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Further enquiries to:

The Administrator  
School of Economics and Finance  
Victoria University of Wellington  
P O Box 600  
Wellington 6140  
New Zealand

Phone: +64 4 463 5353

Email: [alice.fong@vuw.ac.nz](mailto:alice.fong@vuw.ac.nz)

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## **Poverty, Inequality and Natural Disasters – A Survey**

Azreen Karim & Ilan Noy\*

School of Economics and Finance  
Victoria Business School  
Victoria University of Wellington, New Zealand

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**Abstract:** The last few years have seen an explosion of economic research on the consequences of natural disasters. This new interest is attributable first and foremost to a growing awareness of the potentially catastrophic nature of these events, but also a result of the increasing awareness that natural disasters are social and economic events: their impact is shaped as much by the structure and characteristics of the countries they hit as by their physical characteristics. Here, we survey the literature that examines the direct and indirect impact of natural disaster events specifically on the poor and their impact on the distribution of income within affected communities and societies. We also discuss some of the lacunae in this literature and outline a future agenda of investigation.

Paper prepared for the ERIA 2013 project on natural disasters

Key words: disasters, natural, poverty, income distribution

JEL codes: I3, Q54, Q56

\* Corresponding author: EQC-MPI Chair in the Economics of Disasters, School of Economics and Finance, POB 600, Wellington, New Zealand. Email: [ilan.noy@vuw.ac.nz](mailto:ilan.noy@vuw.ac.nz).

## **1. Economic research on disaster impact**

The last few years have seen an explosion of economic research on the consequences of natural disasters. This is probably attributable first and foremost to a growing awareness of the potentially catastrophic nature of these events as evident, for example, in the earthquake and tsunami in South-East Asia in 2004 and the 2011 triple earthquake/tsunami/nuclear disaster in Japan. It is also a result of the increasing awareness that natural disasters are social and economic events: their impact is shaped as much by the structure and characteristics of the countries they hit as by their physical characteristics such as wind speed and rainfall for tropical storms, or the energy unleashed in an earthquake. In addition, much discussion in the past few years has focused on the potential changes that will occur in the pattern and intensity of future events that is associated with human-induced climate change, furthering interest in this topic.

In the past few years, projects have evaluated the growth impact of natural disasters in the short- and medium-long terms, the fiscal impact of disasters (again for various time horizons), the impact on international trade and financial flows, the impact on populations through migration and fertility choices, the impact on human capital, the importance of political economy questions in shaping the disasters' aftermath, and on other related topics. Intriguingly, there is less research on the impact of natural disaster events specifically on the poor and on income distribution (on inequality). Here, we first survey the existing literature on this topic, discuss some of the problems associated with it, and outline a future agenda of investigation.

## **2. A typology of impacts**

Before we discuss this literature, we need to clarify what we mean by disaster impacts, and what are some of the methodological decisions that are inherent in this choice. Cavallo and Noy (2011) distinguish between the direct impact of sudden-onset disasters (the immediate mortality, morbidity,

and physical damage) and the indirect impact that affects the economy in the aftermath of the actual damage caused (including secondary mortality and morbidity, and an impact on economic activity). The World Bank in their survey *Natural Hazards Unnatural Disasters* (2010) employs a different terminology that makes essentially the same distinction: first-order and higher-order effects.

The terminology of n-order effects might be preferable in theory since it enables one to potentially distinguish between second-order effects (e.g., the immediate decline in production as a result of the destruction of productive capital), and third-order (or even higher) effects (e.g., the decline in production that results from the decline in imported inputs that resulted from the shifts in import patterns as a result of a disaster).

These distinctions between second-order and higher-order effects is however difficult to operationalize into a systemic typology. We therefore refrain from using this terminology and persist in using the more coarse distinction between direct and indirect effects. Here, our interest is understanding both the immediate (direct or first-order) effect of disasters on poverty and income distribution and also the consequent indirect (higher-order) effects that have an impact on the lives of the poor and on distribution of incomes and resources within societies.

Another potentially important distinction is between natural disasters that are frequent and occur regularly and those disasters whose nature or magnitude is unusual (and therefore probably unexpected). The distribution of disaster damages is highly skewed, with presence of very extreme - "fat tail" - disasters, whose costs (in terms of mortality, morbidity, and/or physical destruction) are significantly higher than the average disaster costs. The Haiti earthquake of January 2010, for example, led to a mortality that was at least 10 standard deviations higher than in earthquakes of similar or higher strength (Noy, 2013). The 2004 earthquake/tsunami in the Indian Ocean and cyclone Nargis mentioned earlier are also examples of these fat-tail events.

Fat-tail events would be typically associated with extremely small probabilities in common risk assessments, but are nevertheless quite common occurrences worldwide. Importantly, since the probability that such a catastrophic event will occur is thought to be so small, policymakers will tend to ignore this possibility and societies will generally be underprepared for them.

Our interest in this survey paper is to discuss the impact of natural disasters—both the direct and indirect—on poverty and income distribution. In this description, we will distinguish between the impact of sudden-onset catastrophic events and more regular natural hazards that occur in many countries (e.g., typhoons in the Philippines or the annual Monsoon floods in Bangladesh).

### **3. The direct impact of disasters on the poor: Sudden-onset events**

The direct damages from a disaster are not evenly distributed. Comparison between countries clearly shows that richer countries can prevent or mitigate the disaster's impact more effectively and therefore the cost they bear (as a fraction of their economic size) is significantly smaller (Kahn, 2005). The channels that appear to explain this cross-country differences that depend on average incomes have, first, to do with the most obvious channel: preventive measures are normal (or luxury) investment goods, so countries with higher permanent incomes or wealth will be able to devote more resources to prevention or mitigation. Escaleras et al. (2007) argue that corruption explains a lot of the cross country differences in initial impacts of similar events, and it is well documented that corruption is inversely related to average per capita income. Kellenberg and Mobarak (2008) find evidence for a non-linear cross-country relationship between average incomes and direct impacts, where (for some types of disasters) the costs initially increase with incomes, and above a certain threshold (which they typically identify as per capita income level of a lower middle-income country) it starts to decrease.

Most of these papers that identify the cross-country pattern of correlation between income levels and direct disaster impact conclude that this evidence also represent the time-series relationship;

i.e., a country whose incomes will grow over time, will, according to Kellenberg and Mobarak (2008) initially experience higher disaster costs (measured by mortality) and then eventually, as average incomes increase further, lower disaster costs. The evidence regarding this question however is rather less clear. Hallegatte (2012), for example, points out that when these figures are aggregated worldwide, the World's GDP has been growing at about 4% a year in the past several decades, while disaster losses (as measured by EMDAT) have been growing at about 6%. This implies that as the world continues to grow, the cost of disasters is going to increase (relative to the World's economy).

Ultimately, however, identifying the direct impact of disasters on the poor (in magnitude, and relative to the rich) cannot be answered by examining the cross-country distribution of costs and economic activity, since this evidence may be more related to country-wide differences in institutional capacity and policy that are correlated with incomes rather than dependent on incomes directly. The evidence on the distribution of the direct impact of a disaster within a country on households in various income levels is less well understood; the evidence that does exist generally suggests that poorer households are more vulnerable and will bear the direct damages disproportionately at higher levels and as higher shares of their households' income.

A salient feature of disaster risk exposure is the choice of millions of people to live in disaster-prone areas, and these are in many cases predominantly the poor (e.g., Boustan et al., 2012). Examining geographical distribution to test for the poor's exposure to natural disasters, Kim (2012) argues that, on average, the poor are at least two times more exposed relative to the non-poor globally due to about 26 per cent more concentration in disaster-prone areas. Tesliuc and Lindert (2002) present evidence from Guatemala, where the poor seems to be more exposed to natural shocks than the non-poor whereas the reverse is true in the case of man-made shocks. However, as coping with natural disasters seems to be related to prior economic conditions, the average impacts of a fairly regular natural shock (e.g. periodic drought) is found to have a lesser impact compared to a sudden

economic shock (e.g. financial crisis). Tesliuc and Lindert (2002) find that 35.4 percent of the poorest quantile are affected by natural shocks compared to 21.2 percent of the richest quantile, in their research.

A study by UNISDR (2012) in Syria, Jordan and Yemen shows that poverty is most severe in rural non-diversified economies where agriculture is severely limited by low rainfall, degraded lands, erosion and desertification. In Jordan; rains, flash floods and snowstorms affect the densely populated areas possessing the largest share of the country's poor, particularly women. Due to severe ground water scarcity, Yemen experiences extensive risk from water related mortalities - floods, drought and epidemics. UNISDR (2012) conclude that low productivity and water shortage leads to stagnating rural incomes increasing poverty in Syria and Yemen.

Neumayer and Plumper (2007) investigate gender differences in disaster-related mortality, and conclude that generally women are more likely to die than men, or at a much younger age, especially when they come from a disadvantaged socioeconomic background<sup>1</sup>. By one estimate, women represented 70 percent of casualties after the 2004 Indian Ocean in Aceh, Indonesia (World Bank, 2011).

Only a few attempts to analyse the direct impacts of specific natural disasters by examining various indices of poverty, income inequality and human development have been concluded (e.g., Datt and Hoogeveen, 2003; Reardon and Taylor, 1996; Holland et al, 2009 and Rodriguez-Oreggia et al, 2013). A full picture of these impacts is not yet within reach, and whether these are due to direct or indirect channels is not easy to determine.

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<sup>1</sup> A higher level of women's socio-economic rights appears to offset the negative effect of natural disasters on women (Neumayer and Plumper, 2007).



#### 4. Droughts and rainfall fluctuations

Droughts and extreme fluctuations in rainfall are also frequently disastrous, with very noticeable adverse consequences on human populations. In this case, unlike the sudden-onset case, the distinction between direct and indirect effects is less clear-cut. In this section, we therefore focus on the overall effects of these events rather than separating their immediate (direct) impacts and the longer-term indirect effects.

Despite more evidence of the adverse changes in overall poverty in the aftermath of slow-onset natural catastrophes such as droughts, some projects conclude that these disasters do not have much impact on poverty and income distribution (and should be seen as across-the-board adverse shocks). Little et al. (2006), for example, find that droughts did not increase overall rates of poverty in the medium term in Ethiopia. They suggest this is mainly due to increasing income diversification and less emphasis on rain-fed agriculture.<sup>2</sup> However, if anything, the balance of the available evidence seems to suggest that droughts and extreme rainfall volatility do increase poverty even if poverty is also influenced by numerous other factors.

Several projects have analysed the impacts of rainfall shocks on various household socio-economic indicators, including consumption growth, human capital accumulation, life expectancy, and adult and children's anthropometrics as a proxy for health/wellbeing outcomes (e.g., Jensen, 2000; Shah and Steinberg, 2012; Asimwe and Mpuga, 2007; Hoddinott et al, 2011; Dercon, 2004; Hoddinott, 2006; Maccini and Yang, 2009; Tiwari et al, 2013 and Neumayer and Plumper, 2007). An examination of children's educational investments in Côte d'Ivoire revealed, for example, that school enrolment rates declined by 20 percentage points (more than one-third of the original rate) in regions affected by adverse weather conditions (Jensen, 2000).

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<sup>2</sup> This fact has also been pointed out in UNISDR (2012) using data on Syria, Jordan and Yemen.

Maccini and Yang (2009) report that a 20% increase in rainfall in Indonesia during early childhood led to 0.57cm greater height, 0.22 additional completed grades of schooling and to lives in households that are 0.12 standard deviation higher on an asset index scale. Another similar research project, in Nepal, found a 0.15 standard deviation increase in weight-for-age for children aged 0–36 months due to 10% higher rainfall (Tiwari et al, 2013). This has also been evident in Zimbabwe, where Hoddinott et al. (2006, 2011) showed lower annual growth in height of 1.5-2cm among children aged 12-24 months after drought with the most severe impacts on poor households.

Moreover, in the long run, children from relatively wealthier households recovered this lost physical growth while children from poorer homes did not (Hoddinott, 2006). The same study also found a decrease in women's body-mass index by about 3% in the aftermath of a 1994-95 drought. Similarly, in Ethiopia, Yamano et al. (2005) found that children 6-24 months old experienced about 0.9cm less growth in communities with substantial crop damage after severe droughts while food aid acted as an effective insurance mechanism in reducing child malnutrition. Estimating the long-term impacts of 1984 Ethiopian famine, Porter (2008) reveals that children who were under the age of 36 months are years later shorter by almost 3cm.

Evidence from India suggests that parents and children work less and have lower wages during drought years and the reverse case happens when households experience positive rainfall shocks (Shah and Steinberg, 2012). The same study further identified deleterious effects on health, schooling and more interestingly, on later-life wages due to early life exposure to droughts. Dercon (2004) found out that a 10% lower rainfall about 4–5 years earlier had an impact of one percentage point on current consumption growth rates. After controlling for heterogeneity, the paper identified a substantial impact of about 16% lower growth when comparing groups that suffered substantially with those being moderately affected. In Ethiopia, Foltz et al (2013) concluded that both food and non-food

consumption is directly related to rainfall. However, Hou (2010) finds that when a negative income shock occurs due to drought, households tend to buy cheaper calories resulting in a net increase in total calories consumed.

Asiimwe and Mpuga (2007) point out that the timing of the rainfall shock appears to matter. In their examination of Uganda, positive rainfall shocks experienced during planting or harvest times actually result in lower household consumption expenditure. Analysing data on Indonesian rice farmers, Skoufias et al. (2012) argue that although a delayed monsoon does not have a significant impact on average, farmers located in low rainfall exposure areas following the monsoon are negatively affected. A study on Indian agricultural labour market by Mahajan (2012) reported that low rainfall years affect male-female wage gap adversely in rain-fed rice growing regions. Rainfall, of course, matters much more in rural/agricultural communities, than in the typically more prosperous urban ones (at least directly).

Even more nuanced observations about the way different conditions lead to different outcomes in the face of similar shocks were proposed by Reardon and Taylor (1996). They compared the impact of adverse drought shocks on two regions in Burkina Faso, (the dryer, semi-arid Sahel, and the wetter Guinean region); and they find the impacts of droughts appear to be very different, in some cases leading to increases in poverty, and in others the opposite.

## **5. The indirect impacts of sudden-onset events**

The direct impacts are only a part of the economic significance of natural disasters. In general, we do not understand the indirect impacts as well, though they are potentially more severe. These impacts may result from direct damage to the inputs used in production, to infrastructure, or from the fact that reconstruction and rehabilitation pull resources away from other sectors. Further on, the

indirect impacts can manifest themselves in a new equilibrium steady-state in which the economy/society are in a different position to what they were pre-disaster.

In contrast to these adverse consequences, reconstruction spending can provide a boost to the domestic economy. Both government funding and privately funded reconstruction from insurance payments, accumulated saving, or from other sources, is bound to provide some temporary stimulus to the local economy (Cavallo and Noy, 2011). In the longer-run, there is a potential to ‘build-back-better;’ reconstruction can, at least in theory, be a reconstruction to better standards, newer, more advanced and more innovative infrastructure, and may even facilitate a new political equilibrium that enables better policies (whatever ‘better’ means in practice).<sup>3</sup> Equally plausible is the scenario that the new political equilibrium will actually be less beneficial to the poor, if the external shock removed what John Kenneth Galbraith called the ‘countervailing forces’ that prevented elites from capturing specific assets.<sup>4</sup>

Most recent research suggests that aggregate adverse short-run effects, at the national level can be observed in middle- and low-income countries experiencing catastrophic disasters. These countries have difficulty financing reconstruction; as they generally face difficulties conducting counter-cyclical fiscal policy and their insurance and re-insurance markets are significantly shallower (Noy, 2009; von Peter et al., 2012; Strobl, 2012). The same financing constraints that seem to prevent middle- and low-income countries from adequately paying for and implementing successful reconstruction are also the ones that typically inhibit lower-income households.

Analysing the impacts of several types of natural disasters at the municipal level in Mexico, Rodriguez-Oreggia et al. (2013) argue that natural disasters reduce human development and increase

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<sup>3</sup> One can already observe this possibility in the aftermath of what is sometime considered the first international modern natural disaster, the Lisbon earthquake of 1755. Sebastião José de Carvalho e Melo, the prime minister of Portugal, appointed to run the relief operations after the earthquake, wrote: “Politics is not always the cause of revolutions of State. Dreadful phenomena frequently change the face of Empires....We could say that it is necessary that across the land provinces are wasted and cities ruined in order to dispel the blindness of certain nations.” (quoted in Shradly, 2008).

<sup>4</sup> Some examples of this are described in Klein’s book-length investigation in *The Shock Doctrine*.

measures of poverty (food, capacity and asset). They further conclude that floods and droughts are associated with more significant adverse effects when compared to frost, extreme rainfalls and other types of natural disasters. Similarly, Holland et al. (2009) identify evidence indicating a negative relationship between HDI and disasters, and leading to higher poverty levels in Fiji.

Two UNDP projects explored the relationship between natural hazards and poverty in Latin American countries (Baez and Santos, 2008 and Glave et al, 2008). Baez and Santos (2008), on El Salvador, reported that the combined effects of two earthquakes in 2001 led to reduction of household income by one-third of the pre shock average. Evidence from Peru, in Glave et al. (2008), suggests that the effect of disasters on poverty rates ranges between 0.16 and 0.23 percentage points increase in poverty. From distributional point of view, the authors concluded that an increase in average shocks reduces the median of monthly per capita consumption in the bottom 25th and 50th of the distribution by 3.85% and 2.68% respectively.<sup>5</sup>

Baez and Santos (2007) investigated the impact hurricane Mitch in Nicaragua, and found a range of distinct adverse medium-term effects; in particular, they focus on areas that are typically more relevant for poor and identified increased probability of undernourishment and a significant increase in labour force participation among children (though this increase did not correspond with a decline in school enrollments).

As in Baez and Santos (2007), most research has not attempted to isolate separately the impact of these sudden shocks on the poor vs. other income groups. However, most of the mechanisms and impact they identified are more likely to be specifically relevant to more income-constrained households. For example, evidence from Vietnam revealed that riverine floods and

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<sup>5</sup> Comparing impacts of El-Niño shocks to the financial crisis in 1998, Datt and Hoogeveen (2003) show that the largest share of the overall impact on poverty is attributable to the El-Niño shock, ranging between 47% and 57% of the total impact on measures of incidence, depth and severity of poverty relative to the labor market shock that only accounts for 10–17% of the total poverty impact.

hurricanes caused welfare losses up to 23% and 52% respectively inside cities with a population over 500,000 (Thomas et al, 2010); flood-prone urban areas are typically associated with lower-income households. Sawada and Shimizutani (2008), in another example, report that in the aftermath of the 1995 Kobe earthquake in Japan, households that were credit constrained did not manage to regain their consumption levels while households that faced fewer credit restrictions were more successful in recovering.

The importance of credit in facilitating recovery is well documented. Credit constraints may also lead households to sub-optimally sell productive assets in order to smooth consumption after a major but temporary income shock (Mueller and Osgood, 2009). Anttila-Hughes and Hsiang (2012) also find similar dynamics for Philippine households. In their case, while both low- and high-income households experience similar level of damages in the initial impact following an exceptionally strong typhoon, it is only the lower-income households whose consumption does not recover in the years that follow.

Impacts on the poor in the aftermath of a natural disaster are also being observed through migration and remittances pattern (see Gray and Mueller, 2012; Boustan et al, 2012; Attzs, 2008; Clarke and Wallsten, 2003 and Halliday, 2012). A household panel dataset for Jamaica after hurricane Gilbert reveals that remittances increased by only about 25 cents for every dollar of damage (Clarke and Wallsten, 2003). However, Attzs (2008) observes an increase in migration after a hurricane and an increased inflow of remittances (which constitutes 87% of income for the poorest deciles in Jamaica). Intriguingly, in El Salvador, Halliday (2012) identified that the 2001 catastrophic earthquake resulted in a large negative effect on female migration with absolutely no effect on male migration.<sup>6</sup> These studies

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<sup>6</sup> In El Salvador, over 90% of all households do not allocate any males to domestic activities, so the need for domestic labour in the disaster's aftermath may explain this pattern (Halliday, 2012).

further emphasized that women and the poor are more exposed and dealt with the aftermath of a disaster more directly.<sup>7</sup>

Another group of projects had examined the evidence on the impacts of natural shocks on household assets and on consequent income distribution (see Carter et al, 2007; Mogues, 2011; Anttila-Hughes and Hsiang, 2012; Morris et al, 2002; Jakobsen, 2012 and Masozera et al, 2007). Most of these studies point out that, depending upon the severity of the shock, beyond reduction in current income most households also suffer a depletion of assets. Morris et al. (2002) reveals that, after hurricane Mitch, assets of households in the lowest wealth quintile were reduced by 18% compared to 3% for the upper wealth quintile.<sup>8</sup>

Evidence of a poverty trap had been identified by Jakobsen (2012) in the aftermath of hurricane Mitch in rural Nicaragua when non-productive asset holdings are found to reduce significantly affecting the poor disproportionately. Carter et al. (2007) examined two different results on a similar situation in two different case studies. In Honduras, in the medium-term, relatively wealthy households were able to partially rebuild their lost assets unlike the lowest wealth quintiles; whereas in Ethiopia, the poorest households (in wealth) try to hold on to their few assets despite consumption possibilities shrinking during drought periods of severe losses in agricultural production/income.<sup>9</sup>

Several studies analysed the impacts of natural disasters on population dynamics and fertility response (e.g. Martine and Guzman, 2002; Lin, 2004 and Finlay, 2009). Martine and Guzman (2002) identified a reduction in population growth in some Honduran provinces by 92%-40%, depending on

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<sup>7</sup> Boustan et al (2012) adds another layer of complexity by identifying ways in which disaster mitigation efforts may interact with individual migration decisions.

<sup>8</sup> This has also been evident in Masozera et al (2007), who identified vulnerability of lower income groups who have fewer resources available.

<sup>9</sup> van den Berg (2010) adds more nuance about the ability of households at various income levels to pursue possible strategies that allow them to maintain their capital. She concludes that, in the case of Hurricane Mitch, there is little evidence of changes in the transitions between various income levels, suggesting permanent poverty traps rather than a destruction of income-producing assets at higher income levels.

the province, due to the effects of Hurricane Mitch. Lin (2004) reaches similar conclusions. However, Finlay (2009) argues that the event of a large scale natural disaster may have a positive effect on fertility under the assumption that children could be used as an insurance mechanism to compensate for income and asset loss in the aftermath scenario. We can definitely speculate that these dynamic incentives may affect poorer households differently than richer ones; for example that increasing fertility will only be observed for poorer households that do not have access formal retirement insurance products. The evidence on these possible differences, however, does not yet exist.

A UNDP report finds that per capita income reduced by 15% affecting poverty levels in the advent of 2001 earthquake in El Salvador whereas droughts increased poverty incidence by 2 percentage points, on average, in Ecuador. From a distributional point of view, the Peruvian case shows that a one unit increase of average occurrence of shocks leads to a reduction of 2% household per capita consumption in the lowest quartile compared to 1.2% in the richest quartile (Lopez-Calva and Juarez, 2009).

## **6. Coping Responses of the Poor**

A significant body of research has attempted to shed some light on possible coping mechanisms of dealing with natural disasters, typically focussing on the rural poor in low-income countries. Sawada (2007) provides an earlier survey of some of the potential mechanisms in the local regional and global contexts), while Ghorpade (2012) provides a more recent version. Yet, a careful evaluation of the differences among income groups in their coping mechanisms is less common. Helgeson et al. (2012) provides a recent example of a careful study identifying the possible coping mechanisms and evaluating their prevalence with a large survey of Ugandan farmers. Patnaik and Narayanan (2010) examine similar questions with data from two districts in rural India.



Traditional insurance policies are typically unaffordable or unsuited to conditions in rural low-income regions/countries. Thus other insurance products to deal with weather risks have been developed, with a recent enthusiasm for index insurance. Equally important, though are other products for disaster coping strategies such as disaster micro-insurance or other financial instruments such as contingent-repayment in microfinance loans (see Jensen, 2000; Barnett and Mahul, 2007; Mechler et al, 2006; Shoji, 2009; and Janzen and Carter, 2013). Yet, the introduction of insurance tools for the poor is still evolving; and the poor often rely on accumulated savings, mortgaging available assets, donations, remittances, emergency loans from microcredit institutions or traditional moneylenders, and if these fail, direct support from family, neighbours, and friends (Mechler et al, 2006).

Estimating an acceptable and affordable premium for disaster insurance specifically for the poor seems to be extremely difficult not only due to multiple risks on life, health and property but also due to the 'fat-tailed' nature of the natural events. However, index- or micro- insurance products could be effective mechanisms in transferring covariate weather risks for the rural poor as has been (provisionally) observed in Mexico and India (Barnett and Mahul, 2007). Khandker (2007) finds that sixty percent of sampled households adopted some form of what appears to be sub-optimal coping mechanism during a sudden shock. These involved borrowing (often at high interest), skipping meals, selling productive assets or migrating away from affected areas. Yet, identifying whether targeted programs in microfinance and microinsurance are able to compensate the losses adequately and prevent households from resorting to sub-optimal strategies remains to be seen. Shoji (2009) employed a unique dataset and examined the impact of rescheduling of savings and repayment instalments in microfinance, also known as contingent repayment for affected members during a natural disaster. The paper points out that rescheduling decreases the probability of avoiding meals

by 5.1% during negative shocks with larger impact on the poor and particularly more on females. Another study on drought impacts in Kenya by Janzen and Carter (2013) reveals that insured households are 8-41 percentage points less likely to reduce meals and 18-50 percentage points less likely to draw down assets during the recovery process. Silbert and Useche (2012) find that although male-headed households are less vulnerable (to reductions in total consumption), education can still lead female-headed households to better coping decisions. In addition, *ex ante* income diversification also provides an important consumption smoothing strategy (Wong and Brown,2011).

The use of livestock as a buffer stock in terms of reducing the probability of being 'always poor' in the aftermath of a natural disaster has also been examined. Fafchamps et al (1998) argue that livestock sales offset at most 30% and probably closer to 15% of income loss resulting from village level rainfall shocks in West Africa. In Uganda and India, in contrast, livestock are held as a form of liquid savings and selling livestock had been used as the most frequent form of coping strategy after a weather disaster (Helgeson et al, 2012, and Patnaik and Narayanan, 2010, respectively). However, evidence suggests that insurance substantially reduces the probability of selling livestock during a drought improving the chances of advancement in the recovery process (Janzen and Carter, 2013).

Several projects have looked at vulnerability and coping strategies in selected South and South east Asian countries (see Zoleta-Nantes, 2002; Few, 2003; Patnaik and Narayanan,2010; Takashi et al, 2012; Israel and Briones, 2013). Zoleta-Nantes (2002) showed the differential impacts of flood hazards on three vulnerable groups—street children, the urban poor and residents of wealthy neighbourhoods—in metro Manila, the Philippines. She concluded that spatial isolation and lack of participation in decision-making intensified present and future vulnerability at the household and community levels. Another study in Metro Manila, on the impacts of typhoon-related floods by Israel

and Briones (2013), found that the occurrence and intensity of aforementioned disasters have a significant negative effect on household income.

Another study by Takashi et al (2012) on household level recovery after floods in North Pakistan concluded that although households with fewer assets did struggle in the recovery process, the speed of recovery was slower for the richer households later on, leaving an income distribution that was characterized by a mass of households around the income poverty line.<sup>10</sup>

## **7. Long-Term Scenarios in Disasters' Aftermath**

It is perhaps of even greater importance to determine the long-term effects of catastrophic disasters on various income groups, rather than only their direct and indirect short-term impacts. The limited empirical evidence suggests that large natural shocks can have important regional consequences that may persist for decades. The population of New Orleans, for example, is unlikely to recover from the dramatic exodus of people from the region after Hurricane Katrina — in July 2011, six years after the hurricane, the population of the city was still 21% lower than the week before the storm hit. Emigration, as in Katrina's case, is one possible long-term consequence, and at least in Katrina's case, it seems that the poor and the disenfranchised were disproportionately more likely to emigrate in the storm's aftermath.<sup>11</sup> This evidence, however, is only anecdotal; we have no direct evidence that disasters' long-term impact affect the poor any differently than other segments of

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<sup>10</sup> Most research has focussed on first moment impacts of disasters, but it is also important to point out that disasters are also an important source of *damaging fluctuations*, which might trigger responses as these may lead to chronic or intergenerational poverty (Sinha et al, 2002).

<sup>11</sup> Coffman and Noy (2012) describe the impact of a hurricane on a small Hawaiian island, and conclude that the long-term impact of the disaster was a 15% population decline enduring at least two decades after the event. Lynham et al. (2012) provide similar evidence for a tsunami in another Hawaiian island. Hornbeck (2012) examines the long-term impact, at the county level, of the American Dust-Bowl during the 1930s. Hornbeck finds that while there was some adjustment in agricultural activities, there were still substantial declines in productivity and land prices that lasted at least into the 1950s. The main adjustment mechanism he describes is emigration.

society, nor do we have substantial evidence on the distributional consequences, in the long-term, of disaster events.

Analysing the case of Indonesia, Silbert and Useche (2012) pointed out that larger households are 16 percent more vulnerable to future poverty in the presence of shocks, and holding all else equal, larger households are likely to be most vulnerable. Similarly, evidence from Brazil suggests that exposure to drought can reduce rural wages by 9% in the long-term (defined as 5-10 years; Mueller and Osgood, 2009). To shed lights on distributional impacts, a recent study by Yamamura (2013) concluded that although natural disasters have increased income inequality in the short-term, this effect however, decays over time and disappears in the medium term.<sup>12</sup>

From the macroeconomic/aggregate literature, we know that certain economic conditions and policies may lead to increased resilience in the aftermath of disaster, but on the other hand, its negative impact may be exacerbated significantly by others. Relevant factors include the existence or absence of *ex-ante* disaster management plans, the flexibility to re-allocate resources efficiently for disaster relief and reconstruction, the expected access to extra-regional funds from the central government or from other sources (foreign aid, re-insurance payments, etc.), and the ability of the region's dominant economic sectors to rebound. Institutional, cultural and social factors may also play an important constructive role.<sup>13</sup> Whether these differences also matter, in the long-run, at the household level, and differentiate between the poor and others, or have any distributional impacts are all still open questions.

One issue that may turn out to be the most important in determining post-disaster outcomes is not the degree and level of destruction, or the degree of preparedness, but the adjustment in expectations with regard to future events that catastrophes often prompt. Kobe, for example, was not

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<sup>12</sup> Narayanan and Sahu (2011) investigate climate related disaster in the Indian state of Orissa, and find deteriorating health conditions due to these events that reduce the ability of the poor to participate in income generating economic activities.

<sup>13</sup> For evidence on the importance of social capital, see Aldrich (2012).

perceived to be a high-risk area for earthquakes before 1995, an assessment which unsurprisingly changed in the disaster's aftermath. In contrast, the devastation wrought by war, even a very destructive one, may be perceived as a one-off event and therefore not lead to long-term shifts in economic activity (see Davis and Weinstein, 2002). The perceived increased risk of future catastrophic events, however, may inhibit human and capital saving and investment in an affected region for decades (see Aizenman and Noy, 2013). These may well matter differently for people with different socio-economic backgrounds, given the additional exposure of the poor to risk and given possibility of decreased investment leading into poverty traps. Once again, however, this is still an open empirical question, like so many of the other issues been highlighted in this report.

## References

- Aizenman and Noy (2013), 'Public and Private Saving and the Long Shadow of Macroeconomic Shocks', National Bureau of Economic Research Working paper.
- Aheeyar, M. M. M. (2006), 'Cash grants and microfinance in livelihood recovery: experiences from tsunami-affected areas of Sri Lanka', published by Overseas Development Institute: [http://www.odi.org.uk/HPG/papers/BGP\\_SriLanka\\_cash\\_mfinance.pdf](http://www.odi.org.uk/HPG/papers/BGP_SriLanka_cash_mfinance.pdf).
- Aldrich, Daniel (2012). *Building Resilience: Social Capital in Post-Disaster Recovery*. University of Chicago Press.
- Anbarci, N., M. Escaleras, and C. A. Register (2005), 'Earthquake Fatalities: The Interaction of Nature and Political Economy.' *Journal of Public Economics*, 89: 1907–1933.
- Anttila-Hughes, Jesse Keith and Hsiang, Solomon M. (2013), 'Destruction, Disinvestment, and Death: Economic and Human Losses Following Environmental Disaster', Available at SSRN: <http://ssrn.com/abstract=2220501> or <http://dx.doi.org/10.2139/ssrn.2220501>.
- Asiimwe, J. B., & Mpuga, P. (2007), 'Implications of rainfall shocks for household income and consumption in Uganda', AERC Research Paper 168, African Economic Research Consortium.
- Attz, M. (2008) 'Natural disasters and remittances: Exploring the linkages between poverty, gender and disaster vulnerability in Caribbean', SIDS No. 2008.61, Research paper/UNU-WIDER.
- Auffret, P. (2003), 'High Consumption Volatility: The Impact of Natural Disasters?', World Bank Policy Research Working Paper 2962, The World Bank.
- Baez, J. E., & Santos, I. V. (2007), 'Children's vulnerability to weather shocks: A natural disaster as a natural experiment', Social Science Research Network, New York.
- Baez, J., De la Fuente, A., & Santos, I. (2010), 'Do Natural Disasters Affect Human capital? An assessment based on existing empirical evidence', IZA Discussion paper No. 5164.
- Barnett, B. J., & Mahul, O. (2007), 'Weather index insurance for agriculture and rural areas in lower-income countries', *American Journal of Agricultural Economics*, 89(5), 1241-1247.
- Baez, Javier E., and Indhira V. Santos (2008), 'On Shaky Ground: The Effects of Earthquakes on Household Income and Poverty', Background paper of the ISDR/RBLAC-UNDP Project on Disaster Risk and Poverty in Latin America.
- Boustan, L. P., Kahn, M. E., & Rhode, P. W. (2012), 'Moving to higher ground: migration response to natural disasters in the early twentieth century', *The American Economic Review*, 102(3), 238-244.
- Brooks, N. (2003), 'Vulnerability, risk and adaptation: A conceptual framework', Tyndall Centre for Climate Change Research Working Paper, 38, 1-16.

- Carter, M. R., Little, P. D., Mogue, T., & Negatu, W. (2007), 'Poverty traps and natural disasters in Ethiopia and Honduras', *World development*, 35(5), 835-856.
- Cavallo, E., and I. Noy (2011), 'The economics of natural disasters - a survey', *International Review of Environmental and Resource Economics*, 5(1): 1-40.
- Cavallo, E., Galiani, S., Noy, I. and Pantano, J. (2013), 'Catastrophic Natural Disasters and Economic Growth', *Review of Economics and Statistics* (forthcoming).
- Clarke, G., & Wallsten, S. (2003), 'Do remittances act like insurance? Evidence from a natural disaster in Jamaica', Development Research Group, The World Bank.
- Coffman, M. and I. Noy (2012), 'Hurricane Iniki: Measuring the Long-Term Economic Impact of a Natural Disaster Using Synthetic Control', *Environment and Development Economics*, 17, 187-205.
- Cunguara, B., Langyintuo, A., & Darnhofer, I. (2011), 'The role of nonfarm income in coping with the effects of drought in southern Mozambique', *Agricultural Economics*, 42(6), 701-713.
- Datt, G., & Hoogeveen, H. (2003), 'El Niño or El Peso? Crisis, poverty and income distribution in the Philippines', *World Development*, 31(7), 1103-1124.
- Davis, D., and D. Weinstein (2002), 'Bones, Bombs, and Break Points: The Geography of Economic Activity', *American Economic Review*, 92(5), 1269-1289.
- Dercon, S. (2004), 'Growth and Shocks: Evidence from Rural Ethiopia', *Journal of Development Economics*, 74(2): 309-329.
- Dercon, S. and P. Krishnan (2000), 'In Sickness and in Health: Risk Sharing within Households in Rural Ethiopia', *Journal of Political Economy*, 108 (4): 688-727.
- duPont, W. and I. Noy (2012), 'What Happened to Kobe?' University of Hawaii Working Paper 2012-04.
- Escaleras, Monica, Nejat Anbarci, Charles A. Register (2007), 'Public Sector Corruption and Major Earthquakes: A Potentially Deadly Interaction', *Public Choice*, Vol. 132, No. 1/2:pp. 209-230.
- Fafchamps, M., Udry, C., & Czukas, K. (1998), 'Drought and saving in West Africa: are livestock a buffer stock?', *Journal of Development economics*, 55(2), 273-305.
- Few, R. (2003), 'Flooding, vulnerability and coping strategies: local responses to a global threat', *Progress in Development Studies*, 3(1), 43-58.
- Finlay, J. (2009), 'Fertility response to natural disasters: the case of three high mortality earthquakes', World Bank Policy Research Working Paper Series 4883, The World Bank.
- Foltz, J., Gars, J., Özdoğan, M., Simane, B., & Zaitchik, B. (2013), 'Weather and Welfare in Ethiopia', In 2013 Annual Meeting, August 4-6, 2013, Washington, DC, No. 150298, Agricultural and Applied Economics Association.

- Francisco, H. A., Predo, C. D., Manasboonphempool, A., Tran, P., Jarungrattanapong, R., Penalba, L. M., & Zhu, Z. (2011), 'Determinants Of Household Decisions On Adaptation To Extreme Climate Events in Southeast Asia', No. rr2011074, Economy and Environment Program for Southeast Asia (EEPSEA).
- Giesbert, L., & Schindler, K. (2012), 'Assets, shocks, and poverty traps in rural Mozambique', *World Development*, 40(8), 1594-1609.
- Ghorpade, Y. (2012), 'Coping Strategies in Natural Disasters and under Conflict: A Review of Household Responses and Notes for Public Policy', No. 136, Households in Conflict Network.
- Glave, M., Fort, R., & Rosemberg, C. (2008), 'Disaster Risk and Poverty in Latin America: The Peruvian Case Study', Background paper of the ISDR/RBLAC-UNDP Project on Disaster Risk and Poverty in Latin America.
- Gray, C. L., & Mueller, V. (2012), 'Natural disasters and population mobility in Bangladesh', *PNAS* 109(16), 6000-6005.
- Hallegatte, Stephane (2012), 'An Exploration of the link between development, economic growth and natural risk', Policy Research Working Paper Series 6216, The World Bank.
- Halliday, T. J. (2012), 'Intra-household labor supply, migration, and subsistence constraints in a risky environment: Evidence from rural El Salvador', *European Economic Review*, 56(6), 1001-1019.
- Helgeson, J., Dietz, S., & Hochrainer, S. (2012), 'Vulnerability to weather disasters: the choice of coping strategies in rural Uganda', Centre for Climate Change Economics and Policy Working Paper, 107.
- Hoddinott, J., Maluccio, J., Behrman, J. R., Martorell, R., Melgar, P., Quisumbing, A. R., & Yount, K. M. (2011), 'The consequences of early childhood growth failure over the life course.' International Food Policy Research Institute Paper 1073.
- Hoddinott, John (2006), 'Shocks and their consequences across and within households in Rural Zimbabwe', *Journal of Development Studies*, 42:2, 301-321.
- Hoddinott, J., & Kinsey, B. (2001), 'Child growth in the time of drought', *Oxford Bulletin of Economics and Statistics*, 63(4), 409-436.
- Hou, X. (2010), 'Can Drought Increase Total Calorie Availability? The Impact of Drought on Food Consumption and the Mitigating Effects of a Conditional Cash Transfer Program', *Economic Development and Cultural Change*, 58(4), 713-737.
- Hornbeck, R. (2012), 'The Enduring Impact of the American Dust Bowl: Short- and Long-Run Adjustments to Environmental Catastrophe', *American Economic Review*, 102(4): 1477–1507.
- IPCC (2012), '*Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation*', A Special Report of Working Groups I and II of the Intergovernmental Panel on Climate Change [Field, C.B., V. Barros, T.F. Stocker, D. Qin, D.J. Dokken, K.L. Ebi,].



- Israel, Danilo C. and Briones, Roehlano R. (2013), 'Disasters, Poverty and Coping Strategies: The Framework and Empirical Evidence from Micro/Household Data - Philippine Case', presented at 2013 ERIA workshop, Singapore.
- Jakobsen, K. T. (2012), 'In the Eye of the Storm—The Welfare Impacts of a Hurricane', *World Development*, 40(12), 2578-2589.
- Jensen, Robert (2000), 'Agricultural volatility and investments in children', *The American Economic Review*, 90.2: 399-404.
- Jha, Raghendra (2006), 'Vulnerability and Natural Disasters in Fiji, Papua New Guinea, Vanuatu and the Kyrgyz Republic', <http://dx.doi.org/10.2139/ssrn.882203>.
- Kahn, M E. (2005), 'The Death Toll from Natural Disasters: The Role of Income, Geography, and Institutions', *Review of Economics and Statistics*, 87(2): 271–284.
- Kazianga, H. and C. Udry (2006), 'Consumption smoothing? Livestock, insurance and drought in rural Burkina Faso', *Journal of Development Economics* 79 (2006) 413–446.
- Kellenberg, D. K., and A. M. Mobarak (2008), 'Does Rising Income Increase or Decrease Damage Risk from Natural Disasters?', *Journal of Urban Economics* 63(3): 788–802.
- Khandker, S. R. (2007), 'Coping with flood: role of institutions in Bangladesh', *Agricultural Economics*, 36(2), 169-180.
- Kim, Namsuk (2012), 'How much more exposed are the poor to natural disasters? Global and regional measurement', *Disasters* 36(2): 195-211.
- Lal, P. N., Rita, R., & Khatri, N. (2009), 'Economic costs of the 2009 floods in the Fiji sugar belt and policy implications', IUCN.
- Lal, P.N., R. Singh and P. Holland (2009), 'Relationship between natural disasters and poverty: a Fiji case study', SOPAC Miscellaneous Report 678, Global Assessment Report on Disaster Reduction, UNISDR.
- Lin, C. Y. C. (2004), 'The Effects of Natural Disasters and Economic Volatility on Fertility', Available at SSRN 590421.
- Lindell, M. K., & Prater, C. S. (2003), 'Assessing community impacts of natural disasters', *Natural Hazards Review*, 4(4), 176-185.
- Little, P. D., Stone, M. P., Mogues, T., Castro, A. P., & Negatu, W. (2006), 'Moving in place': Drought and poverty dynamics in South Wollo, Ethiopia', *Journal of Development Studies*, 42(2), 200-225.
- Loayza, N., E. Olaberria, J. Rigolini and L. Christiaensen (2012), 'Natural Disasters and Growth: Going Beyond the Averages', *World Development*, 40(7): 1317–1336.

- Lopez-Calva, L. F., & Ortiz-Juarez, E. (2009), 'Evidence and Policy Lessons on the Links between Disaster Risk and Poverty in Latin America', United Nations Development Program, working paper.
- Lynham, J; Noy, I; Page, J (2012), 'The 1960 Tsunami in Hawaii: Long Term Consequences of a Coastal Disaster', School of Economics and Finance, Victoria University of Wellington.
- Maccini, S.L. and D. Yang (2008) 'Under the Weather: Health, Schooling, and Economic Consequences of Early-Life Rainfall', *American Economic Review*, 99:3, 1006–1026.
- Mahajan, K.(2012), 'Rainfall shocks and gender wage gap: Agricultural labor in India', Presented in 8<sup>th</sup> Annual Conference on Economic Growth and Development, Dec 17-19, 2012, Indian Statistical Institute, New Delhi.
- Martine, G., & Guzman, J. M. (2002), 'Population, poverty, and vulnerability: Mitigating the effects of natural disasters', *Environmental Change and Security Project Report*, 8, 45-64.
- Masozera, M., Bailey, M., & Kerchner, C. (2007), 'Distribution of impacts of natural disasters across income groups: A case study of New Orleans', *Ecological Economics*, 63(2), 299-306.
- Mechler, R., Linnerooth-Bayer, J., & Peppiatt, D. (2006), 'Microinsurance for Natural Disaster Risks in Developing Countries', ProVention Consortium.
- Mogues, T. (2011), 'Shocks and asset dynamics in Ethiopia', *Economic Development and Cultural Change*, 60(1), 91-120.
- Morris, S. S., Neidecker-Gonzales, O., Carletto, C., Munguía, M., Medina, J. M., & Wodon, Q. (2002), 'Hurricane Mitch and the livelihoods of the rural poor in Honduras', *World development*, 30(1), 49-60.
- Mueller, V. A., & Osgood, D. E. (2009), 'Long-term impacts of droughts on labour markets in developing countries: evidence from Brazil', *The Journal of Development Studies*, 45(10), 1651-1662.
- Narayan, P. K. (2003), 'Macroeconomic impact of natural disasters on a small island economy: evidence from a CGE model', *Applied Economics Letters*, 10:11, 721-723.
- Narayanan, K., & Sahu, S. K. (2011), 'Health, income inequality and climate related disasters at household level: reflections from an Orissa District', Munich Personal RePEc Archive.
- Neumayer, E., & Plumper, T. (2007), 'The gendered nature of natural disasters: The impact of catastrophic events on the gender gap in life expectancy, 1981–2002', *Annals of the Association of American Geographers*, 97(3), 551-566.
- Noy, I (2012), 'Investing in Disaster Risk Reduction: A Global Fund', Working paper no. 2390, School of Economics and Finance, Victoria University of Wellington.
- Noy, I. (2009), 'The Macroeconomic Consequences of Disasters', *Journal of Development Economics* 88(2), 221-231.

- Patnaik, U., & Narayanan, K. (2010), 'Vulnerability and Coping to Disasters: A Study of Household Behaviour in Flood Prone Region of India', Munich Personal RePEc Archive.
- Porter, C. (2008), 'The long run impact of severe shocks in childhood: Evidence from the Ethiopian famine of 1984', Department of Economics, The University of Oxford.
- Reardon, T., & Taylor, J. E. (1996), 'Agroclimatic shock, income inequality, and poverty: Evidence from Burkina Faso', *World Development*, 24(5), 901-914.
- Rodriguez-Oreggia, E., de la Fuente, A., de la Torre, R., Moreno, H., & Rodriguez, C. (2013), 'The impact of natural disasters on human development and poverty at the municipal level in Mexico', *Journal of Development Studies*, 49(3), 442-455.
- Sawada, Y. (2007), 'The impact of natural and manmade disasters on household welfare', *Agricultural Economics*, 37(s1), 59-73.
- Sawada, Y., & Shimizutani, S. (2008), 'How Do People Cope with Natural Disasters? Evidence from the Great Hanshin-Awaji (Kobe) Earthquake in 1995', *Journal of Money, Credit and Banking*, 40(2-3), 463-488.
- Sawada, Y. (2012), 'Approaches towards Effective Disaster Risk Coping Strategy and Regional Cooperation on Disaster Management', in Sawada, Y. and S. Oum (eds.), *Economic and Welfare Impacts of Disasters in East Asia and Policy Responses*, ERIA Research Project Report 2011-8, Jakarta: ERIA. pp. 27-44.
- Shah, M., & Steinberg, B. M. (2012), 'Could Droughts Improve Human Capital? Evidence from India', Unpublished manuscript, University of California, Davis.
- Shoji, Masahiro (2010), 'Does Contingent Repayment in Microfinance Help the Poor During Natural Disasters?', *Journal of Development Studies*, 46:2,191-210.
- Shrady, N. (2008), *The Last Day: Wrath, Ruin, and Reason in the Great Lisbon Earthquake of 1755*, Viking Press.
- Silbert, Megan, and Maria del Pilar Useche (2012), 'Repeated Natural Disasters and Poverty in Island Nations: A Decade of Evidence from Indonesia', University of Florida, Department of Economics, PURC Working Paper.
- Sinha, S., Lipton, M., & Yaqub, S. (2002), 'Poverty and damaging fluctuations: how do they relate?', *Journal of Asian and African Studies*, 37(2), 186-243.
- Skoufias, E., Katayama, R. S., & Essama-Nssah, B. (2012), 'Too little too late: welfare impacts of rainfall shocks in rural Indonesia', *Bulletin of Indonesian Economic Studies*, 48(3), 351-368.
- Strobl, Eric (2012), 'The economic growth impact of natural disasters in developing countries: Evidence from hurricane strikes in the Central American and Caribbean regions', *Journal of Development Economics*, 97(1), 131-140.

- Takashi, K., Humayun, K., Mir Kalan, S., & Muhammad, T. (2012), 'Household-level Recovery after Floods in a Developing Country: Further Evidence from Khyber Pakhtunkhwa, Pakistan', No. 27, Institute of Economic Research, Hitotsubashi University.
- Tesliuc, Emil D., and Kathy Lindert (2002), 'Vulnerability: A quantitative and qualitative assessment', Guatemala Poverty Assessment Program.
- Thomas, T., Christiaensen, L., Do, Q. T., & Trung, L. D. (2010), 'Natural disasters and household welfare: evidence from Vietnam', World Bank Policy Research Working Paper Series 5491, The World Bank.
- Tiwari, S., Jacoby, H. G., & Skoufias, E. (2013), 'Monsoon Babies Rainfall Shocks and Child Nutrition in Nepal', Policy Research Working Paper 6395, The World Bank.
- United Nations International Strategy for Disaster Reduction (2012), '*Disaster Risk - Poverty Trends in Jordan, Syria, Yemen: Key Findings and Policy Recommendations*', UNISDR Regional Office for the Arab States, Cairo.
- Van den Berg, M. (2010), 'Household income strategies and natural disasters: Dynamic livelihoods in rural Nicaragua', *Ecological Economics*, 69(3), 592-602.
- Vatsa, K., & Krimgold, F. (2000), 'Financing disaster mitigation for the poor', *Managing Disaster Risk in Emerging Economies*, 129-136.
- Vermaak, J., & Van Niekerk, D. (2004), 'Disaster risk reduction initiatives in South Africa', *Development Southern Africa*, 21(3), 555-574.
- Wong, Po Yin, and Philip H. Brown (2011), 'Natural Disasters and Vulnerability: Evidence from the 1997 Forest Fires in Indonesia', *The BE Journal of Economic Analysis & Policy* 11.1.
- World Bank (2011), 'Indonesia-Gender equality in disaster management and climate adaptation', Indonesia gender policy brief; no. 6. Washington DC.
- World Bank (2010), '*Natural Hazards, UnNatural Disasters*', World Bank Publications.
- Yamamura, E. (2013), 'Impact of natural disasters on income inequality: Analysis using panel data during the period 1965 to 2004', Munich Personal RePEc Archive.
- Yamano, Takashi, Harold Alderman, and Luc Christiaensen (2005), 'Child growth, shocks, and food aid in rural Ethiopia', *American Journal of Agricultural Economics*, 87.2: 273-288.
- Zoleta-Nantes, D. B. (2002), 'Differential impacts of flood hazards among the street children, the urban poor and residents of wealthy neighborhoods in Metro Manila, Philippines', *Mitigation and Adaptation Strategies for Global Change*, 7(3), 239-266.

## Appendix: Impacts of Natural Disasters on Poverty Variables and Income Distribution

No.	Study Description	Data/Time period	Sample/Methods	Results/Outcomes
1	<p><b>Author:</b> Carter et al (2007)</p> <p><b>Publication:</b> World Development</p> <p><b>Study area:</b> Ethiopia, Honduras</p> <p><b>Natural Disaster:</b> Hurricane Mitch, Drought</p>	<p><b>Database used:</b> naturally occurring experiments</p> <p><b>Time period:</b> 7 year: Pre-drought (1996-97), drought (1998-2000), recovery (2001-03)</p>	<p><b>Sample size:</b> 416 rural Ethiopian HH, 850 rural Honduran HH</p> <p><b>Modeling technique:</b> Linear regression</p>	<p><i>Honduran</i> data reveals that the medium-term effects of the shock differ by initial household wealth; relatively wealthy house-holds were able to at least partially rebuild their lost assets in the three years following the shock. Contrarily, for the lowest wealth groups, assets were of longer duration and more acute. <i>Ethiopian</i> data reveals the lowest wealth households try to hold on to their few assets despite income and consumption possibilities decrease during the period of severe losses in agricultural production.</p>
2	<p><b>Author:</b> Hoddinott and Kinsey (2001)</p> <p><b>Publication:</b> Oxford Bulletin of Economics and Statistics</p> <p><b>Study area:</b> rural Zimbabwe</p> <p><b>Natural Disaster:</b> Drought</p>	<p><b>Database used:</b> random panel data set</p> <p><b>Time period:</b> 1983 (Jul-Sep), 1984 (Jan-Mar), re-interview in 1997</p>	<p><b>Sample size:</b> 243 children aged 12-24 months</p> <p><b>Modeling technique:</b> Linear regression</p>	<p>This shock lowered annual growth rates for these children between 1.5 and 2 cm. Comparing with identically aged children who had not experienced this drought, these children remained shorter four years after the failure of the rains in 1994/95. The impact is greatest amongst children living in poor households in 1995.</p>
3	<p><b>Author:</b> Cunguara et al (2011)</p> <p><b>Publication:</b> Agricultural Economics</p> <p><b>Study area:</b> Southern Mozambique</p> <p><b>Natural Disaster:</b> Drought</p>	<p><b>Database used:</b> panel survey data</p> <p><b>Time period:</b> 2002 (TIA02), 2005 (TIA05), 2008 (TIA08)</p>	<p><b>Sample size:</b> TIA02 and TIA05 - 1154 HH, TIA08 - 1196HH</p> <p><b>Modeling technique:</b> log linear regression</p>	<p>Participation in nonfarm income-generating activities increases during a drought year. However, households are unlikely to be able to generate a higher mean net income/CAE necessary to compensate for the shortfall in income from crop production. The results also show that relatively poorer households often earn less from nonfarm activities than wealthier ones.</p>
4	<p><b>Author:</b> Mogues, tewodaj (Oct 2011)</p> <p><b>Publication:</b> Economic Development and Cultural Change</p> <p><b>Study area:</b> northeastern Ethiopia</p> <p><b>Natural Disaster:</b> rainfall and income</p>	<p><b>Database used:</b> panel survey data</p> <p><b>Time period:</b> Jun 2000 - Jul 2003 HH survey, livestock holdings data 1996-99</p>	<p><b>Sample size:</b> 448 HH</p> <p><b>Modeling technique:</b> Linear regression; model controls for HH hetero</p>	<p>Shocks are being collectively experienced as well as household-level crop loss leading to an asset drawdown by households. Empirical evidence suggests that these effects are more pronounced in covariant rather than in idiosyncratic shocks pointing to community-level coping mechanisms. Exogenous shocks impacted more on grain stocks than livestock whereas the impact is greater on total livestock than on cattle.</p>

5	<p><b>Author:</b> Dercon, Stefan (2004)</p> <p><b>Publication:</b> Journal of Development Economics</p> <p><b>Study area:</b> rural Ethiopia</p> <p><b>Natural Disaster:</b> Rainfall shocks</p>	<p><b>Database used:</b> panel data</p> <p><b>Time period:</b> 1989 - 1997</p>	<p><b>Sample size:</b> 350 HH</p> <p><b>Modeling technique:</b> log linear model, ML estimation</p>	<p>Evidence suggests that a 10% lower rainfall about 4–5 years earlier had an impact of one percentage point on current consumption growth rates. Estimates controlling for heterogeneity suggest a substantial impact of about 16% lower growth in the 1990s, when comparing groups that suffered substantially with those being moderately affected.</p>
6	<p><b>Author:</b> Tesliuc and Lindert (2002)</p> <p><b>Publication:</b> Guatemala Poverty Assessment Program (GUAPA), WB</p> <p><b>Study area:</b> Guatemala</p> <p><b>Natural Disaster:</b> Bunched shocks (D, FI, H, Q)</p>	<p><b>Database used:</b> pilot LSMS survey module, QPES, ENCOVI Data</p> <p><b>Time period:</b> Year 2000</p>	<p><b>Sample size:</b> N = urban-2609, rural-3706, Guatemala city-921</p> <p><b>Modeling technique:</b> log linear multivariate regression model</p>	<p>Findings show that the poor in Guatemala are disproportionately more exposed to natural disasters and agriculture related shocks and less to economic shocks. 88% percent of the extremely poor and 86% of the poor suffered losses due to shocks compared to 83% of the non-poor and the result is statistically significant. The average impact of each shock on income was estimated to be 28% for job losses whereas 9% for droughts. Moreover, as a result of shocks; income inequality increased by 16%, consumption inequality by 11% and total poverty by 20%.</p>
7	<p><b>Author:</b> Datt and Hoogeveen (2003)</p> <p><b>Publication:</b> World Development</p> <p><b>Study area:</b> Philippines</p> <p><b>Natural Disaster:</b> Drought / El Nino</p>	<p><b>Database used:</b> House Hold survey APIS data</p> <p><b>Time period:</b> Year 1998</p>	<p><b>Sample size:</b> 38,710</p> <p><b>Modeling technique:</b> log linear regression</p>	<p>The economic crisis leads to a 5% reduction in average living standards and a 9% increase in the incidence of poverty, and in depth and severity of poverty by 11% and 13% respectively. The largest share of the overall impact on poverty is attributable to the El Nino shock, ranging between 47% and 57% of the total impact on measures of incidence, depth and severity of poverty while the labor market shock only accounts for 10–17% of the total poverty impact.</p>
8	<p><b>Author:</b> Van den Berg, Marrit (2010)</p> <p><b>Publication:</b> Ecological Economics</p> <p><b>Study area:</b> Nicaragua</p> <p><b>Natural Disaster:</b> Hurricane Mitch</p>	<p><b>Database used:</b> Living Standard Measurement Survey (LSMS) panel data</p> <p><b>Time period:</b> 1998-2001-2005</p>	<p><b>Sample size:</b> 3352 (2005 rural)</p> <p><b>Modeling technique:</b> multinomial logit regression</p>	<p>Result shows that livelihood strategies can be grouped into three welfare categories. Annual farming and farm employment generate low incomes, whereas nonfarm wage employment and livestock farming result in relatively high incomes. Perennial farming, nonfarm self-employment and annual cropping with nonfarm employment are found to be in the middle. High welfare strategies were associated with high levels of capital, and similar numbers of people engagement across years suggest that households that follow low-welfare strategies were trapped in poverty.</p>

9	<p><b>Author:</b> Antilla-Hughes and Hsiang (2012)</p> <p><b>Publication:</b> SSRN (published online)</p> <p><b>Study area:</b> Philippines</p> <p><b>Natural Disaster:</b> Typhoons / Tropical cyclones</p>	<p><b>Database used:</b> Combine Storm data with FIES and DHS panel data; EM-DAT</p> <p><b>Time period:</b> 1993, 1998, 2003 and 2008</p>	<p><b>Sample size:</b> 142,789</p> <p><b>Modeling technique:</b> Time series non-linear regression</p>	<p>Findings show that the Philippines' typhoon climate causes large losses to households' economic well-being, destroys durable assets and depresses incomes. By examining infant mortality rates; substantially increased female infant mortality in the years following storm exposure. Mortality is highest in households where infant daughters face the greatest competition with other children for resources, particularly older brothers. The delayed deaths among female infants outnumber typhoon deaths in the by a factor of 15.</p>
10	<p><b>Author:</b> Rodriguez-Oreggia et al (2010)</p> <p><b>Publication:</b> CID (Harvard) working paper</p> <p><b>Study area:</b> Mexico (municipal level)</p> <p><b>Natural Disaster:</b> ND (Fl, Fr, R,L,Os)</p>	<p><b>Database used:</b> poverty panel dataset (municipalities); DESINVENTAR; HDI</p> <p><b>Time period:</b> 2000 and 2005</p>	<p><b>Sample size:</b> 2,454 municipalities</p> <p><b>Modeling technique:</b> adj. diff-in-diff regression</p>	<p>Results show that natural disasters reduce human development (-0.97, all municipalities) and increase poverty (FP-3.6%, CP-3% and AP-1.5%). Disaggregating by type of event; floods (-0.38 on HDI, 3.5% on FP) and droughts (-1.42 on HDI, 4.3% on FP) have more significant adverse effects compared to frost (-0.78 on HDI, -0.814% on FP), rains (0.905 on HDI, -0.095% on FP) and other natural disasters (-0.78 on HDI, 2.3% on FP).</p>
11	<p><b>Author:</b> UNISDR (2012)</p> <p><b>Publication:</b> UNISDR Regional Office, Cairo</p> <p><b>Study area:</b> Jordan, Syria, Yemen</p> <p><b>Natural Disaster:</b> Bunched shocks (D, Fl, Fr, W-c and h, Q, Lq, Epi, Ss)</p>	<p><b>Database used:</b> DESINVENTAR</p> <p><b>Time period:</b> Jordan: 1981-2010 Syria: 1980-2009 Yemen: 1971-2011</p>	<p><b>Sample size:</b> Jordan: 454 dc,12G Syria: 7326 dc, 14G Yemen: 8945dc</p> <p><b>Modeling technique:</b> Arithmetic tools</p>	<p>Analysis show that poverty is most severe in rural non-diversified economies where agriculture is severely limited by low rainfall, degraded lands, erosion and desertification in Syria, Jordan and Yemen. Data suggests a decadal increase in disaster mortality for Syria (primarily attributed to increasing fire related disasters), which does not confirm any increase in disaster mortality for Jordan and Yemen over the past decade. In Jordan; rains, flash floods and snowstorms affect the densely populated areas possessing the largest share of the country's poor, particularly women. Due to severe ground water scarcity, Yemen experiences extensive risk from water related mortalities - floods, drought and epidemics. Climate variability, low productivity and water shortage leads to stagnating rural incomes increasing poverty in Syria and Yemen.</p>
12	<p><b>Author:</b> Lal et al (2009)</p> <p><b>Publication:</b> IUCN</p> <p><b>Study area:</b> Fiji</p> <p><b>Natural Disaster:</b> Floods</p>	<p><b>Database used:</b> 2009 Flood Economic Survey</p> <p><b>Time period:</b> 2009</p>	<p><b>Sample size:</b> 15-20 % of each category firms</p> <p><b>Modeling technique:</b> ECLAC Disaster Assessment Methodology</p>	<p>The total economic cost of floods in the sugar belt is estimated to be about \$24 million.</p> <p>About 42 percent of flood-affected farms are in severe situation. In terms of basic needs poverty measure, 77% of the flood affected sugarcane families will fall below the poverty line, compared to 54% the families, if not suffered from flooding.</p>

13	<p><b>Author:</b> Namsuk Kim (2012)</p> <p><b>Publication:</b> Disasters</p> <p><b>Study area:</b> Global</p> <p><b>Natural Disaster:</b> Composite Natural Disasters</p>	<p><b>Database used:</b> WB (2008) poverty data and EM-DAT</p> <p><b>Time period:</b> Poverty (2008), EM-DAT (1970-2006)</p>	<p><b>Sample size:</b> 208 countries</p> <p><b>Modeling technique:</b> Disaster Exposure indicator</p>	<p>Result shows that the total net increase of exposure between the 1970s and the 2000s is determined significantly by the increased concentration of the poor (26%) in disaster-prone areas, whereas the contribution remains very small for the non-poor (6%). With varying time trend across regions, poor people in East Asia and Pacific are found to be most exposed to natural disasters followed by those in South Asia and Sub-Saharan Africa.</p>
14	<p><b>Author:</b> Halliday (2012)</p> <p><b>Publication:</b> European Economic Review</p> <p><b>Study area:</b> rural El salvador</p> <p><b>Natural Disaster:</b> Agricultural shocks and earthquakes</p>	<p><b>Database used:</b> BASIS panel data</p> <p><b>Time period:</b> 1997-2002</p>	<p><b>Sample size:</b> 689 (Y-2001), 1365 (Y-1999,2001), 2008 (Y-1997,1999,2001)</p> <p><b>Modeling technique:</b> Model: intra-HH labor supply and migration</p>	<p>The 2001 earthquake resulted in a large negative effect on female migration, but had absolutely no effect on male migration. It also leads to a dramatic increase in the number of hours on women domestic labor, compared to no impact on male domestic hours showing consistency with the finding that over 90% of all households do not allocate any males to domestic activities. It was emphasized that women dealt with the aftermath of the disaster in greater terms.</p>
15	<p><b>Author:</b> Morris et al (2002)</p> <p><b>Publication:</b> World Development</p> <p><b>Study area:</b> Honduras</p> <p><b>Natural Disaster:</b> Hurricane Mitch</p>	<p><b>Database used:</b> integrated House Hold Survey data</p> <p><b>Time period:</b> Interview: b/t may-july 1999, muni upto mar. 1997</p>	<p><b>Sample size:</b> 2398 rural HH</p> <p><b>Modeling technique:</b> ALR (Alternating Logistic Regression)</p>	<p>Findings show that the rural extreme poor were seriously damaged by Hurricane Mitch in Honduras and caused a reduction in current income, a depletion of assets and a number of unanticipated costs. Assets of households in the lowest wealth quintile reduced by 18% (very risky) compared to 3% in upper wealth quintile.</p>
16	<p><b>Author:</b> Asimwe and Mpuga (2007)</p> <p><b>Publication:</b> AERC Research Paper 168</p> <p><b>Study area:</b> Uganda</p> <p><b>Natural Disaster:</b> Rainfall Shocks</p>	<p><b>Database used:</b> House Hold survey data</p> <p><b>Time period:</b> 1992-93, 1999-2000, 2002-2003</p>	<p><b>Sample size:</b> 1992-93 (9900 HH), 1999-2000 (10,696 HH), 2002-2003 (9711 HH)</p> <p><b>Modeling technique:</b> Econometric estimation model</p>	<p>Results show that in the first planting season (March–May), positive rainfall shocks (higher than average) negatively affect total household income. A 100% increase in land owned increases total household income by around 20% and agricultural income by over 50%. The impact of rainfall shocks is significant in the first and second planting seasons (March–May and September–November), where positive rainfall shocks result in lower household consumption expenditure. The consumption spending for households in the North (a war-ravaged region) is about 50% lower than in Central, followed by East (20% lower) and West (12% lower).</p>
17	<p><b>Author:</b> Maccini and Yang (2009)</p> <p><b>Publication:</b> American Economic Review</p>	<p><b>Database used:</b> IFLS (Indonesian Family Life Surveys), GHCN (precipitation and temperature data)</p>	<p><b>Sample size:</b> Men - 4277, Women -4615</p> <p><b>Modeling technique:</b> Reduced-form Linear Relationship</p>	<p>Findings show that higher early-life rainfall leads to improved health, schooling, and socioeconomic status for women. Women with 20% higher rainfall (relative to normal local rainfall) in their year and location of birth are 3.8% less likely to self-report poor or very poor health. They attain 0.57 cm greater height, attain 0.22 more completed grades of schooling, and live in</p>



	<p><b>Study area:</b> Indonesia</p> <p><b>Natural Disaster:</b> Early life Rainfall</p>	<p><b>Time period:</b> 2000</p>		<p>households that score 0.12 st.dev. higher on an asset index. Contrarily, no relationships found between early-life rainfall and adult men's outcomes.</p>
18	<p><b>Author:</b> Attz, Marlene (2008)</p> <p><b>Publication:</b> UNU-WIDER Research Paper</p> <p><b>Study area:</b> Jamaica</p> <p><b>Natural Disaster:</b> Floods, Earthquake and Hurricanes</p>	<p><b>Database used:</b> EM-DAT, poverty assessment studies (CARICOM)</p> <p><b>Time period:</b> 1990s</p>	<p><b>Sample size:</b> CARICOM member states - 17 countries</p> <p><b>Modeling technique:</b> analyzing indicators of Exp., Res. And socio-economic fragility</p>	<p>Reveals that there was an increase in migration after hurricane and an increased flow of remittances (e.g. remittances constituted 87% of their income for the poorest deciles in Jamaica). The poor suffers the most in times of a disaster with women constituting 70% of the world's estimated 1.3 billion poor and at least 40% of households are headed by females in Jamaica i.e. women tend to be more vulnerable to disasters.</p>
19	<p><b>Author:</b> Masozera et al (2007)</p> <p><b>Publication:</b> Ecological Economics</p> <p><b>Study area:</b> New Orleans</p> <p><b>Natural Disaster:</b> Hurricane Katrina</p>	<p><b>Database used:</b> US Census Bureau, American Community Survey, 2004</p> <p><b>Time period:</b> Aftermath of Hurricane Katrina (2005)</p>	<p><b>Sample size:</b> New Orleans, (2002 population 484,674)</p> <p><b>Modeling technique:</b> GIS technology, vulnerability analysis</p>	<p>Findings indicate that lower income groups were more vulnerable during the response and recovery phases. Analysis points out that pre-existing socio-economic conditions i.e. those with the fewest resources and least mobility suffered disproportionately in the aftermath of a natural disaster.</p>
20	<p><b>Author:</b> Tiwari et al (2013)</p> <p><b>Publication:</b> Policy Research Working Paper 6395, World Bank</p> <p><b>Study area:</b> rural Nepal</p> <p><b>Natural Disaster:</b> Rainfall shocks</p>	<p><b>Database used:</b> Demographic and Health Survey (DHS), DHM (171 rainfall stations)</p> <p><b>Time period:</b> 2001, 2006 and 2011</p>	<p><b>Sample size:</b> 2001 (8602 HH), 2006 (9036 HH) and 2011 (10,826 HH)</p> <p><b>Modeling technique:</b> OLS estimation, logical deviation used</p>	<p>Findings suggest that a 10% increase in rainfall from historic norms leads to a 0.15 st. dev. increase in weight-for-age for children ages 0–36 months. This total impact consists of a negative 'disease environment effect' of no more than 0.02 st. dev. and a positive 'income effect' as high as 0.17 st. dev. Consistently, excess monsoon rainfall also enhances child stature iff the monsoon rainfall shock is experienced in the second year of life. Additionally, this transitory child height effect completely dissipates by age 5.</p>
21	<p><b>Author:</b> Silbert and Pilar Useche (2012)</p> <p><b>Publication:</b> PURC Working Paper, University of Florida</p> <p><b>Study area:</b> Indonesia</p> <p><b>Natural Disaster:</b> ND (FI, Q, MMw), Asian Financial Crisis (Economic Shock)</p>	<p><b>Database used:</b> IFLS (Indonesian Family Life Surveys); EM-DAT</p> <p><b>Time period:</b> 1997, 2000 and 2007, over 10 years</p>	<p><b>Sample size:</b> 3269 HH</p> <p><b>Modeling technique:</b> Estimation of Ligon and Schechter(LS) measure, Housing Quality Index (income)</p>	<p>Evidences show that current poverty status is smaller than LS, contributing 40% to vulnerability to poverty. Households' experiencing disaster between 1992-1997 significantly increases vulnerability to future poverty (by nearly 68%) compared to households experiencing a disaster shock between 1995-2000 are 36% less vulnerable to poverty. Households with low endowments of assets (housing, animals), human capital (education), and self-insurance mechanisms (savings, pensioners) are most vulnerable to poverty but more able to cope in times of greater social protection and improving macroeconomic indicators.</p>

22	<p><b>Author:</b> Wong and Brown (2011)</p> <p><b>Publication:</b> B.E. Journal of Economic Analysis and Policy</p> <p><b>Study area:</b> Indonesia</p> <p><b>Natural Disaster:</b> Forest Fire</p>	<p><b>Database used:</b> EM-DAT; IFLS (1993, 1997)</p> <p><b>Time period:</b> 1997 Forest Fire, HH data- 1993 and 1997</p>	<p><b>Sample size:</b> 7224 HH</p> <p><b>Modeling technique:</b> Ligon and Schechter(LS) measure, Estimation of OLS Model</p>	<p>Evidences show that farm households face a 32.4% increase in vulnerability in food consumption relative to non-farm households (1% sig. level). Households with heads who graduated from secondary schools face 51.5% less vulnerability (5% sig. level) and 56.20% less poverty than those with heads who graduated from universities. Male headed households are less vulnerable with a reduction in vulnerability of 25.7%. Moreover, households who own farm businesses face 49.2% more vulnerability than non-farm households with 57.8% risk increase from poverty.</p>
23	<p><b>Author:</b> P.D.Little et al (2006)</p> <p><b>Publication:</b> Journal of Development Studies</p> <p><b>Study area:</b> South Wollo, Ethiopia</p> <p><b>Natural Disaster:</b> Drought</p>	<p><b>Database used:</b> Quantitative and Qualitative data (study -7 rounds,detailed interviews)</p> <p><b>Time period:</b> B/T 2000 and 2003, 62 case studies; recall data 1997-99</p>	<p><b>Sample size:</b> 416 HH, random selection</p> <p><b>Modeling technique:</b> Estimating and analyzing larger sample, group interviews and smaller case study HH</p>	<p>Findings show that the 1999–2000 droughts had a devastating short-term impact on households, particularly among the poorest, but did not increase overall rates of poverty in medium term. A large percentage of poor households actively pursue a range of different economic activities allowing most to attain their pre-drought wealth status without escaping poverty. The greater the dependence on rain fed agriculture-based incomes and less diversification, the greater the risk of poverty.</p>
24	<p><b>Author:</b> Holland et al (2009)</p> <p><b>Publication:</b> SOPAC Miscellaneous Report 678, UNISDR</p> <p><b>Study area:</b> Fiji</p> <p><b>Natural Disaster:</b> Tropical cyclones and floods</p>	<p><b>Database used:</b> NDMO, EM-DAT, GLIDE, FMS and Pacific Disaster Net; HIES, HDI, HPI and IFS database</p> <p><b>Time period:</b> 1990 - 2002</p>	<p><b>Sample size:</b> N = 8,35,869</p> <p><b>Modeling technique:</b> OLS regression</p>	<p>Results confirm the existence of a complex two way relationship between disaster and economic and social wellbeing in Fiji. Regression analysis indicates a neg. relationship between the HDI and disasters (R2 0.7). Therefore, a decrease in HDI means higher poverty levels. In addition, disaster increases poverty although poverty is influenced by numerous other factors.</p>
25	<p><b>Author:</b> Reardon and Taylor (1996)</p> <p><b>Publication:</b> World Development</p> <p><b>Study area:</b> Burkina Faso</p> <p><b>Natural Disaster:</b> Agroclimatic Shock (severe drought)</p>	<p><b>Database used:</b> House Hold-Farm survey data (ICRISAT)</p> <p><b>Time period:</b> 1983-84, 1984-85</p>	<p><b>Sample size:</b> 150 HH, 25 per vill.</p> <p><b>Modeling technique:</b> Income source decomposition (GINI), Foster-Greer-Thorbecke (FGT) poverty index</p>	<p>Results show that in the <i>Sahelian</i> zone (poorest agro climate and most diversified incomes) inequality decreases but poverty increases after drought. Contrarily, in the <i>Guinean</i> zone (superior agro climate), poverty and inequality are positively related. During drought, both increase and absolute poverty level are highest in <i>Sahelian</i> zone, where P rises to 0.19 and more than 50% of households are in poverty. The <i>Sahelian</i> zone experiences a 250% increase in number of households in poverty and nearly 10 fold increase in poverty level as measured by FGT index.</p>
26	<p><b>Author:</b> Jha, Raghbendra (2006)</p> <p><b>Publication:</b> Australia South Asia Research Centre, ANU</p>	<p><b>Database used:</b> WDI (2005); EM-DAT</p>	<p><b>Sample size:</b> N= Fiji (.84 mill.),the Kyrgyz rep. (5.1 mill.), PNG (5.5 mill.)and Vanuatu (.21 mill.)</p>	<p>Analysis show that if consumption continued at an average pace, over MDG to be attained in 2015, Fiji would experience a net drop in per capita consumption of 22.74%. In Kyrgyz republic the drop would have been 17.14%. However, in case of Papua New Guinea, there would have been a rise in per capita consumption</p>

	<p><b>Study area:</b> Fiji, the Kyrgyz rep., PNG and Vanuatu</p> <p><b>Natural Disaster:</b> ND (Earthquakes, Slides, Floods and Windstorms)</p>	<p><b>Time period:</b> Fiji (1960-85, 1997-99), the Kyrgyz rep. (1990-2003), PNG (1961-1999) and Vanuatu (1983-1995)</p>	<p><b>Modeling technique:</b> Certainty-Equivalent Consumption Growth, macroeconomic aggregates (corresponding ND)</p>	<p>of 33.03% in 2015 over its value in 1999. In Vanuatu, per capita consumption would have grown by 2.67% over the period 1995–2015. Certainty equivalent consumption growth are found to be lower (negative, in some cases) than average real per capita consumption growth.</p>
27	<p><b>Author:</b> Neumayer and Plumper (2007)</p> <p><b>Publication:</b> Annals of the Association of American Geographers</p> <p><b>Study area:</b> Global</p> <p><b>Natural Disaster:</b> ND (D, Q, Epi, Ext. temp, Fam, Fir, Fl, Ins. Infes, L, V, S and Ws)</p>	<p><b>Database used:</b> EM-DAT; International Data Base (IDB) of US Census Bureau, WB</p> <p><b>Time period:</b> 1981 - 2002</p>	<p><b>Sample size:</b> 141 Countries, 4605 Natural Disasters</p> <p><b>Modeling technique:</b> OLS regression</p>	<p>Evidences show that on average natural disasters lower the life expectancy of women and in cases at an earlier age compared to men. This contrasts with the assumption that female life expectancy is generally higher than that of males. Disaster strength (approximated by the number of people killed relative to population size) is positively related with gender gap in life expectancy. However, this effect on gender gap deteriorates with the higher level of women's socioeconomic status.</p>
28	<p><b>Author:</b> Jakobsen (2012)</p> <p><b>Publication:</b> World Development</p> <p><b>Study area:</b> rural Nicaragua</p> <p><b>Natural Disaster:</b> Hurricane Mitch</p>	<p><b>Database used:</b> Nicaraguan Living Standards Measurement Studies (LSMSs)</p> <p><b>Time period:</b> 1998, 1999 and 2001</p>	<p><b>Sample size:</b> 3000 HH</p> <p><b>Modeling technique:</b> Multi-step methodology (Differences-in-Difference)</p>	<p>Evidence suggests that the hurricane did not have an adverse impact on the ownership of productive assets among the affected households on average. However, non-productive asset holdings seem to have significantly reduced affecting the poorest households disproportionately.</p>
29	<p><b>Author:</b> Kahn et al (2012)</p> <p><b>Publication:</b> American Economic Review</p> <p><b>Study area:</b> 467 SEA (State Economic Area)</p> <p><b>Natural Disaster:</b> ND (Fl, Q, H, T)</p>	<p><b>Database used:</b> Disaster data (American Red Cross –ARC circulars) Migration data- setting up two panel datasets from 1920-30 and 1935-40.</p> <p><b>Time period:</b> 1920-1940</p>	<p><b>Sample size:</b> 15000 randomly selected men</p> <p><b>Modeling technique:</b> Conditional Logit Models of Migration</p>	<p>Findings indicate that in the 1920s and 1930s population were repelled from tornado-prone areas with a larger effect on potential in-migrants than on existing residents, while flood events were associated with net in-migration.</p>

30	<p><b>Author:</b> Mueller and Osgood (2009)</p> <p><b>Publication:</b> Journal of Development Studies</p> <p><b>Study area:</b> Brazil</p> <p><b>Natural Disaster:</b> Drought</p>	<p><b>Database used:</b> Brazilian National Household Surveys,</p> <p>Climate data- International Research Institute for Climate and Society Data</p> <p><b>Time period:</b> 1992,1993 and 1995</p>	<p><b>Sample size:</b> 300,000 individuals,</p> <p>13,197 weather stations</p> <p><b>Modeling technique:</b> Reduced-form regression analysis</p>	<p>Results show that an increase in the standard deviation below the mean of precipitation can have an 18% effect on rural wages within 5 years of drought and a 9% effect on rural wages within 5-10 years of drought.</p>
31	<p><b>Author:</b> Mueller and Qisumbing (2011)</p> <p><b>Publication:</b> Journal of Development Studies</p> <p><b>Study area:</b> Bangladesh</p> <p><b>Natural Disaster:</b> Flood</p>	<p><b>Database used:</b> Bangladesh Flood Impact panel household survey</p> <p><b>Time period:</b> November 1998 to May 2004</p>	<p><b>Sample size:</b> 757 HH (126 villages)</p> <p><b>Modeling technique:</b> Pooled Ordinary Least Squares (OLS) Regression</p>	<p>Analysis suggests that real wages of casual and salaried agricultural workers declined only in the short-term, while magnitude of the salaried income losses was sufficiently high (between 34.3% and 45.6%), wages stabilized over time.</p>
32	<p><b>Author:</b> Shah and Steinberg (2012)</p> <p><b>Publication:</b> University of California, Davis</p> <p><b>Study area:</b> India</p> <p><b>Natural Disaster:</b> Rainfall shocks (positive and negative)</p>	<p><b>Database used:</b> Rainfall data-University of Delaware</p> <p>Schooling and Health data- Annual Status of Education Report (ASER)</p> <p>Wages data-National Sample Survey (NSS)</p> <p><b>Time period:</b> 2005-2009</p>	<p><b>Sample size:</b> Around 3 million rural children</p> <p><b>Modeling technique:</b> Regression analysis</p>	<p>Evidence shows that children and parents work less and have lower wages in drought years and the reverse holds true for positive rainfall shocks. The study further pointed out that early-life exposure to droughts has deleterious effects on health, schooling and later-life wages.</p>
33	<p><b>Author:</b> Foltz et al (2013)</p> <p><b>Publication:</b> American Agricultural and Applied Economics Association meeting presentation</p> <p><b>Study area:</b> Ethiopia</p> <p><b>Natural Disaster:</b> Drought, Rainfall and Temperature</p>	<p><b>Database used:</b> Ethiopia Rural Household Survey (ERHS)</p> <p><b>Time period:</b> 1995-2009</p>	<p><b>Sample size:</b> 15 collection of villages</p> <p><b>Modeling technique:</b> Logit regression analysis</p>	<p>Findings suggest that food and non-food consumption are a direct function of weather in Ethiopia and being in a vulnerable area may not actually result in being worse-off relative to being poor in a non-vulnerable area.</p>

34	<p><b>Author:</b> Thomas et al (2010)</p> <p><b>Publication:</b> Policy Research Working Paper (World Bank)</p> <p><b>Study area:</b> Vietnam</p> <p><b>Natural Disaster:</b> Droughts, Floods and Cyclones</p>	<p><b>Database used:</b> Geo-referenced meteorological data, National Living Standard Measurement Surveys</p> <p><b>Time period:</b> 2002, 2004 and 2006</p>	<p><b>Sample size:</b> population over 500,000</p> <p><b>Modeling technique:</b> Reduced form regression analysis</p>	<p>Results indicate that short-run losses from natural disasters can be substantial, with riverine floods causing welfare losses up to 23% and hurricanes reducing welfare by up to 52% inside cities with a population over 500,000.</p>
35	<p><b>Author:</b> Skoufias et al (2011)</p> <p><b>Publication:</b> Policy Research Working Paper (World Bank)</p> <p><b>Study area:</b> rural Indonesia</p> <p><b>Natural Disaster:</b> Rainfall shocks</p>	<p><b>Database used:</b> IFLS2 and IFLS3, 32 weather stations</p> <p><b>Time period:</b> 1997-1998, 2000</p>	<p><b>Sample size:</b> 267 communities</p> <p><b>Modeling technique:</b> Regression analysis</p>	<p>Findings suggest that a delay in the monsoon onset does not have a significant impact on the welfare of rice farmers although households located in areas exposed to low rainfall following the monsoon are negatively affected.</p>
36	<p><b>Author:</b> Shoji (2009)</p> <p><b>Publication:</b> Journal of Development Studies</p> <p><b>Study area:</b> Bangladesh</p> <p><b>Natural Disaster:</b> Floods</p>	<p><b>Database used:</b> unique dataset collected from follow-up survey by IFPRI (International Food Policy Research Institute)</p> <p><b>Time period:</b> 2004-2005</p>	<p><b>Sample size:</b> 326 HH</p> <p><b>Modeling technique:</b> Recursive Bivariate Probit model estimation</p>	<p>Results show that rescheduling plays the role of safety net by decreasing the probability that people skip meals during negative shocks by 5.1% and the effect is even higher on the landless and females.</p>
37	<p><b>Author:</b> Baez and Santos (2008)</p> <p><b>Publication:</b> UNDP Research for Public Policy papers</p> <p><b>Study area:</b> El Salvador</p> <p><b>Natural Disaster:</b> Earthquake</p>	<p><b>Database used:</b> BASIS El Salvador Rural Household Surveys</p> <p><b>Time period:</b> 1996-2002</p>	<p><b>Sample size:</b> 700 HH</p> <p><b>Modeling technique:</b> Econometric estimation (Double-Difference) analysis</p>	<p>Evidence suggests that effect of both earthquakes is associated with a reduction in household income per capita of one-third of the pre shock average for households in the upper half of the ground shaking distribution. The results further define an increase in the depth and severity of poverty and the pervasive effects are likely to persist in medium to long-term.</p>

38	<p><b>Author:</b> Patnaik and Narayanan (2010)</p> <p><b>Publication:</b> Munich Personal RePEc Archive</p> <p><b>Study area:</b> Uttar Pradesh, India</p> <p><b>Natural Disaster:</b> Floods</p>	<p><b>Database used:</b> Primary Household Survey data collection; EM-DAT</p> <p><b>Time period:</b> 1950-2007</p>	<p><b>Sample size:</b> 600 villages</p> <p><b>Modeling technique:</b> multivariate probit model estimation</p>	<p>Results show that households adopt a wide variety of risk coping measures e.g. receiving monetary transfers, relief, selling of livestock and borrowing. The study also highlighted that monetary transfers are the most effective means of coping strategies but unlikely to be used to cope with health shocks in the study area.</p>
39	<p><b>Author:</b> Janzen and Carter (2013)</p> <p><b>Publication:</b> University of California, Davis</p> <p><b>Study area:</b> Kenya</p> <p><b>Natural Disaster:</b> Drought</p>	<p><b>Database used:</b> Index-based Livestock Insurance (IBLI) pilot project data</p> <p><b>Time period:</b> 2009, 2011</p>	<p><b>Sample size:</b> 924 HH</p> <p><b>Modeling technique:</b> Difference-in-Difference equation estimation</p>	<p>Findings indicate that insured households are 18-50 percentage points less likely to draw down assets and 8-41 percentage points less likely to reduce meals compared to uninsured households.</p>
40	<p><b>Author:</b> Yamamura (2013)</p> <p><b>Publication:</b> Munich Personal RePEc Archive</p> <p><b>Study area:</b> Global</p> <p><b>Natural Disaster:</b> Natural occurrence of events, in general</p>	<p><b>Database used:</b> Standardized Income Distribution Database (SIDDI); EM-DAT</p> <p><b>Time period:</b> 1965-2004</p>	<p><b>Sample size:</b> 86 countries</p> <p><b>Modeling technique:</b> Regression analysis</p>	<p>Evidence suggests that natural disasters have increased income inequality in the short-term. Interestingly, it has further been reported that this effect disappears in the medium-term.</p>

*Notes:* The acronyms used above are explained as follows: TIA (Trabalho de Inquérito Agrícola – National Agricultural Survey), LSMS (Living Standard Measurement Survey), QPES (Qualitative Poverty and Exclusion Field Study), ENCOVI (Encuesta Nacional de Condiciones de Vida), APIS (Annual Poverty Indicators Survey), FIES (Family Income and Expenditure Survey), DHS (Demographic and Health Survey), EM-DAT (Emergency Events Database), DESINVENTAR (Disaster Information Management System), HDI, UNDP (United Nations Development Programme), UNISDR (United Nations International Strategy for Disaster Reduction), IUCN (World Conservation Union), ECLAC (Economic Commission for Latin America and the Caribbean), BASIS (fielded by the Ohio State University and the Fundación Salvadoreña para el Desarrollo Económico y Social (FUSADES)), IFLS (Indonesian Family Life Survey), GHCN (Global Historical Climatology Network), CARICOM (Caribbean Community Secretariat), DHM (Department of Hydrology and Meteorology), NDMO (National Disaster Management Office), GLIDE (Global Identifier Number), FMS (Fiji Meteorological Service), HIES (Household Income Expenditure Survey), HPI (Human Poverty Index), IFS (International Financial Statistics), ICRISAT (International Crops Research Institute for the Semi-Arid Tropics), WDI (World Development Indicators), WB (World Bank), dc (data card), OLS (Ordinary Least Squares), ND (Natural Disaster) - (D-Drought, H-Hurricane, FI-Flood, Fr-Frost, R-Rainfall, L-Landslide, Lq-Liquefaction, W-Wave-cold and heat, Q-Quakes, S-Snowstorms, MMw-Mass Movement wet, Epi-Epidemics, Ext.temp-Extreme Temperature, Fir-Fires, Fam-Famines, Ins. Infes – Insect Infestations, V-Volcano, S-surges, Ws-Windstorms, T- Tornado, Os-Others), HH (Household).