
	Full sample	Rural sample	Full sample	Rural sample	Full sample	Rural sample	Full sample	Rural sample
	Coeff. (St.E.)	Coeff. (St.E.)	Coeff. (St.E.)	Coeff. (St.E.)	Coeff. (St.E.)	Coeff. (St.E.)	Coeff. (St.E.)	Coeff. (St.E.)
Floods	0.013	-0.055	0.043	-0.033	0.042	0.046	-0.034	-0.051
	(0.038)	(0.069)	(0.049)	(0.080)	(0.042)	(0.043)	(0.056)	(0.058)
Height-for-age z-score in 2006	0.698***	0.714***	0.720***	0.701***	0.843***	0.829***	0.641***	0.649***
	(0.026)	(0.035)	(0.023)	(0.059)	(0.027)	(0.031)	(0.029)	(0.035)
Observations	1,531	458	554	132	1,579	1,275	812	659
R-squared	0.666	0.632	0.721	0.617	0.698	0.658	0.601	0.619

*Note: Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1.*

Holding other factors constant the coefficients in Tables 5 and 6 suggest that:

- in Ethiopia drought was not associated with a significant negative effect on height at 8 years of age, but was associated with lower height-for-age at 15 years. For the full sample, this effect is about 0.19 standard deviations of height-for-age. Though significant, this finding is smaller than the positive effect associated with increased height-for-age in previous rounds (2006). One standard deviation in height-for-age in 2006 was associated with 0.72 standard deviations of height-for-age in 2009.
- in Andhra Pradesh, drought was shown to have a significant effect in the full sample of 8 year olds. In some ways this is counterintuitive as the effect of a drought seemed associated with being slightly taller than otherwise expected, but the effect is small, significance is very marginal and not the case for 15 year olds. The cause of this is not immediately clear, but such a result might occur if, say, drought was also associated with other factors not in the model (for example community response) which themselves counterbalanced the negative effect of drought. Again previous height-for-age is a strong predictor of subsequent height.
- in Vietnam and Peru flooding was not shown to have independent effects on children's height, however, previous height-for-age is a strong predictor of subsequent height;
- the direction of the impact associated with environmental shock was mostly negative, though the effect size was small and usually not significant.

As with Table 4, we consider some of the other factors (summarised in Table 7 and shown in appendix E) which related to differences in height-for-age scores at 8 and 15. The clearest message is the consistent importance of earlier height-for-age z-scores but additionally higher wealth levels and higher parental education either were associated with positive or non-significant impacts on height-for-age. Being a boy is sometimes associated with lower height-for-age than girls, though not in Peru (the link between gender and height-for-age across countries is discussed by Wamani et al. 2007).

Table 7: Summary of determinants of height-for-age scores (full sample only, all countries)

	Ethiopia		Andhra Pradesh		Peru		Vietnam	
Age (in years)	8	15	8	15	8	15	8	15
Child is older	n/s	+	n/s	n/s	n/s	n/s	-	-
Child is a boy	-	-	n/s	n/s	n/s	+	-	n/s
Higher birth order	n/s	n/s	n/s	n/s	n/s	n/s	n/s	n/s
Higher wealth levels	+	n/s	n/s	n/s	n/s	n/s	+	+
Higher maternal education	n/s	n/s	+	n/s	n/s	n/s	n/s	n/s
Higher paternal education	n/s	n/s	n/s	n/s	+	n/s	n/s	n/s
Larger household size	n/s	n/s	n/s	n/s	n/s	n/s	n/s	n/s
Older household head	n/s	n/s	+	n/s	n/s	n/s	n/s	n/s
Head of the household is a man	n/s	n/s	n/s	n/s	n/s	+	n/s	n/s
Household is urban	n/s	n/s	n/s	n/s	n/s	n/s	n/s	-
Household experienced a drought/flood in period 2006–2009	n/s	-	+	n/s	n/s	n/s	n/s	n/s
Height-for-age z-score in 2006	+	+	+	+	+	+	+	+

Notes: + = greater HAZ; - = lower HAZ; ns= non-significant. In the full regressions wealth is expressed as 4 dummy variables referenced against the poorest quintile. To simplify this here, wealth is marked as associated with an effect where in full regressions there is some evidence that being in one of the less poor quintiles (2–5) rather than the poorest (1) was significant.

In summary:

- flooding is associated with an increased severity of food insecurity in Peru and Vietnam;
- there seem to be no effects in Ethiopia and Andhra Pradesh from droughts on food insecurity;
- Peruvian households report an average of 4.5 points on an index of food insecurity. Experience of a flood was associated with an additional 1.4 points of increased insecurity, or about one-fifth of the 'distance' between the 25th and 75th percentile;
- there is evidence that previous food insecurity increases the severity of food insecurity in a household, highlighting the recurrent experience of food insecurity for some households;
- there is evidence in Ethiopia that for 15-year-olds having experienced a recent drought gained less height between the age of 12 and 15.This is not evidenced in the other countries;
- previous height-for-age is strongly predictive of current height, reinforcing the importance of children's early circumstances for their later growth.

6 CONCLUSION

The paper provides an empirical exercise estimating the extent of environment-related shocks, and food insecurity in the Young Lives households. As noted at the start, Young Lives is pro-poor rather than nationally representative of the countries in which data is collected. Therefore these findings are not statements about the countries as a whole, nor are they comparisons of levels of shocks or food insecurity in the countries. The key benefit of this cohort analysis here is being able to look over time, and to connect earlier circumstances with later outcomes.

Young Lives households face a high exposure to environmental shocks, but the pattern varies by country and over time. Many families experience food insecurity, especially when defined in terms of eating a limited range of food. Panel analysis shows adverse events are sometimes recurrent and over time a greater number of households are 'at risk' of adverse circumstances than at any one point. This matters since recurrent adverse circumstances are likely to have compounding impacts. The association of previous food insecurity with current insecurity may not be surprising but is indicative of the often chronic nature of risk.

The incidence of reported environmental shocks is concentrated by location, livelihood, and poverty. These factors interact – poorer, rural, agriculture-dependent households are the most likely to report environmental crisis. The pattern looks somewhat different in urban and rural areas. Broadly, in rural areas, the analysis is consistent with covariant effects, with the risk of exhausting area resilience. In urban areas the story appears to be one of inequality, with the (generally lower) levels of risk disproportionately experienced by more disadvantaged households.

There is important evidence that higher food insecurity is linked with environmental shocks in Peru and Vietnam. We do not see the same effects in Ethiopia and Andhra Pradesh. Household factors predicting food insecurity include low wealth or education levels. There is a less clear cut story in terms of children's height-for-age. Most models do not show significant negative effects associated with environment, on top of other background circumstances (wealth level, previous height, etc.). The exception to this is Ethiopia where previous drought was associated with children being shorter than expected at 15 years old, on top of other background circumstances. That we see an impact at an older age and not at a younger age point is in some ways surprising (since linear growth patterns are usually thought to be set quite young). Where we do not see effects, however, this is not necessarily surprising since it is the households' ability to cope with shocks, not just the environmental events per se, that shape impacts on children's development. Put positively, this is evidence that improved living standards within households are a buffer to the impact of environmental shocks on children.

Since this analysis has focused on environmental shocks, households reliant on agriculture are at a particular risk of shocks. Given societies cannot do without growing food, mitigating this risk suggests reducing the extent, impact of such shocks or improving land quality to improve productivity. Communities with mixed livelihood bases may be more resilient to environmental shocks.

Improving resilience to shocks in specific areas is important as location is shown to be an important predictor of environmental risk, especially in rural areas. Some findings to support this were:

- in Ethiopia, in rural areas irrigation was associated with marginally significant but positive reductions in drought reports;
- in Peru, access to credit or finance was associated with lower chances of reporting a flood;
- in Andhra Pradesh, using the Mahatma Gandhi National Rural Employment Guarantee Scheme (MGNREGS) was associated with increased drought reporting which is suggestive of individuals using the scheme in response to high drought pressure (i.e. effective policy reach).

The case of irrigation in Ethiopia highlights area infrastructure improvements, with the implication these can reduce the level of shocks generated by climatic events. The second example of credit and finance highlights how access to coping mechanisms might enhance the ability of individuals to deal with shocks. Access to savings, borrowing, or insurance are all importance strategies. However, not everyone has equal access to these (for example borrowing may require being judged as 'credit worthy'). Indeed borrowing to buy assets that may subsequently be lost in environmental shock carries the risk of leaving the household in a worse situation. The third example, of the MGNREGS scheme, shows evidence of outside support provided to particular areas affected by shocks to secure basic livelihoods through an employment guarantee at minimum wage. Such interventions, bringing external resources to stressed communities, protect longer-term resilience where these communities can invest in productive assets or prevent the running down of resources.

There are differences in the pattern of who is affected in urban and rural areas. In rural areas, a greater number of households seem to be affected, whereas, in urban areas, the overall shock level is lower but there is greater disparity in those affected. Social protection strategies can have both an area-based and/or household-targeting element. This analysis certainly gives support for an area-based element in rural areas, such as with the MGNREGS. But if particular households are at greater risk in urban areas that suggests the need for more of a household-based mechanism of allocating resources.

Finally, as a general conclusion from this report, both anti-poverty and area-based development policies are in line with increasing the resilience of households to the adverse effects of drought, flood or other environmental events. Social protection is an important response to concerns over climate shocks.

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NOTES

1 Since results will be influenced by the incidence of drought and flood in the study years, worse droughts or floods may have different effects

2 A panel study collects data on the same individuals over time. A cohort study collects data on a selected group of same aged individuals. Young Lives is both.

3 This involves the purposive sampling of a small number of settings, deemed to represent a certain type of population or area.

4 See http://www.younglives.org.uk/publications/TN

5 A fuller table is provided in Appendix A.

6 Preliminary analysis suggested flooding has more serious consequences.

7 In Ethiopia, Andhra Pradesh and Vietnam, agricultural households refer to households where the most important activity is agriculture in terms of time spent; in Peru, it refers to household whose most important money-making activity is agriculture.

8 Wealth is measured using an index composed of three equally weighted domains, household consumer durables, service access, and housing conditions.

9 All names of communities and children are pseudonyms.

10 I.e. as years of education of the Young Lives child's mother.

11 This scheme is provided in rural areas, guaranteeing work days and intended to be a buffer to the impact of environmental shocks. It had only been part implemented in 2006.

12 Exchange rate of August 15, 2006.

13 We use ordinary least squares (OLS) on a binary outcome (i.e. the report of an environmental shock to the household) to model the probability of households reporting a shock. This estimation is often referred to as the linear probability model (LPM). The advantage over a logit estimation (often used on binary outcomes) is that coefficients are easier to estimate and interpret while allowing for community/cluster fixed effects (FE). All models presented in this paper take into account the fact that individuals living in the same community are more homogenous than individuals living in a different community by clustering standard errors at the site/community level. This increases the robustness of the estimation but does not alter the coefficients of the regression.

14 The interpretation should take into account the type of variable and unit of measurement in which each variable is presented. For instance, the effect sizes presented in Figure 5 for a continuous variable such as maternal education are those of a unit increase, this is an increase of one year of education since the variable is measured in years. On the other hand, the effect size of a binary or dummy variable such as household is 'urban' is interpreted for those 'being or belonging in that group'. In Figure 5, for example, being in an urban household decreases the likelihood of reporting a drought by 13.7 percentage points. As a convention, we give the binary variable the name of the group represented by the value of 1.

15 The R-squared is a statistical measure of the extent to which the difference in the outcome variable can be explained by the model. It ranges from 0 to 1. An R-squared of 0.5, for example, indicates 50 per cent of the variability in the outcome is being accounted for.

16 This point requires some caution. The results from Peru and Vietnam are very different, which could be a substantive difference in the experiences in the samples. However, we do not rule out that this might reflect a methodological difference in how respondents answered the question in each country (for example, there are slight differences in questions asked between rounds, and each was translated into national languages).

17 Constructed following the methodology used by Coates et al. (2007).

18 Iqqub are the customary rotating credit associations in Ethiopia.

19 Unobserved characteristics may affect results, so we test associations rather than causes.

20 The index of food insecurity is a simple sum of all frequency-of-occurrence questions (in Appendix B) as opposed to categories of food insecurity in Figure 8 which are drawn according to the severity of the frequency-of-occurrence. Therefore, it is technically possible that a low score (i.e. a score of one) in the index relates to a mild, moderate, or even severe category of food insecurity (though not the opposite way around).

21 I.e. rank all households by food security, the 25th percentile is the point after the first quarter, the 75th after three quarters of households.

22 All data is from 2009 except for characteristics that may be affected by the effects of an environmental shock, such as wealth levels (where we use 2006 reports). Shock reports were collected in 2009, but the question reflects on the period from 2006 to 2009.

23 Initially we modelled multiple age points, however, to do so was reliant on using data collected in years with different levels of shocks, making it difficult to separate out what is associated with age and what is associated with the level or nature of shocks when the data was collected. Therefore. we report only on data collected in 2009.

24 Z-scores provide a way of standardising data by expressing data in standard deviations of the distribution of scores in the population.

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APPENDICES

Appendix A: Percentage of households reporting environmental shocks by group and country 2009

		Drought				Floods			
		Ethiopia		Andhra Pradesh		Peru		Vietnam	
		%	N	%	N	%	N	%	N
Location	Rural	51.7	1721	9.9	2109	19.2	754	17.9	2110
	Urban	10.1	1135	1.1	701	8.2	1820	5.5	566
Ethnicity	Majority	35.5	2046	8.4	2237	11.8	1795	14.9	2326
	Minority	34.6	811	5.4	579	10.8	762	17.5	355
	Urban and minority	12.2	327	1.1	280	6.5	310	0.0	3
	Urban and majority	9.3	806	1.2	421	8.6	1498	5.5	563
	Rural and minority	49.8	484	9.1	298	13.7	452	17.6	352
	Rural and majority	52.4	1236	10.0	1811	27.9	297	17.9	1756
Head of household	Female	25.3	621	5.4	202	8.1	397	12.8	336
	Male	38.0	2239	7.9	2612	12.0	2209	15.6	2339
	Urban and male	8.9	773	1.1	648	8.6	1504	4.9	469
	Urban and female	12.7	362	1.9	52	6.3	315	8.2	97
	Rural and male	53.2	1463	10.2	1959	19.7	680	18.2	1870
	Rural and female	42.6	258	6.7	149	14.9	74	14.6	239
Primary livelihood	Non-Agricultural	12.3	1293	5.6	1515	7.3	1704	11.0	1570
	Agricultural	56.4	1434	10.5	1258	18.9	884	21.7	1074
	Urban and Agricultural	29.5	61	0.0	18	17.8	353	13.3	15
	Urban and Non-agricultural	7.9	1004	1.2	669	5.9	1455	5.1	547
	Rural and Agricultural	57.5	1371	10.6	1238	19.5	523	21.8	1058
	Rural and Non-agricultural	27.5	287	9.1	843	17.0	224	14.2	1017
Household wealth level	Poorest quintile	58.7	576	10.5	572	19.9	523	13.5	496
	Least poor quintile	8.0	566	1.4	559	3.9	515	6.5	526
	Urban and least poor	6.1	510	0.8	382	3.6	502	4.5	356
	Urban and poorest	32.3	31	0.0	14	16.7	138	0.0	3
	Rural and least poor	25.0	56	2.8	176	25.0	8	10.6	170
	Rural and poorest	60.1	544	10.6	557	21.3	375	13.6	493

Notes *(1) Majority group refers to: Amhara, Oromo, and Tigrinya people in Ethiopia (versus other); SC, ST, BC tribes in India (versus other); Spanish mother-tongue speakers in Peru (versus Quechua and other speakers); and Kinh in Vietnam (versus other).*
(2) In Ethiopia, Andhra Pradesh, and Vietnam agricultural primary livelihood refers to households where the most important activity is agriculture in terms of time spent. For Peru, the definition is in terms of money-making activity.
(3) 'Poorest' and 'least poor' categories refer to first and fifth quintiles of a wealth index which is a composite of three equally weighted elements (service access, housing conditions, and consumer durables).

APPENDIX B: REGRESSION PREDICTORS OF REPORTING ENVIRONMENTAL SHOCKS, BY COUNTRY (2009)

Table B1: Ethiopia: Probability of reporting a drought in 2009

	(1) Full sample LPM	(2) Rural sample LPM	(3) Full sample FE	(4) Rural sample FE
Ethnicity (ref. category): 'other' ethnic group				
Household belongs to Amhara group	0.051	0.136	0.006	0.058
	(0.106)	(0.148)	(0.019)	(0.033)
Household belongs to Oromo group	-0.106	-0.154	0.019	0.061**
	(0.091)	(0.119)	(0.022)	(0.021)
Household belongs to Tigrinya group	0.274**	0.322**	-0.013	-0.133
	(0.106)	(0.138)	(0.025)	(0.204)
Wealth index in 2006	-0.398***	-0.458**	-0.253***	-0.301***
	(0.123)	(0.212)	(0.067)	(0.082)
Maternal education in years	-0.001	-0.004	-0.001	-0.004
	(0.004)	(0.009)	(0.002)	(0.004)
Paternal education in years	0.002	0.006	-0.000	0.001
	(0.003)	(0.005)	(0.002)	(0.003)
Head of the household is male	0.014	0.042*	0.006	0.010
	(0.017)	(0.021)	(0.012)	(0.019)
Household size in 2006	0.006	0.009	-0.001	-0.000
	(0.005)	(0.007)	(0.004)	(0.005)
Household owned livestock in 2006	0.038	0.000	-0.015	-0.037
	(0.033)	(0.050)	(0.022)	(0.044)
Household had access to credit/finance in 2006	-0.016	-0.057	0.043	0.053
	(0.044)	(0.053)	(0.028)	(0.042)
Household had access to water harvesting scheme in 2006	0.028	0.002	0.032	0.021
	(0.071)	(0.071)	(0.026)	(0.027)
Household had access to irrigation scheme in 2006	-0.076	-0.102*	-0.002	-0.002
	(0.059)	(0.058)	(0.017)	(0.020)
Income (ref. category): share of non-farm income: 0% and 20% in 2006				
Share of non-farm income: 20% and 40% in 2006	-0.121***	-0.104**	-0.028	-0.023
	(0.039)	(0.037)	(0.031)	(0.032)
Share of non-farm income: 40% and 60% in 2006	-0.182***	-0.154***	-0.037	-0.022
	(0.052)	(0.050)	(0.031)	(0.033)
Share of non-farm income: 60% and 80% in 2006	-0.214***	-0.184**	-0.029	-0.018
	(0.068)	(0.074)	(0.042)	(0.054)
Share of non-farm income: 80% and 100% in 2006	-0.275***	-0.341***	-0.077*	-0.112*
	(0.070)	(0.078)	(0.044)	(0.063)
Household is urban	-0.137*		-0.082	
	(0.077)		(0.083)	
Constant	0.562***	0.573***	0.493***	0.604***
	(0.101)	(0.126)	(0.050)	(0.098)
Observations	2,296	1,553	2,296	1,553
R-squared	0.312	0.163	0.013	0.013
Number of clusters			20	15

Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1.

Notes *(1) Standard errors are clustered at the site (cluster) level.*
(2) Columns 1 and 2 present the linear probability model using OLS. In columns 3 and 4, FE refers to cluster fixed effects.
(3) Non-farm income includes: income from land (not used for crops); income from wages (i.e. salaried or regular wage work); income from business or self-employment in non-agricultural activities (e.g. profits from trading commodities, from processed food/alcohol, handicrafts, carpentry, services, etc.); and income from transfers (i.e. from government or organizations, remittances and earnings from assets and savings) in the last 12 months.
Farm income includes: income from crops sold, income from wages (i.e. agricultural wage work); and consumption from own harvest in the last 12 months.
Share of non-farm income is: non-farm income/(non-farm income + farm income)

Table B2: Andhra Pradesh: Probability of reporting a drought in 2009

	Full sample LPM	Rural sample LPM	Full sample FE	Rural sample FE
Ethnicity (ref. category): 'other' ethnic group				
Household belongs to SC caste	0.028	0.036	0.026	0.032
	(0.022)	(0.030)	(0.019)	(0.024)
Household belongs to ST caste	-0.056	-0.055	-0.014	-0.013
	(0.042)	(0.048)	(0.034)	(0.040)
Household belongs to BC caste	-0.003	-0.001	0.003	0.004
	(0.014)	(0.022)	(0.006)	(0.010)
Wealth Index in 2006	-0.031	-0.031	0.031	0.046
	(0.043)	(0.051)	(0.029)	(0.033)
Maternal education in years	-0.001	-0.001	-0.004**	-0.006**
	(0.002)	(0.003)	(0.002)	(0.003)
Paternal education in years	0.002	0.002	-0.000	-0.000
	(0.001)	(0.002)	(0.001)	(0.002)
Head of the household is male	0.017	0.024	0.008	0.014
	(0.023)	(0.030)	(0.021)	(0.027)
Household size in 2006	-0.001	-0.001	-0.000	-0.000
	(0.004)	(0.005)	(0.004)	(0.005)
Household owned livestock in 2006	0.048**	0.050**	0.037**	0.037**
	(0.021)	(0.022)	(0.015)	(0.016)
Household had access to credit/finance in 2006	-0.034	-0.034	-0.018	-0.015
	(0.041)	(0.045)	(0.014)	(0.016)
Employment days provided for the household by the MGNREGS in 2006	0.001***	0.001***	-0.000	-0.000
	(0.000)	(0.000)	(0.000)	(0.000)
Household's most important activity in terms of time spent is agricultural in 2006	-0.012	-0.010	-0.023	-0.024
	(0.015)	(0.016)	(0.015)	(0.015)
Household is urban	-0.060*		-0.024	
	(0.029)		(0.017)	
Constant	0.102**	0.089	0.088**	0.086**
	(0.048)	(0.053)	(0.034)	(0.038)
Observations	2,561	1,961	2,561	1,961
R-squared	0.045	0.025	0.010	0.010
Number of clusters			20	16

Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1.

Notes *(1) Standard errors are clustered at the site (cluster) level.*
(2) Columns 1 and 2 present the LPM using OLS. In columns 3 and 4, FE stands refers to cluster fixed effects.

Table B3: Peru: Probability of reporting a flood in 2009

	Full sample LPM	Rural sample LPM	Full sample FE	Rural sample FE
Ethnicity (ref. category): 'other' ethnic group				
Household belongs to Spanish group	0.051	0.125**	-0.049	-0.135***
	(0.045)	(0.058)	(0.060)	(0.037)
Household belongs to Quechua group	-0.079	-0.115*	-0.090	-0.326***
	(0.049)	(0.056)	(0.057)	(0.078)
Wealth Index in 2006	-0.175*	0.020	-0.031	0.189
	(0.089)	(0.282)	(0.051)	(0.113)
Maternal education	-0.001	-0.003	-0.005*	-0.011
	(0.003)	(0.010)	(0.002)	(0.007)
Paternal education	0.000	0.002	0.001	0.003
	(0.003)	(0.008)	(0.003)	(0.008)
Head of the household is male	0.006	0.089*	-0.005	0.079*
	(0.023)	(0.044)	(0.021)	(0.043)
Household size in 2006	0.004	0.005	0.001	-0.004
	(0.002)	(0.006)	(0.002)	(0.006)
Household owned livestock in 2006	0.030*	-0.138	0.002	-0.210
	(0.017)	(0.136)	(0.019)	(0.153)
Household had access to credit/finance in 2006	-0.070**	-0.094**	-0.038	-0.032
	(0.030)	(0.033)	(0.022)	(0.030)
Household's most important activity in terms of monetary income is agricultural in 2006	0.044	0.047*	0.002	0.020
	(0.032)	(0.024)	(0.030)	(0.033)
Household is urban	-0.053		-0.034	
	(0.062)		(0.031)	
Constant	0.214***	0.246	0.264***	0.576***
	(0.047)	(0.143)	(0.051)	(0.126)
Observations	1,950	548	1,950	548
R-squared	0.088	0.095	0.011	0.042
Number of clusters			20	16

Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1.

Notes *(1) Standard errors are clustered at the site (cluster) level.*
(2) Columns 1 and 2 present the LPM using OLS. In columns 3 and 4, FE stands for cluster fixed effects.

Table B4. Vietnam: Probability of reporting a flood in 2009

	Full sample LPM	Rural sample LPM	Full sample FE	Rural sample FE
Ethnicity (ref. category): 'other' ethnic group				
Household belongs to Kinh	0.043	0.049	0.025	0.042
	(0.067)	(0.042)	(0.068)	(0.044)
Wealth Index in 2006	0.332*	-0.022	0.345	-0.029
	(0.189)	(0.060)	(0.204)	(0.068)
Maternal education in years	-0.003	-0.002	0.000	-0.000
	(0.004)	(0.003)	(0.005)	(0.004)
Paternal education in years	-0.004	-0.002	-0.005	-0.003
	(0.003)	(0.003)	(0.004)	(0.003)
Head of the household is male	0.001	-0.046**	0.012	-0.050*
	(0.017)	(0.019)	(0.022)	(0.028)
Household size in 2006	-0.000	-0.002	0.002	-0.002
	(0.003)	(0.003)	(0.004)	(0.005)
Household owned livestock in 2006	-0.010	0.073***	-0.025	0.065**
	(0.032)	(0.025)	(0.032)	(0.027)
Household had access to credit/finance in 2006	0.047	0.015	0.061*	0.025
	(0.028)	(0.014)	(0.030)	(0.015)
Income (ref. category): share of non-farm income: 0% and 20% in 2006				
Share of non-farm income: 20% and 40% in 2006	-0.023	-0.012	-0.025	-0.012
	(0.042)	(0.033)	(0.043)	(0.034)
Share of non-farm income: 40% and 60% in 2006	0.014	-0.002	0.007	-0.007
	(0.043)	(0.038)	(0.043)	(0.038)
Share of non-farm income: 60% and 80% in 2006	-0.062	-0.068	-0.075	-0.077*
	(0.061)	(0.044)	(0.062)	(0.044)
Share of non-farm income: 80% and 100% in 2006	-0.168*	-0.132**	-0.176*	-0.136**
	(0.086)	(0.053)	(0.089)	(0.055)
Household is urban	-0.084			
	(0.052)			
Constant	0.085	0.235***	0.060	0.240***
	(0.063)	(0.039)	(0.073)	(0.042)
Observations	2,255	2,255	1,795	1,795
R-squared	0.063	0.037	0.052	0.037
Number of clusters		20		16

Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1.

N.B. *(1) Standard errors are clustered at the site (cluster) level.*
(2) Columns 1 and 2 present the LPM using OLS. In columns 3 and 4, FE stands for cluster fixed effects.
(3) Non-farm income includes: income from land (not used for crops); income from wages (i.e. salaried or regular wage work); income from business or self-employment in non-agricultural activities (e.g. profits from trading commodities, from processed food/alcohol, handicrafts, carpentry, services, etc.); and income from transfers (i.e. from government or organizations, remittances and earnings from assets and savings) in the last 12 months.
Farm income includes: income from crops sold, income from wages (i.e. agricultural wage work); and consumption from own harvest in the last 12 months.
Share of non-farm income is: non-farm income/(non-farm income + farm income)

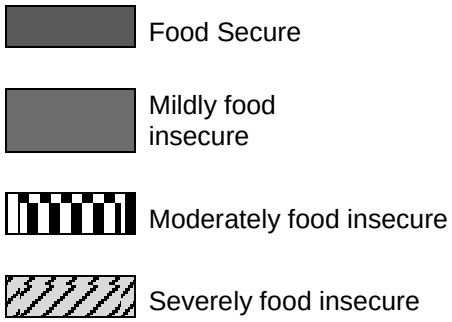
APPENDIX C: FOOD SECURITY

Table C1: Questions in food security index

	Ocurrence of food insecurity		**Frequency of occurrence** **a. How often did this happen?**
1	In the past 12 months, did you ever worry that your household would run out of food before you get money to buy, or could acquire, more?	1a	01 = Rarely, one or two months in the year. 02 = Sometimes, some months but not always. 03 = Always or nearly always or all months.
2	Were you or any household member not able to eat the **kinds of foods you want** because of lack of money? (For example, no meat, no fish, no fruit, no desserts.)	2a	
3	Did you or any household member have to eat a **limited variety of foods** due to a lack of money? (For example, only rice and beans, no vegetables or meat, only potatoes.)	3a	
4	Did you or any household member have to eat some **foods that you did not want to eat** because of a lack of money to obtain other types of food? (For example, wild foods, immature crops, broken rice, discarded food.)	4a	
5	Did you or any household member have to **eat less (portion size) in a meal** than you wanted because there was not enough food?	5a	
6	Did you or any household member have to **reduce the number of meals eaten** a day because there was not enough food? (For example skip breakfast or lunch.)	6a	
7	Was there ever **no food to eat** in your household because of lack of money to get food?	7a	
8	Did you or any household member **go to sleep at night hungry** because there was not enough food?	8a	
9	Did you or any household member go a **whole day and night** without eating anything because there was not enough food?	9a	

Table C2: Categories of food insecurity

Question	Frequency		
	Rarely (1)	Sometimes (2)	Often (3)
1a			
2a			
3a			
4a			
5a			
6a			
7a			
8a			
9a			



Note: table taken from Coates et al. (2007)

APPENDIX D: DETERMINANTS OF FOOD INSECURITY BY COUNTRY

Table D1: Effects of droughts in Ethiopia and Andhra Pradesh on food insecurity, 2009

	Ethiopia		India	
	Full sample OLS	Rural Sample OLS	Full sample OLS	Rural Sample OLS
Ethnicity (ref. category): 'other' ethnic group				
Household belongs to: Amhara group (Ethiopia), SC (India)	-0.814	-1.486	0.818***	0.959***
	(0.698)	(1.762)	(0.180)	(0.196)
Household belongs to: Oromo group (Ethiopia), ST (India)	0.470	0.078	-0.579*	-0.442
	(0.449)	(0.635)	(0.292)	(0.337)
Household belongs to: Tigrinya group (Ethiopia), BC (India)	-1.107	-0.991	0.214	0.256
	(0.786)	(1.413)	(0.149)	(0.205)
Mother's Education in years	-0.099***	-0.053	-0.077***	-0.082***
	(0.032)	(0.038)	(0.023)	(0.024)
Father's Education in years	-0.070**	-0.026	-0.046**	-0.055**
	(0.029)	(0.038)	(0.020)	(0.022)
Household size	0.031	0.074	-0.051	-0.082**
	(0.050)	(0.061)	(0.033)	(0.034)
Age of the household	0.014*	0.005	-0.003	0.002
	(0.007)	(0.008)	(0.006)	(0.007)
Head of the household is male	-1.393***	-1.866***	-0.911**	-0.581
	(0.295)	(0.277)	(0.374)	(0.472)
Wealth index in 2006	-4.725***	-3.252**	-3.704***	-3.465***
	(0.982)	(1.490)	(0.628)	(0.695)
Household is urban	1.309**	-	0.134	-
	(0.534)	-	(0.291)	-
Region (ref. category): Tigray (Ethiopia) and Telangana (Andhra Pradesh)				
Region: Addis Ababa (Ethiopia); Coastal Andhra (India)	2.000***	1.135	0.946*	0.856
	(0.703)	(1.561)	(0.455)	(0.595)
Region: Amhara (Ethiopia); Rayalaseema (India)	2.099***	3.378	0.229	0.251
	(0.783)	(2.296)	(0.379)	(0.488)
Region: Oromia (Ethiopia)	1.246	1.619	-	-
	(1.070)	(1.589)	-	-
Region: SNNP (Ethiopia)	2.804***	3.063*	-	-
	(0.930)	(1.634)	-	-
Household experienced a drought in period 2006-2009	0.602	0.515	0.363	0.195
	(0.380)	(0.416)	(0.259)	(0.231)
Experience of food shortage in 2006	1.788***	1.763***	1.102***	1.026***
	(0.161)	(0.164)	(0.248)	(0.296)
Constant	6.071***	5.934***	5.778***	5.375***
	(1.039)	(1.591)	(0.769)	(0.875)
Observations	2,382	1,590	2,651	2,016
R-squared	0.203	0.211	0.134	0.095

Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1.

Notes *(1) Standard errors are clustered at the community level in Ethiopia and site (cluster) level in Andhra Pradesh.*
(2) Dependent variable is the index of food insecurity in 2009.

Table D2. Effects of floods in Peru and Vietnam on food insecurity, 2009

	Peru		Vietnam	
	Full sample OLS	**Rural Sample OLS**	**Full sample OLS**	**Rural Sample OLS**
Ethnicity (ref. category): 'other' ethnic group				
Household belongs to: Spanish mother tongue (Peru); Khin (Vientam)	-1.173**	-0.758	0.153	-0.217
	(0.457)	(0.598)	(0.278)	(0.248)
Household belongs to: Quechua mother tongue (Peru)	-1.789***	-0.933	-	-
	(0.596)	(0.749)	-	-
Mother's Education in years	-0.141***	0.022	-0.146***	-0.098**
	(0.035)	(0.032)	(0.036)	(0.035)
Father's Education in years	-0.099**	-0.053	-0.112***	-0.087***
	(0.036)	(0.055)	(0.028)	(0.029)
Household size	0.156**	0.099	-0.009	-0.034
	(0.065)	(0.091)	(0.068)	(0.084)
Age of the household	-0.010	0.009	0.008	0.010
	(0.011)	(0.010)	(0.009)	(0.009)
Head of the household is male	-1.304***	-1.638**	-0.563**	-0.514
	(0.257)	(0.618)	(0.264)	(0.343)
Wealth index in 2006	-3.438***	-4.462**	-7.882***	-8.474***
	(0.671)	(1.845)	(0.831)	(0.849)
Household is urban	1.215***	-	1.007**	-
	(0.384)	-	(0.475)	-
Region (ref. category): Jungle (Peru) and Mekong River Delta (Vietnam)				
Region: Coast (Peru); Northern Uplands (Vietnam)	0.771**	-1.951*	-1.260***	-1.309***
	(0.367)	(0.948)	(0.298)	(0.277)
Region: Highlands (Peru); Red River Delta (Vietnam)	-0.033	-0.656	1.983***	1.936***
	(0.317)	(0.768)	(0.362)	(0.343)
Region: Central Coastal (Vietnam)	-	-	1.426***	1.494***
	-	-	(0.335)	(0.313)
Household experienced a flood in period 2006-2009	1.372**	0.769**	1.058***	1.031***
	(0.521)	(0.311)	(0.157)	(0.144)
Experience of food shortage in 2006	1.781***	0.510	1.799***	1.662***
	(0.332)	(0.307)	(0.319)	(0.329)
Constant	8.264***	7.880***	8.894***	8.981***
	(0.613)	(0.798)	(0.661)	(0.710)
Observations	2,098	595	2,425	1,959
R-squared	0.155	0.087	0.213	0.213

Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1.

Notes *(1) Standard errors are clustered at the community level in Ethiopia and site (cluster) level in Andhra Pradesh.*
(2) Dependent variable is the index of food insecurity in 2009.

APPENDIX E: DETERMINANTS OF CHILDREN'S PHYSICAL DEVELOPMENT (BY AGE AND COUNTRY)

Table E1: Effects of droughts in Ethiopia on height-for-age z-scores, 2009

	At age 8		At age 15	
	Full Sample Coeff. (St.E.)	Rural Sample Coeff. (St.E.)	Full Sample Coeff. (St.E.)	Rural Sample Coeff. (St.E.)
Age of child (in months)	0.003	0.009**	0.015*	0.025**
	(0.005)	(0.004)	(0.008)	(0.010)
Child is male	-0.078***	-0.120***	-0.700***	-0.876***
	(0.028)	(0.029)	(0.096)	(0.093)
Birth order	0.011	0.013	0.008	-0.009
	(0.011)	(0.012)	(0.011)	(0.014)
Ethnicity (ref. category): 'other' ethnic group				
Child belongs to Amhara group (Ethiopia)	-0.003	0.212	-0.130	-0.248
	(0.096)	(0.135)	(0.144)	(0.259)
Child belongs to Oromo group (Ethiopia)	-0.038	0.044	-0.048	-0.260**
	(0.082)	(0.126)	(0.121)	(0.116)
Child belongs to Tigrinya group (Ethiopia)	-0.025	0.267**	-0.418	-1.631***
	(0.111)	(0.108)	(0.302)	(0.549)
Mother's Education in years	0.001	-0.009	0.010	0.001
	(0.009)	(0.012)	(0.011)	(0.015)
Father's Education in years	-0.009	-0.013	-0.014	0.009
	(0.006)	(0.009)	(0.009)	(0.010)
Household size	-0.018	-0.038**	0.006	0.000
	(0.015)	(0.017)	(0.015)	(0.015)
Age of the household	-0.000	-0.001	0.002	0.004
	(0.002)	(0.002)	(0.003)	(0.004)
Head of the household is male	0.037	0.021	-0.007	-0.017
	(0.076)	(0.094)	(0.083)	(0.093)
Wealth index in 2006	0.627**	0.344	0.015	-0.207
	(0.268)	(0.353)	(0.347)	(0.546)
Household is urban	-0.060		-0.000	
	(0.130)		(0.151)	
Region (ref. category):Tigray				
Region: Addis Ababa	0.212*	-	-0.175	-1.751**
	(0.107)	-	(0.294)	(0.612)
Region: Amhara	0.003	-	-0.172	-1.245**
	(0.195)	-	(0.263)	(0.443)
Region: Oromia	0.206	0.537***	-0.262	-1.116**
	(0.150)	(0.081)	(0.312)	(0.511)
Region: SNNP	-0.102	0.238	-0.524	-1.730***
	(0.151)	(0.195)	(0.309)	(0.517)
Household experienced a drought in period 2006-2009	-0.056	-0.017	-0.196***	-0.179***
	(0.059)	(0.050)	(0.052)	(0.051)
Height-for-age z-score in 2006	0.669***	0.725***	0.768***	0.794***
	(0.032)	(0.025)	(0.036)	(0.048)
Constant	-0.571	-1.054**	-2.269	-2.885
	(0.454)	(0.381)	(1.429)	(1.868)
Observations	1,566	1,048	795	531
R-squared	0.477	0.514	0.649	0.698

Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1.

Notes: (1) Standard errors are clustered at the community level in Ethiopia.

Table E2: Effects of droughts in Andhra Pradesh on height-for-age z-scores, 2009

	At age 8		At age 15	
	Full Sample	Rural Sample	Full Sample	Rural Sample
	Coeff. (St.E.)	Coeff. (St.E.)	Coeff. (St.E.)	Coeff. (St.E.)
Age of child (in months)	-0.009	-0.002	0.005	0.005
	(0.005)	(0.005)	(0.007)	(0.009)
Child is male	0.014	-0.027	-0.052	-0.140**
	(0.039)	(0.037)	(0.063)	(0.062)
Birth order	-0.018	-0.004	0.018	0.004
	(0.018)	(0.019)	(0.022)	(0.026)
Ethnicity (ref. category): 'other' ethnic group				
Child belongs to SC	-0.045	-0.060	-0.227**	-0.263***
	(0.067)	(0.069)	(0.103)	(0.073)
Child belongs to ST	-0.291***	-0.299**	-0.288**	-0.404***
	(0.089)	(0.106)	(0.116)	(0.092)
Child belongs to BC	-0.017	-0.038	-0.028	-0.119*
	(0.049)	(0.056)	(0.076)	(0.063)
Mother's Education in years	0.012**	0.010*	0.017	0.016
	(0.004)	(0.005)	(0.010)	(0.012)
Father's Education in years	-0.003	-0.007	-0.001	-0.002
	(0.004)	(0.004)	(0.009)	(0.010)
Household size	0.002	0.003	0.003	-0.006
	(0.007)	(0.008)	(0.016)	(0.019)
Age of the household	0.003**	0.004*	0.001	0.003
	(0.002)	(0.002)	(0.003)	(0.003)
Head of the household is male	0.066	0.038	-0.038	-0.010
	(0.056)	(0.064)	(0.101)	(0.111)
Wealth index in 2006	0.139	0.091	0.105	0.130
	(0.097)	(0.088)	(0.197)	(0.189)
Household is urban	0.116		-0.075	
	(0.081)		(0.072)	
Region (ref. category): Telangana				
Region: Coastal Andhra	0.087	0.111	0.115	0.148**
	(0.082)	(0.092)	(0.070)	(0.067)
Region: Rayalaseema	-0.094	-0.026	-0.012	0.020
	(0.081)	(0.095)	(0.079)	(0.080)
Household experienced a drought in period 2006-2009	0.112*	0.084	-0.033	-0.034
	(0.056)	(0.060)	(0.072)	(0.073)
Height-for-age z-score in 2006	0.760***	0.775***	0.657***	0.678***
	(0.035)	(0.046)	(0.039)	(0.029)
Constant	0.425	-0.163	-1.590	-1.486
	(0.507)	(0.507)	(1.295)	(1.633)
Observations	1,732	1,311	881	676
R-squared	0.624	0.619	0.524	0.531

Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1.

Notes: (1) Standard errors are clustered at the site (cluster) level in Andhra Pradesh.

Table E3: Effects of floods in Peru on height-for-age z-scores, 2009

	At age 8		At age 15	
	Full sample	**Rural sample**	**Full sample**	**Rural sample**
	Coeff. (St.E.)	**Coeff. (St.E.)**	**Coeff. (St.E.)**	**Coeff. (St.E.)**
Age of child (in months)	-0.004	-0.007	0.001	0.004
	(0.005)	(0.006)	(0.005)	(0.015)
Child is male	-0.070	-0.051	0.218***	-0.083
	(0.045)	(0.066)	(0.060)	(0.172)
Birth order	0.003	-0.003	0.014	-0.014
	(0.010)	(0.013)	(0.009)	(0.020)
Ethnicity (ref. category): 'other' ethnic group				
Child belongs to Spanish group	0.086	0.063	-0.107	0.153
	(0.069)	(0.083)	(0.068)	(0.161)
Child belongs to Quechua group	-0.006	-0.151	-0.156*	-0.044
	(0.081)	(0.094)	(0.080)	(0.216)
Mother's Education in years	0.008	-0.008	0.013	-0.011
	(0.006)	(0.010)	(0.008)	(0.021)
Father's Education in years	0.012*	0.015**	-0.001	0.024*
	(0.006)	(0.006)	(0.007)	(0.012)
Household size	-0.009	0.006	-0.008	0.031
	(0.010)	(0.019)	(0.009)	(0.021)
Age of the household	-0.002	-0.002	0.001	0.008*
	(0.002)	(0.003)	(0.003)	(0.004)
Head of the household is male	0.042	0.070	0.109***	-0.010
	(0.045)	(0.104)	(0.033)	(0.076)
Wealth index in 2006	0.138	0.219	-0.160	-0.396
	(0.126)	(0.392)	(0.166)	(0.528)
Household is urban	-0.023		-0.029	
	(0.058)		(0.069)	
Region (ref. category): Jungle				
Region: Coast	-0.029	0.577	0.019	0.120
	(0.106)	(0.338)	(0.046)	(0.092)
Region: Highlands	-0.079	0.102	0.128***	0.120
	(0.111)	(0.066)	(0.044)	(0.132)
Household experienced floods in period 2006-2009	0.013	-0.055	0.043	-0.033
	(0.038)	(0.069)	(0.049)	(0.080)
Height-for-age z-score in 2006	0.698***	0.714***	0.720***	0.701***
	(0.026)	(0.035)	(0.023)	(0.059)
Constant	0.142	0.384	-0.805	-1.679
	(0.391)	(0.554)	(0.956)	(2.676)
Observations	1,531	458	554	132
R-squared	0.666	0.632	0.721	0.617

Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1.

Notes: (1) Standard errors are clustered at the site (cluster) level in Peru.

Table E4: Effects of floods in Vietnam on height-for-age z-scores, 2009

	At age 8		At age 15	
	Full sample	Rural sample	Full sample	Rural sample
	Coeff. (St.E.)	Coeff. (St.E.)	Coeff. (St.E.)	Coeff. (St.E.)
Age of child (in months)	-0.014***	-0.015***	-0.010*	-0.009
	(0.004)	(0.005)	(0.005)	(0.006)
Child is male	-0.072**	-0.080**	0.030	0.000
	(0.028)	(0.031)	(0.047)	(0.052)
Birth order	0.009	0.015	-0.004	-0.004
	(0.020)	(0.023)	(0.018)	(0.020)
Ethnicity (ref. category): 'other' ethnic group				
Child belongs to Kinh	0.138**	0.148**	0.196**	0.183*
	(0.057)	(0.062)	(0.091)	(0.092)
Mother's Education in years	-0.007	-0.008	-0.002	-0.003
	(0.005)	(0.005)	(0.009)	(0.007)
Father's Education in years	0.001	0.005	0.003	0.007
	(0.005)	(0.006)	(0.009)	(0.009)
Household size	-0.012	-0.010	0.001	0.011
	(0.014)	(0.020)	(0.017)	(0.017)
Age of the household	-0.002	-0.003	-0.001	0.000
	(0.002)	(0.002)	(0.004)	(0.004)
Head of the household is male	0.049	0.021	0.001	0.049
	(0.054)	(0.063)	(0.070)	(0.084)
Wealth index in 2006	0.449***	0.473***	0.328**	0.301*
	(0.117)	(0.123)	(0.157)	(0.164)
Household is urban	0.055		-0.310***	
	(0.053)		(0.059)	
Region (ref. category): Mekong River Delta				
Region: Northern Uplands	0.235**	0.229**	0.069	0.067
	(0.102)	(0.102)	(0.093)	(0.097)
Region: Red River Delta	0.265**	0.249**	0.151	0.148
	(0.098)	(0.097)	(0.093)	(0.098)
Region: Central Coastal	0.160	0.148	0.128	0.125
	(0.098)	(0.096)	(0.097)	(0.102)
Household experienced floods in period 2006-2009	0.042	0.046	-0.034	-0.051
	(0.042)	(0.043)	(0.056)	(0.058)
Height-for-age z-score in 2006	0.843***	0.829***	0.641***	0.649***
	(0.027)	(0.031)	(0.029)	(0.035)
Constant	1.048***	1.130***	1.025	0.732
	(0.380)	(0.406)	(0.931)	(1.067)
Observations	1,579	1,275	812	659
R-squared	0.698	0.658	0.601	0.619

Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1.

Notes: (1) Standard errors are clustered at the community level in Vietnam.

APPENDIX F: SUMMARY STATISTICS USED ON REGRESSIONS

Table F1: Ethiopia (2006 and 2009)

	Younger cohort						Older cohort						Both cohorts					
	2006 (age 5)			2009 (age 8)			2006 (age 12)			2009 (age 15)			2006			2009		
	N	Mean	S.D	N	Mean	S.D	N	Mean	S.D	N	Mean	S.D	N	Mean	S.D	N	Mean	S.D
Age of child	1,912	61.9	3.9	1,884	96.9	3.7	980	144.6	3.8	974	179.9	3.6	-	-	-	-	-	-
Child is male	1,912	0.5	0.5	1,886	0.5	0.5	980	0.5	0.5	974	0.5	0.5	-	-	-	-	-	-
Birth order	1,907	3.4	2.3	1,879	3.5	2.3	977	3.8	2.4	969	3.8	2.4	-	-	-	-	-	-
Belongs to other group	1,787	0.2	0.4	1,761	0.2	0.4	914	0.2	0.4	909	0.2	0.4	2,701	0.2	0.4	2,670	0.2	0.4
Belongs to Amhara group	1,787	0.3	0.5	1,761	0.3	0.5	914	0.3	0.5	909	0.3	0.5	2,701	0.3	0.5	2,670	0.3	0.5
Belongs to Oromo group	1,787	0.2	0.4	1,761	0.2	0.4	914	0.2	0.4	909	0.2	0.4	2,701	0.2	0.4	2,670	0.2	0.4
Belongs to Tigrinya group	1,787	0.2	0.4	1,761	0.2	0.4	914	0.2	0.4	909	0.2	0.4	2,701	0.2	0.4	2,670	0.2	0.4
Height-for-age z-score	1,908	-1.5	1.1	1,878	-1.2	1.1	974	-1.4	1.2	961	-1.4	1.3	-	-	-	-	-	-
Wealth index	1,902	0.3	0.2	1,885	0.3	0.2	979	0.3	0.2	971	0.4	0.2	2,881	0.3	0.2	2,856	0.3	0.2
Maternal education in years	1,894	3.1	3.9	1,867	3.1	3.9	966	2.8	3.5	959	2.8	3.5	2,860	3.0	3.8	2,826	3.0	3.7
Paternal education in years	1,826	4.7	4.3	1,801	4.6	4.3	913	4.1	4.1	909	4.1	4.1	2,739	4.5	4.3	2,710	4.5	4.3
Household size	1,912	6.0	2.1	1,886	6.2	2.0	980	6.5	2.1	974	6.4	2.1	2,892	6.2	2.1	2,860	6.2	2.0
Age of the household head	1,912	41.0	11.0	1,883	44.2	11.0	980	46.6	11.4	974	48.7	11.5	2,892	42.9	11.5	2,857	45.8	11.4
Head of the household is male	1,912	0.8	0.4	1,886	0.8	0.4	980	0.7	0.4	974	0.7	0.4	2,892	0.8	0.4	2,860	0.8	0.4
Household is urban	1,912	0.4	0.5	1,884	0.4	0.5	980	0.4	0.5	972	0.4	0.5	2,892	0.4	0.5	2,856	0.4	0.5
Region: Addis Ababa	1,912	0.1	0.4	1,886	0.1	0.3	980	0.1	0.4	974	0.1	0.4	2,892	0.1	0.4	2,860	0.1	0.4
Region: Amhara	1,912	0.2	0.4	1,886	0.2	0.4	980	0.2	0.4	974	0.2	0.4	2,892	0.2	0.4	2,860	0.2	0.4
Region: Oromia	1,912	0.2	0.4	1,886	0.2	0.4	980	0.2	0.4	974	0.2	0.4	2,892	0.2	0.4	2,860	0.2	0.4
Region: SNNP	1,912	0.3	0.4	1,886	0.3	0.4	980	0.2	0.4	974	0.2	0.4	2,892	0.3	0.4	2,860	0.2	0.4
Region: Tigray	1,912	0.2	0.4	1,886	0.2	0.4	980	0.2	0.4	974	0.2	0.4	2,892	0.2	0.4	2,860	0.2	0.4
Food Insecurity Index	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2,860	6.543	4.444
Household owns livestock	-	-	-	-	-	-	-	-	-	-	-	-	2,856	0.7	0.5	-	-	-
Household has access to credit/finance	-	-	-	-	-	-	-	-	-	-	-	-	2,852	0.7	0.5	-	-	-
Household has access to water harvesting scheme	-	-	-	-	-	-	-	-	-	-	-	-	2,839	0.2	0.4	-	-	-
Household has access to irrigation scheme	-	-	-	-	-	-	-	-	-	-	-	-	2,841	0.2	0.4	-	-	-
Share of non-farm income: 0% and 20%	-	-	-	-	-	-	-	-	-	-	-	-	2,808	0.3	0.5	-	-	-
Share of non-farm income: 20% and 40%	-	-	-	-	-	-	-	-	-	-	-	-	2,808	0.1	0.4	-	-	-
Share of non-farm income: 40% and 60%	-	-	-	-	-	-	-	-	-	-	-	-	2,808	0.1	0.3	-	-	-
Share of non-farm income: 60% and 80%	-	-	-	-	-	-	-	-	-	-	-	-	2,808	0.1	0.3	-	-	-
Share of non-farm income: 80% and 100%	-	-	-	-	-	-	-	-	-	-	-	-	2,808	0.4	0.5	-	-	-

Table F2: Andhra Pradesh (2006 and 2009)

	Younger cohort						Older cohort						Both cohorts					
	2006 (age 5)			2009 (age 8)			2006 (age 12)			2009 (age 15)			2006			2009		
	N	Mean	S.D	N	Mean	S.D	N	Mean	S.D	N	Mean	S.D	N	Mean	S.D	N	Mean	S.D
Age of child	1,950	64.3	3.9	1,931	95.4	3.8	994	147.9	4.3	975	179.3	4.1	-	-	-	-	-	-
Child is male	1,950	0.5	0.5	1,931	0.5	0.5	994	0.5	0.5	976	0.5	0.5	-	-	-	-	-	-
Birth order	1,950	2.0	1.1	1,930	2.0	1.1	994	2.3	1.4	976	2.3	1.4	-	-	-	-	-	-
Belongs to: SC	1,950	0.2	0.4	1,931	0.2	0.4	994	0.2	0.4	976	0.2	0.4	2,944	0.2	0.4	2,907	0.2	0.4
Belongs to: ST	1,950	0.1	0.4	1,931	0.1	0.4	994	0.1	0.3	976	0.1	0.3	2,944	0.1	0.3	2,907	0.1	0.3
Belongs to: BC	1,950	0.5	0.5	1,931	0.5	0.5	994	0.5	0.5	976	0.5	0.5	2,944	0.5	0.5	2,907	0.5	0.5
Belongs to: other group	1,950	0.2	0.4	1,931	0.2	0.4	994	0.2	0.4	976	0.2	0.4	2,944	0.2	0.4	2,907	0.2	0.4
Height-for-age z-score	1,937	-1.7	1.0	1,924	-1.4	1.0	977	-1.5	1.0	970	-1.6	1.0	-	-	-	-	-	-
Wealth index	1,948	0.5	0.2	1,929	0.5	0.2	994	0.5	0.2	967	0.5	0.2	2,942	0.5	0.2	2,896	0.5	0.2
Maternal education in years	1,946	3.7	4.4	1,926	3.7	4.4	986	2.8	4.0	970	2.8	4.0	2,932	3.4	4.3	2,896	3.4	4.3
Paternal education in years	1,947	5.6	5.0	1,927	5.6	5.0	988	4.7	4.9	971	4.7	4.9	2,935	5.3	5.0	2,898	5.3	5.0
Household size	1,950	5.5	2.2	1,931	5.4	2.3	994	5.2	1.8	976	5.1	1.9	2,944	5.4	2.1	2,907	5.3	2.2
Age of the household head	1,949	38.5	11.9	1,926	38.6	9.2	994	42.5	9.6	974	44.2	8.7	2,943	39.9	11.3	2,900	40.5	9.4
Head of the household is male	1,949	0.9	0.2	1,930	0.9	0.2	994	0.9	0.3	974	0.9	0.3	2,943	0.9	0.3	2,904	0.9	0.3
Household is urban	1,946	0.3	0.4	1,926	0.3	0.4	992	0.2	0.4	974	0.2	0.4	2,938	0.3	0.4	2,900	0.3	0.4
Region: Coastal Andhra	1,945	0.3	0.5	1,914	0.4	0.5	992	0.3	0.5	972	0.3	0.5	2,937	0.3	0.5	2,886	0.3	0.5
Region: Rayalaseema	1,945	0.3	0.5	1,914	0.3	0.5	992	0.3	0.5	972	0.3	0.5	2,937	0.3	0.5	2,886	0.3	0.5
Region: Telangana	1,945	0.4	0.5	1,914	0.4	0.5	992	0.3	0.5	972	0.3	0.5	2,937	0.4	0.5	2,886	0.3	0.5
Food Insecurity Index	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2,906	3.1	3.5
Household is reliant on agricultural activities	-	-	-	-	-	-	-	-	-	-	-	-	2,941	0.5	0.5	2,861	0.4	0.5
Household owns livestock	-	-	-	-	-	-	-	-	-	-	-	-	2,906	0.4	0.5	-	-	-
Household has access to credit/finance	-	-	-	-	-	-	-	-	-	-	-	-	2,850	0.8	0.4	-	-	-
Employment days provided for the household by the MGNREGS	-	-	-	-	-	-	-	-	-	-	-	-	722	32.5	39.6	-	-	-

Table F3: Peru (2006 and 2009)

	Younger cohort						Older cohort						Both cohorts					
	2006 (age 5)			2009 (age 8)			2006 (age 12)			2009 (age 15)			2006			2009		
	N	Mean	S.D	N	Mean	S.D	N	Mean	S.D	N	Mean	S.D	N	Mean	S.D	N	Mean	S.D
Age of child	1,963	63.5	4.7	1,942	94.9	3.6	685	147.8	5.7	675	178.7	4.1	-	-	-	-	-	-
Child is male	1,963	0.5	0.5	1,943	0.5	0.5	685	0.5	0.5	678	0.5	0.5	-	-	-	-	-	-
Birth order	1,961	2.6	2.0	1,913	2.6	1.9	684	2.9	2.1	669	2.9	2.1	-	-	-	-	-	-
Spanish speaker (mother tongue)	1,954	0.7	0.5	1,906	0.7	0.5	677	0.7	0.5	663	0.7	0.5	2,631	0.7	0.5	2,569	0.7	0.5
Quechua speaker (mother tongue)	1,954	0.3	0.4	1,906	0.3	0.4	677	0.3	0.4	663	0.3	0.4	2,631	0.3	0.4	2,569	0.3	0.4
Other language (mother tongue)	1,954	0.0	0.2	1,906	0.0	0.2	677	0.0	0.2	663	0.0	0.2	2,631	0.0	0.2	2,569	0.0	0.2
Height-for-age z-score	1,950	-1.5	1.1	1,937	-1.2	1.1	680	-1.5	1.1	669	-1.5	0.9	-	-	-	-	-	-
Wealth Index	1,963	0.5	0.2	1,935	0.5	0.2	684	0.5	0.2	675	0.6	0.2	2,647	0.5	0.2	2,610	0.6	0.2
Maternal education in years	1,954	7.6	4.2	1,906	7.5	4.2	682	7.2	4.2	668	7.2	4.2	2,636	7.5	4.2	2,574	7.5	4.2
Paternal education in years	1,906	8.8	3.6	1,859	8.8	3.6	652	8.7	3.7	637	8.7	3.7	2,558	8.8	3.7	2,496	8.8	3.7
Household size	1,963	5.5	2.1	1,943	5.4	1.9	685	5.6	2.0	678	5.4	1.9	2,648	5.5	2.1	2,621	5.4	1.9
Age of the household head	1,962	38.5	11.2	1,938	40.3	10.7	685	43.7	10.5	678	45.4	10.7	2,647	39.8	11.3	2,616	41.6	10.9
Head of the household is male	1,963	0.9	0.3	1,942	0.9	0.3	685	0.8	0.4	678	0.8	0.4	2,648	0.9	0.3	2,620	0.8	0.4
Household is urban	1,963	0.7	0.5	1,915	0.7	0.5	685	0.8	0.4	670	0.7	0.4	2,648	0.7	0.5	2,585	0.7	0.5
Region: Coast	1,963	0.4	0.5	1,943	0.4	0.5	685	0.4	0.5	678	0.4	0.5	2,648	0.4	0.5	2,621	0.4	0.5
Region: Highlands	1,963	0.5	0.5	1,943	0.5	0.5	685	0.4	0.5	678	0.4	0.5	2,648	0.5	0.5	2,621	0.5	0.5
Region: Jungle	1,963	0.2	0.4	1,943	0.2	0.4	685	0.2	0.4	678	0.1	0.4	2,648	0.2	0.4	2,621	0.2	0.4
Food Insecurity Index	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2,604	4.5	4.4
Household owns livestock	-	-	-	-	-	-	-	-	-	-	-	-	2,585	0.7	0.5	-	-	-
Household has access to credit/finance	-	-	-	-	-	-	-	-	-	-	-	-	2,582	0.7	0.5	-	-	-
Household is reliant on agricultural activities	-	-	-	-	-	-	-	-	-	-	-	-	2,397	0.4	0.5	-	-	-

Table F4: Vietnam (2006 and 2009)

	Younger cohort						Older cohort						Both cohorts					
	2006 (age 5)			2009 (age 8)			2006 (age 12)			2009 (age 15)			2006			2009		
	N	Mean	S.D	N	Mean	S.D	N	Mean	S.D	N	Mean	S.D	N	Mean	S.D	N	Mean	S.D
Age of child	1,970	63.1	3.7	1,960	96.6	3.8	990	147.0	3.9	974	180.6	3.8	-	-	-	-	-	-
Child is male	1,970	0.5	0.5	1,961	0.5	0.5	990	0.5	0.5	976	0.5	0.5	-	-	-	-	-	-
Birth order	1,970	1.8	1.1	1,952	1.8	1.1	990	2.2	1.3	976	2.2	1.3	-	-	-	-	-	-
Belongs to Kinh	1,969	0.9	0.3	1,960	0.9	0.3	990	0.9	0.3	976	0.9	0.3	2,959	0.9	0.3	2,936	0.9	0.3
Height-for-age z-score	1,956	-1.3	1.0	1,932	-1.1	1.1	988	-1.4	1.1	967	-1.4	0.9	-	-	-	-	-	-
Wealth Index	1,952	0.5	0.2	1,907	0.6	0.2	979	0.5	0.2	945	0.6	0.2	2,931	0.5	0.2	2,852	0.6	0.2
Maternal education in years	1,954	6.9	3.9	1,936	6.9	3.9	981	6.8	3.8	967	6.8	3.8	2,935	6.8	3.8	2,903	6.8	3.8
Paternal education in years	1,922	7.5	3.9	1,904	7.5	3.9	955	7.7	3.9	941	7.7	3.9	2,877	7.6	3.9	2,845	7.6	3.9
Household size	1,970	4.7	1.5	1,961	4.6	1.4	990	4.9	1.4	976	4.5	1.4	2,960	4.7	1.5	2,937	4.6	1.4
Age of the household head	1,969	38.6	12.0	1,950	41.5	11.9	990	42.1	8.4	976	45.1	8.5	2,959	39.8	11.0	2,926	42.7	11.0
Head of the household is male	1,969	0.9	0.3	1,951	0.9	0.3	990	0.9	0.3	976	0.9	0.3	2,959	0.9	0.3	2,927	0.9	0.3
Household is urban	1,970	0.2	0.4	1,952	0.2	0.4	990	0.2	0.4	976	0.2	0.4	2,960	0.2	0.4	2,928	0.2	0.4
Region: Northern Uplands	1,958	0.2	0.4	1,948	0.2	0.4	985	0.2	0.4	968	0.2	0.4	2,943	0.2	0.4	2,916	0.2	0.4
Region: Red River Delta	1,958	0.2	0.4	1,948	0.2	0.4	985	0.2	0.4	968	0.2	0.4	2,943	0.2	0.4	2,916	0.2	0.4
Region: Central Coastal	1,958	0.4	0.5	1,948	0.4	0.5	985	0.4	0.5	968	0.4	0.5	2,943	0.4	0.5	2,916	0.4	0.5
Region: Mekong River Delta	1,958	0.2	0.4	1,948	0.2	0.4	985	0.2	0.4	968	0.2	0.4	2,943	0.2	0.4	2,916	0.2	0.4
Food Insecurity Index	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2,928	4.2	4.2
Household owns livestock	-	-	-	-	-	-	-	-	-	-	-	-	2,923	0.5	0.5	-	-	-
Household has access to credit/finance	-	-	-	-	-	-	-	-	-	-	-	-	2,923	0.8	0.4	-	-	-
Share of non-farm income: 0% and 20%	-	-	-	-	-	-	-	-	-	-	-	-	2,727	0.2	0.4	-	-	-
Share of non-farm income: 20% and 40%	-	-	-	-	-	-	-	-	-	-	-	-	2,727	0.1	0.3	-	-	-
Share of non-farm income: 40% and 60%	-	-	-	-	-	-	-	-	-	-	-	-	2,727	0.1	0.3	-	-	-
Share of non-farm income: 60% and 80%	-	-	-	-	-	-	-	-	-	-	-	-	2,727	0.1	0.3	-	-	-
Share of non-farm income: 80% and 100%	-	-	-	-	-	-	-	-	-	-	-	-	2,727	0.5	0.5	-	-	-

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