

Conferencia Interamericana de Seguridad Social



**Centro Interamericano de
Estudios de Seguridad Social**

Este documento forma parte de la producción editorial de la Conferencia Interamericana de Seguridad Social (CISS)

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NATURAL DISASTERS AND POVERTY IN LATIN AMERICA: WELFARE IMPACTS AND SOCIAL PROTECTION SOLUTIONS

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Introduction

Latin American countries are in constant (and ever increasing) peril of natural hazards. Only last year Mexico underwent its worst drought in six decades, and suffered historical losses in 2010 due to hurricane Alex in northeastern Mexico and then serious floods in various southern states. Chile drew worldwide attention (along with Haiti some weeks before) for the earthquake that occurred off its coast in late February 2010, one of the strongest earthquakes ever recorded.

While asserting that natural disasters decrease welfare (and therefore increase poverty) seems obvious, proving this in a credible way has long proved challenging, and more so in the long-run. Even without fully understanding the extent and channels through which disasters can leave permanent scars on their victims, it has been commonly asserted that disaster prevention pays off. Many interventions prior to, and following disasters have focused on investments to improve basic infrastructure, such as climate-proofing roads and bridges. Valuable as this is, there has been insufficient attention to people-oriented investments such as livelihood protection.

Within this context, the Inter-American Conference on Social Security (*CISS*) and the United Nations Development Programme (UNDP) Office in Mexico jointly organized the conference “Natural Disasters in Latin America: Welfare Impacts and Social Protection Solutions” held in Mexico City in January 2010. The main objectives of the conference were to improve the understanding of (i) how natural disasters affect household’s welfare, and (ii) how can social protection better protect livelihoods against disaster impacts.

This volume presents five papers from the above conference. Three case studies which analyze how natural disasters affect poverty in the short and long-run, and two policy papers that discuss country experiences in the region and elsewhere to show how social protection mechanisms (one paper emphasizing conditional cash transfer programs), can shield households from natural disasters.

* I would like to thank Margaret Arnold for her comments on an earlier draft of this paper.

1. An Organizing Framework

Latin America lies within one of the world's most active seismic regions—the Pacific Ring of Fire. Mexico, Central America and western South America are also in the path of hurricanes and tropical storms originating in the Caribbean Sea, Atlantic and Pacific Oceans; and drought is widely dispersed across the regions' semiarid tropics. Moreover, recent evidence and predictions indicate that in many parts of Latin America, variability in rainfall and temperatures driven by climate change are already affecting agricultural production and food security (e.g., Baez and Mason 2008; De la Torre, Fajnzylber, and Nash 2009).

Many hazard-prone countries and areas in Latin America are also densely populated and developed, leading to high degrees of population and GDP exposure: According to the World Bank natural disaster hotspots study (Dilley, et al. 2005), eight of the thirty most exposed countries to multiple natural hazards worldwide, in terms of population at risk are in Latin America (see Table 1). Such exposure to hazards will likely remain in urban areas as people and economic assets will continue concentrating in cities through population growth, migration, urbanization and economic development. Latin America is one of the most urbanized regions of the world, and about 150 million people are expected to live in earthquake-prone areas within Latin America and the Caribbean by 2050. Similarly, while the share of agriculture in regional GDP has declined over the last three decades, countries such as Honduras and Guatemala still have more than half of their populations residing in rural areas (Baez and Mason 2008).

Of course, the greater density and exposure of people and economic activities to hazards needs not become a disaster, especially when households and communities have adequate preparations. Safely built housing and strong physical infrastructure reduce (physical) vulnerability, as does the ability to evacuate communities during a cyclone, which is a sign of institutional strength. If the hazard turning into disaster cannot be prevented, credit and private savings from borrowing schemes with friends and neighbors kick in to absorb the event's impacts, as well as transfers from relatives. Governments and donors provide relief, emergency medical assistance and temporary shelters. However, private and public mechanisms for managing disaster risk hardly ever fully protect households from adverse impacts. Natural hazards can still bring about death, injury, disruption of socio-economic activities and damage or destruction to property, crops, livestock, natural resources and other physical assets, pushing people into sudden poverty.

In sum, disasters stem from (a) the **exposure** of households and economic assets to natural hazards, which are natural events with potentially damaging consequences, and (b) their **vulnerability** to suffer losses from hazards given this exposure. People and economies can take measures prior to hazards to reduce their vulnerability or after the disaster to absorb the losses and recover. **Economic and welfare impacts** will be determined by this capacity to prevent disasters or resist losses.

Table 1
Latin American and Caribbean Countries in Areas at Risk from Two or More Hazards

Position in global ranking (% of population in areas at risk)	Country	% of total area at risk	% of population in areas at risk	% of GDP in areas at risk	GDP in billions
1	Jamaica	94.9	96.3	96.3	8
4	El Salvador	88.7	95.4	96.4	16
6	Dominican Republic	87.2	94.7	95.6	19
8	Guatemala	52.7	92.1	92.2	27
10	Costa Rica	51.9	84.8	86.6	18
11	Colombia	21.2	84.7	86.6	97
14	Trinidad and Tobago	66.7	82.4	83.1	13
17	Antigua and Barbuda	53.4	80.4	80.4	1
18	Barbados	79.9	79.9	79.9	
21	Ecuador	24.4	73.6	72.2	30
24	Nicaragua	21.6	68.7	67.9	4
25	Mexico	15.9	68.2	71.1	676
27	Dominica	68.3	67	68.3	
29	Chile	5.2	64.9	67.7	94
34	Venezuela	4.9	61.2	65.9	109
37	Argentina	1.8	57.4	63.2	152
40	Honduras	19	56	56.5	7
42	Uruguay	3	55	55	13
55	Haiti	44.4	47.9	56	4
66	Peru	4	41.5	53.7	68

Source: Natural Disaster Hotspots: A Global Risk Analysis (Dilley et al. 2005); World Development Indicators (WDI) 2004; For some countries, GDP estimates are not available.

2. Welfare Impacts of Disasters: Empirical Challenges and Short-Run Evidence

Estimating the causal impact of natural disasters on poverty is complex. As discussed in De la Fuente, et al. (2008), a first challenge is the existence of double causality: Poverty can drive people to settle in harm's way (steep slopes, squatter settlements), and affect the intensity of hazard

impacts on them, but hazard impacts can also impoverish people. Addressing this identification problem requires datasets that span over time to know what happens before and after the disaster, and to account for baseline characteristics that can make some households more susceptible to hazards than others.

The analysis of disaster impacts on poverty also requires identification strategies that exploit the variation in exposure to natural disasters (or their intensity). Often such identification is hard to attain because household surveys, the standard tools for measuring poverty, lack questions on disasters upon which one can create counterfactuals to explore actual impacts (What would have happened to a household if the shock had not occurred?), or surveyed areas may not have experienced a disaster at all.

In some cases, data has been collected prior to and following serious disasters, so lessons can be learned on their short-run impact. Premand (in this volume) relies on survey data collected before and after Hurricane Mitch struck Nicaraguan agricultural households in October 1998. Data was obtained from a nationally representative panel fielded in 1998 and 2001, plus an additional round in 1999 for households from the panel affected by the hurricane (though not representative of the country nor the population affected by Mitch). The 1999 survey contains self-reported measures of hurricane-induced floods and displacement as well as economic losses. The author also compiled satellite rainfall records interpolated at the municipal level to capture the intensity of the hurricane, mending potential biases in self-reporting hazard severity.

The first part of the paper tries to identify the average impact of the hurricane using a consumption growth model between 1998 and 1999. Estimates reveal that households having suffered a flood (caused by Mitch), but not self-reported losses or exogenous rainfall, had a growth rate 20% lower than other households. This interpretation is very cautious and contemplates that households who left the panel between 1998 and 1999 are not those who suffered most from the hurricane. According to the author, the absence of significant effects from the rainfall variable is plausible despite the earlier result because the affecting floods mainly happened due to river overflows, which can be driven by rainfall in other municipalities.

Mitch's medium term impact is then analyzed using a difference-in-difference methodology. For this, the author uses the "1998-2001" panel, with households re-surveyed in 1999 (because they were located in regions affected by Mitch) forming the treatment group. Control variables were included to account for pre-shock observed differences between treated and comparison households. No significant medium-term effect of households located in municipalities affected by the hurricane were identified.

Indeed, disaster impacts can last a few weeks or months. If remedial action is taken right after the disaster, the consumption drops or income losses observed can be smoothed leading to rapid recovery. Likewise, public health interventions can stabilize morbidity surges. So while formal and informal coping mechanisms were not formally assessed by Premand, a possible interpretation from his results could be that existing mitigation mechanisms prevented adverse welfare effects in the medium run.

On the contrary, when households have few assets to protect themselves during hardship, and public protective measures come too late, the negative and seemingly transitory effects on their members can become permanent disadvantages. For instance, nutrition shortfalls in children may affect their human development later in life. Coping strategies that appear to be temporary adjustments to difficult times, such as withdrawing children from school to get them to work or depleting available productive assets, can become permanent shifts with high costs in the future.

Related work on Mitch in Nicaragua has found asset liquidation (Carter et al. 2007) and diminution of investments in children's human capital (Baez and Santos 2007) in response to the hurricane. In fact, as Table 2 shows, many studies in Latin America have documented short-run impacts from disasters on households' human capital, including increases in morbidity (De la Fuente and Fuentes 2010), and child labor (Santos 2007; Baez and Santos 2007; Vakis, Kruger and Mason 2004), and reductions in nutrition (Baez and Santos 2007), and school attendance (Santos 2007; de Janvry et al. 2006; Ureta 2005). This is worrisome because damage from natural hazards to human and physical capital can undermine the capacity of households to earn a living (Clark and Hulme 2005), leading to sluggish consumption growth and earnings many years after the shock.

Table 2
Welfare Impacts of Natural Disasters in Latin America
Selected Cases

Country	Unit of observation	Short-run impact	Natural hazard	Data	Main results
El Salvador (Baez & Santos 2009)	Households	Changes in households' income.	2001 Earthquakes.	Two-wave panel (2000-2002).	Earthquakes were associated with a reduction of \$1,760 <i>colones</i> —a third of pre-shock average per capita income.
Nicaragua (Baez & Santos 2007)	Households	Changes in schooling, child labor, health and nutritional outcomes between 1998 and 2001 among children in regions directly hit by Mitch compared to children in control areas.	Hurricane Mitch in 1998.	Three-wave panel (1998-2001).	Children in regions hit by Mitch were 8.7 percentage points more likely to be undernourished. Labor force participation increased by 58% among children in areas affected by the hurricane, and the proportion of children both enrolled in school and working more than doubled.
Mexico (De la Fuente & Fuentes 2010)	Children (0-5)	Change in the probability of experiencing disease for children in households affected by a natural disaster.	Droughts, Earthquakes, floods, and frost.	Five-wave panel (1998-2000).	Odds of disease for children in households suffering a drought were 1.15-1.36 times greater than for non-affected children.

Table 2 (continued)

Country	Unit of observation	Short-run impact	Natural hazard	Data	Main results
El Salvador (Santos 2007)	Households	Changes in child labor, health and nutritional outcomes among children in regions struck by earthquakes.	2001 Earthquakes.	Two-wave panel (2000-2002).	Conditional on being sick - children in affected areas were 30% less likely to be taken for medical consultation. Children in households most affected by the earthquakes were almost three times more likely to work (from 6.5% to 16.5%) after the shock.
Nicaragua (Premand in this volume)	Households	Changes in households' consumption	Hurricane Mitch in 1998.	Three-wave panel (1998-2001).	Households that suffered a flood caused by Mitch, had a growth rate 20% lower than non-affected households.
Mexico (De Janvry et al. 2006)	Households	Probability of school enrollment for children from 8-16 during academic years 1998/99 and 1999/2000.	Droughts.	Four-wave panel (1998-2000).	Primary children withdrawn from school during shocks were about 11 percent less likely to continue studying the next semester compared to children who stood in school.
Country	Unit of observation	Long-run impact	Natural hazard	Data	Main results
Peru (Rosemberg et al. in this volume)	Households	Probability of staying in chronic poverty between 2002-2006.	Natural disasters.	Five-wave panel (2002-06).	The probability of being "always poor" is 2.3-4.8 times higher than to be "never poor" for those households that experienced a natural disaster.

Table 2 (continued)

Country	Unit of observation	Long-run impact	Natural hazard	Data	Main results
Mexico (Rodriguez-Oreggia et al. 2010)	Municipalities	Changes in poverty levels and Human Development Index between 2000-2005.	Droughts, earthquakes, floods, and hurricanes.	Two-wave geographical panel (2000-05).	Human Development Index drops by about -0.0068 on average (equivalent to losing on average 2 years of human development gains over the same period) in disaster-affected municipalities. Poverty levels increased between 1.5-3.7 percent, depending on the measure considered, with floods and droughts being the most significant events affecting poverty.
Nicaragua (Premand & Vakis in this volume)	Households	Downward consumption-poverty trajectories and poverty persistence between 1998-2005.	Hurricane Mitch, droughts, floods.	Three-wave panel (1998-2005).	Droughts between 1998 and 2001 increase the probability of downward trajectories by 20%, the strongest impact, and bring a probability higher by 14% to remain at the bottom of the welfare distribution in 2005.
Brazil (Mueller & Osgood 2009)	Households	Impact of weather variability in the long-term earnings of households that permanently migrated out of agriculture in Brazil driven by droughts.	Droughts between mid 1980s and mid 1990s.	Cross-sectional panel.	An increase in the average number of standard deviations below mean rainfall reduced rural earnings by 17.7 percent in the following five years and by 26.3 between the fifth and tenth year.

Source: Own elaboration.

3. Disasters Can Lead to Poverty Persistence

If studying the short-run impact of disasters has to be often opportunistic, more so is the study of their long-run impacts. Few household panels in Latin American countries comprise more than two rounds of data and spanning over long periods of time. The works in this volume by Rosemberg, Fort and Glave (for rural Peru) and Premand and Vakis (for Nicaragua) comply with both characteristics.

Rosemberg et al. (in this volume) explore the relationship between natural hazards and household poverty dynamics in Peru. The analysis employs the national household survey *ENAHO*, which provides five periods of consumption data between 2002-2006, with information for 2,091 rural households. It also includes information on durables, productive assets and the incidence (Did you experience a natural disaster in the past 12 months? Yes or No), impact and responses to natural hazards.

The authors create poverty transition categories (non-poor, former poor, new poor, and chronic poor) and then model the probabilities of entering, exiting, remaining or staying out of poverty as a function of the hazards experienced by households and some household and community characteristics, based on multinomial logit regressions. According to their estimates, experiencing a natural disaster increases the chances that a household in their sample enters into or stays in poverty, relative to “never being poor”.

Assessing hazard impacts through dichotomous variables can make comparisons across households fairly uneven because their magnitudes are homogenized. The authors therefore discuss the potential limitations arising from using as an indicator of natural hazards such subjective question, and also provide information on the distribution of the answers to this question by multiple households characteristics to help the reader make up his/her mind on whether this is an appropriate indicator of natural hazards or not.

The loss of information that results from collapsing consumption or incomes into (binary) poverty transition categories remains a valid concern in their exercise. Focusing on poverty spells ignores dynamics between the base and terminal years, and hence does not distinguish between transitory and permanent trend effects or trajectories. For instance, a “sometimes poor” household can become very heterogeneous when there are more than two observations per household, as in the Peruvian case. The spells approach would equally label a household as transitorily poor if it falls below the poverty line twice than if it does four times. Hence, Rosemberg et al. also examine the effects of natural hazards on the growth of per capita consumption levels, and find negative impacts.

Premand and Vakis (in this volume) further adopt an original methodology to assess the medium-to-long-run impact of disasters on poverty without relying on binary poverty transition categories in their analysis. They examine whether shocks set households into downward consumption trajectories over time (mobility) or lock them in poverty (persistence), using a three-round panel of Nicaraguan households spanning 1998-2005. During this period, Nicaragua was severely hit by droughts, Hurricane Mitch, and drops in coffee prices.

The authors define welfare trajectories as a sequence of households' position along a welfare distribution over the three rounds of data. Household expenditure distributions in each round are divided into terciles. Therefore, for poverty persistence, they are interested in households that belonged to the lowest welfare tercile in all three rounds of data considered. While the initial cut-off by tercile is arbitrary, they focus on terciles because they loosely linked to Nicaragua's poverty lines, which adds some intuition in the interpretation. Moreover, the nature of their results does not change considering other cut-offs (using quintiles or other x-tiles).

To identify if shocks increase the probability of exhibiting poverty persistence or set off downward mobility, they use nearest neighbor matching techniques (complemented by probit regressions). This means that households similar on observable characteristics at the beginning of the panel, but who do not suffer from the same incidence of shocks, are compared.

After carefully constructing matching estimates, they confirm that shocks between 1998 and 2001 increase the probability that households suffer downward mobility and poverty persistence in their sample. More concretely, in those households that reported a drought in 2000-2001 the probability of experiencing a downward trajectory (from terciles 3 or 2) increased between 10-15%, the strongest impact; and for households already at the bottom of the welfare distribution (initially in the first tercile) drought brought a probability higher by around 10% to remain there in 2005, so did Hurricane Mitch by 7% and the drop in coffee prices between 1998 and 2001 by 8%.

Staying at the bottom is probably explained by the slow and incomplete recovery from shocks that characterizes poor households. Past work of Hurricane Mitch in Honduras has shown that the poor lost a greater share of assets during the disaster and recovered at a slower rate than the non-poor (Carter, et al. 2007). Similarly, an examination of income dynamics in El Salvador showed that the speed recovery from income shocks—some caused by natural disasters—was much lower for the poor households (Rodriguez-Meza 2004). Poor households, who already struggle to maintain their meager assets during disasters, are therefore put at risk of falling into or staying in poverty traps.

The evidence presented up to this instance relates to a temporal or permanent effect from shocks on poor households, but uninsured disaster risk (before disasters occur) can also lead households to adopt low-risk activities and asset portfolios at the expense of lower mean returns and incomes. Such tradeoffs were identified, for instance, between traditional potato and improved potato varieties for different types of plots in the Peruvian Andes (Bellon, Brush, and Taylor 1992). However, despite its relevance, this type of evidence is still scarce in the region.

In sum, the empirical papers in this volume reinforce the need to insure against risk. Uninsured risk increases poverty, through ex-ante behavioral responses, affecting activities, assets and technology choices (and for which knowledge gaps remain in Latin America), as well as through possibly permanent effects from transitory shocks via asset loss, malnutrition, child labor, and withdrawal from schooling. This is why effective risk management policies, including social protection measures, are needed.

4. Embedding Disaster Risk Management into Social Protection

Social Protection (SP) supports the poorer and more vulnerable by strengthening their assets and livelihoods, as well as improving their capacity to manage risk (Grosh et al. 2008). Examples include the provision of cash transfers, conditional and unconditional, workfare programs, food/nutrition aid, social insurance, social funds, and labor market policies. Many of these SP instruments already exist in Latin America, and could also help victims of a disaster (See de Janvry, Sadoulet and Vakis in this volume).

Traditionally, SP policies have been identified with disaster risk management only as emergency responses. But intervening only after hazards turn into disasters remains dangerous: support often comes at a fraction of what is needed, and may not reach those affected rapidly enough to protect long-earned welfare gains. As the last layer of response against disasters, if social protection fails the welfare consequences could be catastrophic.

Siegel and De la Fuente (in this volume) therefore advocate for advancing the planning and financing of social protection policies prior to hazards, so that these can be scaled up (for existing beneficiaries) and expanded (to include persons not benefitting from existing programs) during disasters. On the planning side, better information systems are needed to understand who is exposed to disaster risks; so that when these arrive victims get quick and relevant support. Clear and transparent rules for accessing funds for SP interventions are also crucial. For this, contingency funds and insurance payouts triggered by weather indices (level of precipitation, wind speed, etc) can make disbursements much predictable and faster.

A government with a well-functioning safety net against disasters should also leave as little residual risk as possible for SP to bear. Introducing measures that reduce the vulnerability of beneficiaries to natural hazards into social protection policies is one step in such direction. Some work in this respect has already started within safety nets and social insurance. Promising policies include the restoration of physical infrastructure (protective barriers) and environmental assets (reforestation) through public works to reduce communities' exposure to disasters; subsidized premiums conditional upon policy-holders adopting risk-reduction measures; livelihood cash transfers to help families diversify their livelihood activities and therefore exposure to risk; and microfinance products bundled with risk-reduction measures (e.g. housing improvement loans conditional on employing earthquake-resistant materials).

Now, introducing additional responsibilities and risk reduction measures into social protection actions could be contentious. Take the case of *Oportunidades*, the conditional cash-transfer program in Mexico. Numerous evaluations have confirmed its success in helping the poorest to accumulate human capital, but less so in granting an adequate transition into labor markets to its graduates (Rodriguez-Oreggia and Freije 2008). Hence, it is not self-evident that this flagship program of social policy in Mexico should expand its design to become a social protection instrument, instead of granting its youth "graduates" funds to continue into university-level studies or by connecting them to career-type employment opportunities; or simply remain faithful to its original mandate.

Yet, at the same time, *Oportunidades* requires the presence of a purpose-built safety-net that protects its accomplishments in human capital against shocks (i.e., prevent beneficiaries from resorting to adverse coping strategies such as child labor). De Janvry, Sadoulet and Vakis (in this volume) argue that CCTs themselves could serve this purpose, and at the same time avoid that non-poor, but highly vulnerable people to disasters fall into poverty by expanding support towards them when needed.

De Janvry and co-authors consider that many innovative program features already exist that could be integrated into existing or new CCT programs to give them an extended insurance function. They discuss three areas where doing this would require special attention: (i) eligibility of beneficiaries, (ii) program's effectiveness, and (iii) financial sustainability.

Oportunidades has already been performing as safety net against disasters through its cash-based component, but incidentally, not by design. Means-testing and geographic targeting for CCTs such as *Oportunidades* were conceived to identify the structurally poor (Skoufias 2003). New measures would be needed to identify those vulnerable to disasters (and likely to fall into temporary poverty). Eligible households could be determined prior to shocks using probability equations that render vulnerability scores (for instance, on the likelihood of dropping school due to a disaster). Under such modality, eligibility would only require to verify if the shock occurred, for instance, via weather-based indices. Alternatively, eligibility could be established after shocks occurred through the calculation of scores based on indicators sensitive to the occurrence of the shock. This would imply verifying if and to what extent people had been affected by a disaster.

Clear and transparent rules for receiving benefits are also fundamental for program effectiveness. If incumbents know that support will arrive when a disaster strikes, they might be encouraged to adopt investment decisions with a longer and more profitable perspective. And once the shock arrives, victims should have the certainty that benefits will arrive swiftly, ruling out the need for employing adverse coping strategies. Such credibility, and hence its risk-management value, can be reinforced through appeal and complaint mechanisms embedded into the program.

The authors also show that imposing school attendance as pre-condition for receiving cash transfers (versus unconditional transfer) prevents the decapitalization of child human capital. The transfer modality is also a key to success: cash injections give flexibility of use to beneficiaries and can be more cost-effective and timely if infrastructure and distribution technologies are in place whereas food aid is especially useful when there is non-availability or restricted access to food markets and surges in staple prices (De la Fuente 2010).

Program rules must discourage abuse to ensure financial sustainability; otherwise in contexts of stagnant growth and reduced employment opportunities, as found in many poor communities across Latin America, households may over-rely on public transfers at the expense of intensifying their own income-generating strategies. Limitations on the length and scope of benefits can encourage self-restraint and limit program abuse.

Finally, introducing mechanisms that foster graduation can strengthen the case for adding another layer of financial responsibility to the safety net. Providing skills and risk management instruments to help livelihoods diversify income and increase productivity can accelerate their exit from poverty and, in consequence, their reliance on anti-poverty programs.

Hazard risks and their transformation into disasters is a recurrent experience for many poor households in Latin America. The adverse impacts of disasters on consumption, nutrition, health and schooling are becoming increasingly well documented, and this volume contributes to such effort by providing some order of magnitude of those impacts, especially in the long-run. Civil and social protection authorities in many Latin American countries may be willing to become more proactive, but struggle to bring in relevant actors (finance ministries) when it comes to resource allocation. The provision of magnitudes on the poverty/disaster linkage and profiles of those likely affected, as papers in this volume do, could strengthen their cause. Hazard risk prevention requires myriad measures to work harmoniously together, and politicians may not always be willing to invest in preventive measures upfront and wait for their successor to reap the benefits. By contrast, social protection interventions (SP), which are deeply rooted in most Latin American countries and already help to assist disaster victims, can also serve to revamp the disaster prevention agenda without a radical redesign. This volume provides concrete ideas to improve and expand the protective function of conditional cash transfers and other safety net programs against disasters, but also to use them as a vehicle to promote people's livelihoods, thereby reducing the vulnerability to future hazards. Of course, a government that is well organized to have a good safety net may also be one that has taken sufficient prevention measures against a disaster.

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