The Future Harvest Foundation and CARE

Weathering Natural Disasters—Refocusing Relief and Development through Improved Agricultural and Environmental Practices

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Supported by USAID

June 2004

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1. Introduction

The world has suffered and largely withstood natural disasters throughout its long history. Today these "natural calamities" continue to wreak environmental havoc and cause much agricultural devastation. They displace and disrupt thousands of families in the poorest of nations, crippling what are often already woefully inadequate economic development efforts, and destroying infrastructure that was years in the making. They also impose staggering costs for relief and rehabilitation efforts. Nowhere is this more evident than in Southern Africa, where severe recurrent droughts have been affecting millions and have required massive shipments of food aid to avert catastrophe.[1] In Central America as well, drought-related food crises are affecting several million people.[2]

Few in the relief and development communities missed the terrible irony associated with the fact that the 1990s—designated by the United Nations as the International Decade for Natural Disaster Reduction—turned out to be the worst decade on record for natural disasters. But even these veterans found the frequency and intensity of the catastrophic events that occurred during the century's closing decade almost incomprehensible. Massive floods in China and Bangladesh affected hundreds of millions, while drought in the Horn of Africa affected some 3 million people, and a hurricane in Central America caused some 10,000 casualties and $10 billion in damages.[3] These were only a few instances among many horrendous events of a truly horrific decade.

Such tallies left many of those responsible for preparing and protecting the world from these devastating events increasingly frustrated and disheartened. If even the best efforts of the world's leading assistance agencies had been unable to keep up with—much less mitigate—the increasing onslaught of natural disasters, what solutions could they provide for the new millennium?

The impact of natural disasters is overwhelming and disproportionately severe in developing countries, many of which are already environmentally fragile, have rapidly increasing populations, and are economically underdeveloped. Disasters make the poor even poorer and further increase the susceptibility of their communities to future disasters. More alarming for these vulnerable peoples and those charged with helping them, are predictions that such catastrophic events are expected to occur with even greater frequency and intensity in the 21st Century.

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[1] World Food Programme, "UN Food Agency Approves $66 Million Aid Operation for Central America," Press Release: October 30, 2002): Countries affected in Southern Africa include Zambia, Zimbabwe, Malawi, Lesotho, Mozambique, and Swaziland, in Central America: Guatemala, El Salvador, Nicaragua, and Honduras. World Press Review, 49,10, 2003

[2] UNCCP Fact Sheet, May-2003

[3] Annual Report of International Federation of Red Cross and Red Crescent, 2000

It has long been known that agricultural development and sustainable natural resource management are critically linked to long-term economic growth, food security, and environmental renewal. Yet, these practices also contain the potential for mitigating, reducing, or preventing disasters. Yet, time and again, progress in agricultural development and environmental conservation, particularly in developing countries, is severely and instantly eroded by natural disasters. This cycle need not continue.

This study looks at how the international community can best take advantage of the critical linkages between relief, development, and natural resources management in the agriculture and environment sectors. It examines crucial connections researchers have discovered between development and natural disasters. The study explores current knowledge regarding factors that can increase a region's vulnerability to disaster; and assesses how disaster mitigation and reduction might best be achieved through sound agricultural development and environmental practices. It finds that *sustainable agriculture and natural resource management are inextricably linked and together are essential components of the disaster-reduction agenda in the developing world.*

Although weather-related natural disasters have always been a part of the global landscape, their marked increase over the last 15 years has resulted in enormous destruction, particularly damaging to the lives and livelihood of the rural poor. The study looks at this trend and the ways that climate and other weather hazards can undermine agriculture and degrade the environment. It also considers various strategies to reduce risks and enhance local capacity to cope with the long and short-term impact of natural disasters.

The study also examines some of the most recent thinking and literature in the relief and development sectors. It finds many experts emphasizing the connections between overpopulation, rapid urbanization, and poor environmental management choices. Others are focused on the links between global warming, climate change, and the increased intensity of weather-events. And some argue that the structure and delivery of humanitarian relief itself--through its primary focus on "temporary" relief efforts--has actually exacerbated the negative effects of disasters, often leading to chronic dependency and increased vulnerability.

Most relief and development communities agree, however, that the currently ingrained cycle of disaster, vulnerability, and dependence does not have to be the accepted norm. Increasing evidence suggests that appropriately designed humanitarian relief not only can meet the immediate needs of disaster victims, but can also lay the foundation for future sustainable development, thereby making communities more resilient and less vulnerable to future events. The data also show that disaster vulnerability assessments must become a critical part of ongoing development work, rather than an activity associated solely with relief activities. There is a growing agreement as well that the historically rigid separation

between relief and development activities needs to be moderated in order to ensure the new paradigms of "resilient development" and "developmental relief."

The study finds that disaster-sensitive agricultural development can greatly mitigate the impacts of natural disasters. Similarly, it makes the case for agricultural development relief, which can serve to meet the immediate relief needs of a community while simultaneously decreasing that community's vulnerability to future disasters by making it more self-reliant.

This evolution in thinking and practices is presented through a series of "snapshots from the field." The field reports gathered for the study serve to underscore the over-arching theme that agricultural development and environmental renewal of natural resources are intertwined and essential elements for mitigating the effects of future disasters in the developing world. These include powerful examples of famine prevention in Africa, flood proofing in Asia, and hurricane resiliency in Latin America from development, relief, and research organizations. The cases illustrate more effectively than any recitation of facts and figures on how appropriate disaster relief and development work can build local capacities in sustainable agriculture and natural resource management, while at the same time reducing a community's vulnerability to future natural hazards. Because this is an approach that is evolving and fluid, rather than pointing to firm conclusions, these instructive reports represent collaborative "works in progress" undertaken by the victims of natural disasters in concert with those attempting to provide them with sustainable relief and future economic development.

For such collaborative approaches to take hold and succeed, however, the relief and development communities must address and overcome some significant challenges. The inherently political nature of relief efforts is one. Another is the often highly politicized relief effort in donor countries, and the so-called "CNN Factor" that affords the most donor attention to disasters that receive the most coverage. These circumstances often translate into missed opportunities for sustainable development. Instead of using disaster relief as an opportunity to address important basic development problems such as land use, watershed management, and poverty reduction, in ways that might prevent future disasters, focus is given to highly visible activities such as delivering foodstuffs. These activities simply provide more positive and immediate political advantage.

A variety of promising new approaches, from effective early warning systems, risk mapping, and soil conservation to the selection, development, and multiplication of disaster-resistant seeds, are increasingly being marshaled to address the tremendous need for resilient development and developmental relief. These approaches and the case studies that are used to illustrate them lead to the major policy recommendations in this study. First, nascent efforts to bridge the gap between relief and development at the programmatic level need to be supported, promoted, and scaled up. New agricultural and environmental technologies will play a key role in the promotion of preparedness,

mitigation, and long-term development strategies that continue to reduce the vulnerability of poor, rural populations, and other marginalized groups. Second, the mechanisms for promoting resilient development and developmental relief must also encourage the transfer of knowledge and technology in both directions. Local peoples themselves must actively participate in the process through capacity-building efforts and through the mobilization of existing local capacity, even in disaster settings. Finally, the international community must attend to the macro-level constraints that often militate against institutional change, such as the media-driven nature of response, the politicization of disaster relief, and the institutional divide between relief and development actors.

Countering the daunting statistics, entrenched bureaucratic positions, and short public attention-spans that have long thwarted sustainable disaster relief efforts is the strong and growing consensus that devastating impacts from natural disasters can and will be largely mitigated–and even avoided–through sound and consistent agricultural and environmental development. Evident as well is an increasing confidence in the will of governments, international organizations, and non-governmental organizations to take on the kinds of relief and development initiatives needed to generate long-term economic growth, enhance food security, and sustain environmental renewal on a global basis.

2. Developing Nations: "Sitting Targets" for Natural Disasters

"Natural disasters occur only where natural extremes of the environment meet a community that is vulnerable."[4] In other words, a natural event becomes a "natural disaster" when it outstrips a country or region's ability to cope. With their limited capacity either to prevent or absorb the adverse effects of extreme meteorological and seismic conditions, developing countries are particularly vulnerable to natural hazards.

Hazards, or dangers, are normal. Natural disasters, in this sense, can helpfully be seen as "extensions of a pervasive normal hazardousness."[5] That is, they are both normal and comprehensible, and thus, one might presume, manageable. But not all hazards lead to disaster. While hazard events such as wind, rain, hurricanes, or earthquakes may threaten human life and wellbeing, this is only the case if the event occurs in an area of human settlement.

Vulnerability is an individual's and community's susceptibility to the negative consequences of natural disasters. Disasters are not equal-opportunity events and vulnerability can explain the severity of a disaster. They may also interfere with a disaster response and can continue to exist long after the natural event has ended.

There are many different types of vulnerability, including physical, economic, and social. Thus, a community's vulnerability may be "as much a contributor to the cause of "natural" disasters as are the physical phenomena.[6] One of the most visibly obvious aspects of vulnerability is poverty. The impoverished have fewer resources with which to cope in the face of physical calamity than do those who are less poor or not poor. Other common factors that indicate specific vulnerability include: gender, ethnicity, and literacy.

Risk is a chance or possibility of danger, loss, injury or other adverse consequences.[7] Assessed risk aims to quantify whatever is at risk, for example, the extent of agricultural crops lost, miles of road destroyed, health and medical facilities made inoperative. Risk is assessed to a specific kind of hazard (e.g. hurricane, drought, volcanic eruption), so as to be able to determine who and what are at risk to a specific hazard.

How a natural disaster will affect a community or nation is a function of the coincidence of natural hazards, or dangers, and human vulnerability, or the susceptibility of people to the event. Neither hazards alone nor vulnerability alone can explain or predict impacts from natural disasters. Instead, the level of risk to a particular community is determined by a calculation of the level of vulnerability plus the calculation of the perceived hazard.

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[4] Lewis, p.19.
[5] *Development in Disaster-Prone Places: Studies of Vulnerability*, op. cit.
[6] Lewis, op. cit. *Development in Disaster-Prone Places: Studies of Vulnerability*
[7] *The Oxford Dictionary and Thesaurus*, New York: Oxford University Press, 1996.

Thus, the equation Risk = Vulnerability + Hazard suggests how different populations can have differing levels of vulnerability (and risk) to the same hazard.

$$\text{Risk} = \text{Vulnerability} + \text{Hazard}$$

Among the most at-risk populations in developing countries are the illiterate, small-scale farmers, plantation workers, and female-headed households. The Hurricane Mitch disaster illustrated the vulnerability of the populations at risk (see Table 1.)

Table 1: At-risk Populations in Central America and their Vulnerability

At-risk population	Example of Vulnerability
Illiterate individuals[8]	Unable to read early warning announcements and instructions in temporary shelters; less able to participate in disaster preparedness training
Small agricultural producers	Disproportionately located on eroded hillsides; lost "insurance" in form of seeds and implements
Street children, especially in Tegucigalpa	Flooded out of living space; substantially unincorporated into temporary shelters
Squatters, especially on lakeshores in Nicaragua	Located in high-risk flood plains; less likely to request assistance due to extra-legal status and fear of eviction
Banana plantation workers[9]	Dependent upon private sector for all social services, while female partner and child are dependent on male worker
Female-headed households	More likely to lose household possessions; slower to return to economic productivity
Indigenous populations	Little information about disaster conditions due to poor infrastructure; linguistic and cultural challenges in early warning; not reached by relief organizations; for some indigenous groups, women are more marginalized than men in leadership and decision making

During Hurricane Mitch, people living in flood plains or on lakeshores had a higher level of risk than those living at higher altitudes. This is true despite the fact that the hazard, in the form of inches of rain or volume of wind, was equivalent for both groups. This pattern of vulnerability is illustrative of most natural disasters: rural communities, particularly the poor and other marginalized groups, face greater vulnerability and suffer more during and after natural disasters.

In comparison, industrialized countries are better able to withstand the often-significant relative economic losses (typically the result of their comparatively expensive roads,

[8] UNDP reports that up to 80% of ex-combatants in Nicaragua are illiterate. These individuals, already the target of "re-integration" programs in the country, were especially vulnerable to the disaster.
[9] Reports from the region indicate that plantation workers were isolated and did not receive the same level of assistance as those reached by the government.

housing, and economic infrastructure) because they have the resources that enable them to bounce back quickly. As a percentage of GDP, the economic cost of natural disasters can be as much as 20 times higher in developing countries than it is in developed ones. In terms of loss of life, there is little comparison: 96 percent of all recorded disaster fatalities between 1985 and 1999 occurred in developing countries.[10] The developed world suffers many weather-related emergencies but they rarely reach the level of a "disaster" because industrialized countries are able to cope with the effects.

Natural disasters are particularly destructive to the rural areas of developing countries, where infrastructure, social services, and health care are often in short supply. Seventy five percent of the world's poorest people—or some 900 million people who earn a dollar a day or less—live and work in rural areas.[11] Although natural disasters can affect millions of urban poor, relief and rebuilding efforts usually begin in the cities, where rehabilitation is faster and relatively easier. But it is the rural areas, which often support urban food needs, and the rural poor, who are mostly subsistence farmers, who suffer the most serious consequences of agricultural and environmental decimation following natural disasters.

At the broader community level, the rural poor face not only the prospects of low agricultural production, but also a lack of access to basic infrastructure. At the household level, the economic costs of natural disasters can be devastating to marginalized people. Even when the impact of a natural disaster on the national economy is low, disaster events can create havoc within poor households.[12] The lack of access by poor families to adequate infrastructure, their lack of insurance, and their tendency to be living in physically vulnerable areas, and the often poor quality of their housing cause the poor to suffer far more from a given event than the rich.[13] Other conditions that increase the vulnerability of the poor to natural disasters include: inadequate infrastructure (including paved roads, electricity, health services, markets, and the like); inability and lack of incentives to conserve natural resources or undertake preparedness or mitigation efforts; and gender, age, and ethnicity issues. This lack of infrastructure represents one of the clearest links of natural disasters to poverty.[14]

While poverty itself is the broadest category of vulnerability, within that rubric are such factors as gender, age, level of education and ethnicity. For example, women and children are often more vulnerable to the affects of disasters than men. Women are particularly

[10] IFRC 1999, pp. 39-40.
[11] International Fund for Agricultural Development website: World Poverty Knowledge Base, Rural Poverty Report 2001—The Challenge of Ending Rural Poverty, October 2002
[12] Delaney and Shrader (1999)
[13] Ceveriat, Celine (T/K) IDB chapter
[14] Freeman, Paul K. "Infrastructure, Natural Disasters, and Poverty," in *Managing Disaster Risk in Emerging Economies* (Draft), op. cit.

vulnerable because of their unequal social and economic positions.[15]

3. The Eye of the Storm and other Natural Disasters

Developing nations of the world are literally in the eye of the storm. Because of their location between the Tropics of Cancer and Capricorn, they are the geographical target of many weather-related phenomena. And because of their economic vulnerability, they are unable to provide protections to mitigate the scale and magnitude of hurricanes, floods, or other events.

There were three times as many major natural disasters during the 1990s as during the 1960s.[18] During the 1990s, 94 percent of the major natural disasters occurred in developing countries. Since the mid-1990s there has been a gradual increase in the number of natural disasters in Asia, Africa, and Latin America despite preparedness programs in place.[19] The continuing vulnerability of developing countries to disasters suggests the need for a reassessment of approaches and priorities.

Natural Disasters Impacts

Natural disasters include storms, floods, droughts, and forest fires, as well as earthquakes and volcanic eruptions. The incidence of earthquakes and volcanic eruptions or geophysical disasters have remained fairly constant in the decade of the 1990s, while the number of storms, floods, droughts, and forest fires more than doubled in the second half of the decade.[20]

This study focuses on weather-related disasters and the consequent, often multiple, emergency situations that follow them, as well as the particular impact they have on poor rural communities in the developing world. These weather- related disasters include both slow-onset emergencies, whose effects develop more gradually and often have longer-lasting impacts, such as drought, and rapid-onset events, which are triggered by sudden and usually temporary sudden natural hazards, such as storms.

Storms—Winds and Flooding

The term “storm” is deceptively simple. It is often used to describe a great variety of atmospheric disturbances. These can range from ordinary rain showers to severe wind-related disturbances known as tornadoes and tropical storms. Tropical storms with wind speeds exceeding 119 km/h are known by various names including, hurricane, typhoon, *Willy Willy*, and cyclone. Storms are usually accompanied by flooding, which often does more damage than winds. Storms occur most frequently within seven tropical cyclone

[18] UNDP: 1999.
[19] Combination of Table 1 Total number of natural disasters by continent, page 185, and Table 5, Total number of reported disasters by type and year, page 189 World Disasters Report 2002)
[20] World Disaster Report, 2001, page 162.

basins located throughout the world. These basins are bordered primarily by developing countries, where tropical storms do the most damage (see Table 1).

Tropical Cyclone Basins

1.Atlantic Basin (including the North Atlantic Ocean, the Gulf of Mexico, and the Caribbean Sea)

- Hurricane Georges in September 1998, Haiti, Dominican Republic, Cuba, St Kitts & Nevis, Dominica, and Antigua and Barbuda;
- Hurricane Mitch in late October and early November 1998, Nicaragua, Honduras, El Salvador and Guatemala
- Hurricane Lenny in November 1999, areas in the Caribbean Sea
- Erin, Felix, Gabrielle and Iris- between August and October, 2001
- Gustow, Isadore, Kyle and Lili- 2002

2. Northeast Pacific Basin (from Mexico approximately to the dateline) – The tropical storms occur mainly in the ocean. Recent examples include:

- Hurricane Dora in August 1999
- Hurricane Carlotta in June 2000
- Hurricane Kenna in October 2002

3. Northwest Pacific Basin (from the dateline to Asia, including the South China Sea)

- Typhoon Thelma in November 1991, Philippines
- A series of typhoons in Laos and floods in Cambodia in 1996
- Typhoon Linda, Vietnam, 1997
- Extensive flooding in central, south-eastern and north-eastern parts of China in 1998
- Heavy flooding in Vietnam, 1999
- Storms and heavy floods in Cambodia, 2000
- Typhoon Wukong, Laos, 2000
- Wutip, September 2001
- Podul, October 2001

- Faxai,
- Mitag, Hagibis, Chattan, Halong, Fengshan, Higos and Pongsona in 2002
- Kujira, 2003

4. North Indian Basin (including the Bay of Bengal and the Arabian Sea) –
   - Three major floods in Bangladesh, August-September, 1998
   - Cyclone, Orissa, India, October 1999
   - Severe floods, Bangladesh, August-September 2000
   - Severe floods, India and Nepal, July-September 2000

5. Southwest Indian Basin (from Africa to about 100°East) –
   - Cyclone Gretelle, Madagascar, 1997
   - Heavy floods associated with the Cyclones Leon-Elyne, Gloria, and Hudah, In Mozambique, Madagascar, Botswana, South Africa, Swaziland, Zimbabwe, and Zambia, February 2000
   - Torrential El Niño rains, Somalia, 1998

6. Southeast Indian/Australian Basin (100°East to 142°East)
   - Cyclone Steve, February 2000
   - Cyclone Tessi, April 2000

7. Australian/Southwest Pacific Basin (142°East to about 120°West) –
   - Variously severe tropical storms that occur primarily in the ocean.

(Source of above information: FAO Committee on Agriculture, Sixteenth Session, Rome 26-30 March 2001, Reducing Agricultural Vulnerability to Storm-Related Disasters. Item 6 of the Provisional Agenda.)

Despite improved storm warning and flood awareness measures, during the 1990s there was a 300 percent rise in the number of individuals affected by floods and storms. Between 1973 and 1997 hurricanes, cyclones, typhoons, storms and tornadoes claimed, on average, each year an estimated 11,000 lives and made more than more 1.1 million people homeless.[21]

[21] Janet N. Abramovitz, Natural disasters – At the hand of God or man? ENN http://www.enn.com, June 23, 1999

During 1990-1999, windstorms and flood-related disasters together accounted for 60 percent of the total economic loss caused by natural disasters. A significant percentage of disaster casualties, in terms of deaths, injuries and people displaced from their homes and income, are also attributable to storms and floods. Much of the devastation was due in part to the increase in population in storm-prone areas.[22]

Flooding in Orissa, India in 1999 affected 1 million hectares of land, killed 10,000 people, and destroyed massive amounts of stored grain. When Hurricane Mitch swept through Nicaragua, Honduras, El Salvador, Guatemala, and Cuba in 1998, it caused 20,000 casualties. In the Dominican Republic, one-third of the crop area was destroyed, with costs estimated at US$278 million. Cuba lost 70 percent of its plantain crop and 60 percent of its root crops and suffered serious damage to its irrigation infrastructure. Haiti lost 15- to 20-percent of its planted crops and 80 percent of its plantation bananas and livestock on more than 100,000 small farms. Damage to livestock and crops in Nicaragua, Honduras, El Salvador, and Guatemala was extensive. Widespread flooding in central, southeastern, and northeastern China in the same year affected 22 million acres of crops, destroying some 4.8 million. In Africa in 2000, three cyclones devastated food supplies. In Mozambique, 98,000 tons of cereals and beans were lost, with the economic damage estimated at US$1 billion. In Madagascar, 142,000 hectares of paddy rice, 5,000 hectares of maize, 2,400 hectares of cassava, and 33,000 hectares of export crops were affected.

Not only do storms destroy crops and disrupt food supplies, storms also affect land quality and production potential and are a major contributor to deforestation. As they flood coastal areas with salt water, storm surges often result in salinization of agricultural land. The effect on cropping and yields are even greater if the surge occurs after the main rainy season, as the salt cannot be quickly diluted. Floods, which deposit a layer of alluvium on cultivated land, may bury crops and change soil quality.

Tropical storms, hurricanes and ice storms can all affect forest resources, either directly through the impact of high winds and ice, which destroy trees, or indirectly through flood damage or mudslides, which affect forest health and growth. Flood-stressed trees are prime targets for attack by secondary organisms including certain root and collar-rot diseases favored by waterlogged, oxygen-deficient soil conditions, in conjunction with mould fungi. Severe storms can also influence the availability of wood for fuel. Wood is the primary source of fuel in the majority of developing countries, and two-in-five people worldwide rely on fuel wood or charcoal as their main or sole sources of domestic energy for heating or cooking. In developed countries, fuel wood accounts for less than 10 percent of total fuel consumption.[23]

[22] World Disaster Report of the International Federation of the Red Cross 2000
[23] Forests, fuel and the future - Wood energy for sustainable development - Forestry topics report no. 5, Lamb, 1996 UNFAO,

Conversely, scientists find that forests can also play a role in mitigating the impact of storms by providing windbreaks, buffer zones, and agroforestry systems. Mangroves and other coastal forests also protect natural resources from storms. It is generally believed that deforestation was a contributing factor to the extensive damage from the recent hurricanes in Central America and the Caribbean. In Honduras, sites with vegetative contour bunding, or rock walls and trees, withstood the storm quite well, while sites that did not have these, were devastated by massive landslides. More tree windbreaks surrounding and within plantations would have substantially reduced the damage and economic loss.

Population growth in low-lying coastal areas puts more people at risk of flooding, wind damage, and storm surges. The possibility of landslide casualties during heavy rains also increases with the growth of settlements on sloping terrains around urban areas. Settlement on flood plains further enhances the likelihood of flooding as well.

The El Niño Factor

El Niño is one example of the increasing frequency of extreme meteorological events. It helps to explain unexpected droughts and floods and record heat waves and snowstorms that trigger human disasters. By definition, El Niño is a periodic natural event, but in the past 20 years it has become more intense and frequent. A wide body of research links it to global warming. If that is so, then we could be stuck with many El Niños as part of the world weather system over the next several decades. But, if not, it would only underscore the unpredictability of the world's weather system and its capacity to capriciously unleash extreme conditions on unsuspecting populations.

During the first 11 months of 1998 alone, El Niño-related disasters, including the record Asian floods that devastated China, Bangladesh, India, and Papau New Guinea and Central America's "storm of the century"—Hurricane Mitch—caused more than $89 billion in economic losses, displaced 300 million people from their homes and livelihoods, and resulted in 32,000 deaths. World Bank loans for prevention and reconstruction activities to only eight of the severely affected countries totaled $359 million.

Other less well-known, but no less destructive, impacts of El Niño included Papua New Guinea's worst drought in 100 years, unabated freezing weather that left much of Quebec without electricity, mudslides that destroyed countless homes in California, and widespread forest fires that blazed in various regions throughout the world. In some regions, such as the west coast of South America, Oceania, and southern and eastern Africa, climate extremes of such magnitude occur so frequently that the ability of affected populations to cope is consistently overwhelmed, leading to recurring disasters.

As recent trends in the incidence of storms are likely to continue, the greatest challenge will be to find ways to prevent or minimize the enormous economic losses and human suffering in the countries that are vulnerable to storms and floods. Scientists expect that developing countries will continue to experience thousands of human casualties and the loss of tens of billions of dollars every two- to seven-years unless more investment is made in better forecasting and preparation for the El Niño weather phenomenon.

Drought

When regular patterns of rainfall fail over successive seasons, drought occurs. Losses in crop production affect rural communities first, leading to hunger and, if local and national governments fail to find and provide emergency food, to famine. While any combination of emergencies can result in disastrous famines, most famines are precipitated by crop failures caused by massive and severe drought and the inability of local and national governments to cope. This was the case in Ethiopia in the mid-1970s and mid-1980s and is the case again today in these same areas, where some 100 million people are at risk of famine. Drought is a substantial threat to the welfare of rural populations, economic growth, and sustainable development in many countries in Africa, South America, and Asia.

In addition to obvious losses in yields in crop and livestock production, drought is also associated with increases in insect infestations, plant disease, and wind erosion. Droughts can bring increased insect and disease problems to forests and reduce growth as well**.** This phenomenon was recently witnessed in Afghanistan, which has suffered from severe drought for the last five years. Locust plagues erupted throughout the country as farmers began to prepare their fields for replanting in mid-2002. The incidence of forest and range fires increases substantially during extended droughts, which in turn places both human and wildlife populations at higher levels of risk.

Food emergencies are often caused by drought. Like natural disasters, the incidence of drought is on the rise. Among the cases of food emergencies occurring in 33 countries in 2001, the majority was caused by weather-related events and the majority of those were the result of drought (see Table 3.1).

TABLE 3.1—Countries Facing Food Emergencies and their Causes, 2001

AFRICA (16 countries)	
Angola	Civil strife, population displacement
Burundi	Civil strife and insecurity
Congo, Dem. Rep.	Civil strife, IDPs and refugees
Congo, Rep. of	Past civil strife
Eritrea	IDPs, returnees and drought
Ethiopia	**Drought**, IDPs
Guinea	Civil strife, population displacement
Kenya	**Drought**
Liberia	Past civil strife, shortage of inputs
Madagascar	**Drought**/cyclones
Rwanda	**Drought** in parts
Sierra Leone	Civil strife, population displacement
Somalia	**Drought,** civil strife
Sudan	Civil strife in the south, **drought**
Tanzania	Food deficits in several regions
Uganda	Civil strife in parts, **drought**

ASIA (11 countries)	
Afghanistan	**Drought,** civil strife
Armenia	**Drought,** economic constraints
Azerbaijan	**Drought,** economic constraints
Cambodia	Floods
Georgia	**Drought,** economic constraints
Iraq	Sanctions, drought
Jordan	**Drought**
Korea, DPR	Adverse weather, economic problems
Mongolia	Economic problems, harsh winter
Tajikistan	D**rought**
Uzbekistan	**Drought** in Karakalpakstan

LATIN AMERICA (4 countries)	
Haiti	Structural economic problems
Honduras	Past adverse weather
Nicaragua	Past adverse weather
El Salvador	Earthquakes

EUROPE (2 countries)	
Russian Federation	Civil strife in Chechnya and vulnerable groups
Federal Republic of Yugoslavia	Vulnerable groups and refugees

Source: FAO

Drought can also cause environmental losses from damages to plant and animal species, wildlife habitat, and air and water quality; forest and range fires; degradation of landscape quality; loss of biodiversity; and soil erosion. Although some of the effects of drought can be short-term, other environmental effects can linger or may even become permanent.

Wildlife habitat, for example, may be degraded through the loss of wetlands, lakes, and vegetation. The degradation of landscape quality, including increased soil erosion, may lead to permanent loss of biological productivity of the landscape.

Desertification typically occurs when drought combines with human and animal population pressures. Overgrazing is a frequent practice in dry lands and is the single activity that most contributes to desertification. Grains and cereals are the most frequently grown crops in dry land farming, a practice that refers to rain-fed agriculture in semiarid regions where water is the principal factor limiting production. The very nature of dry land farming makes it hazardous unless special conservation measures are followed to protect the land, water and livestock assets in a sustainable manner.

Wildfires

The 1990s were marked by periods of severe drought throughout the world, setting the stage for devastating wildfires that occurred in practically every corner of the world. For example, during the 2000 fire season an estimated 200 million hectares in sub-equatorial Africa burned

Forest fires significantly affect people, property, natural resources, and consequently the human environment. They affect the functioning of ecosystems in a number of ways, including by regulating plant succession, regulating accumulation of fuels, controlling species and age structure of the vegetation, affecting occurrence and levels of insect and disease populations, influencing nutrient cycling and water regimes, regulating biotic productivity, diversity and stability, and, indirectly, determining availability of wildlife habitats.

The extent and effects of forest fires are related not only to climatic, environmental, and fuel conditions, but also to national policies, laws, and institutional objectives concerned with such issues as human settlement, land tenure, environmental regulations and forestry practices. The expansion of traditional shifting cultivation and land clearing because of increased population pressures combined with widespread drought and excessive fuel loads, may produce fires of disastrous proportions. Policies governing timber harvesting and land settlement can also contribute to an increase in the susceptibility of forests to fire.

The Climate Connection

Climate change is growing in its potential to influence environmental conditions and is described in the following chapter. Many of the changes, such as in average temperatures, rainfall, and sea levels, will appear to be gradual. But, shifts in averages may cause dramatic changes in the risks of extreme climatic events.[24] Increasing environmental

[24] International Federation of Red Cross and Red Crescent Societies, *World Disasters Report 1999*. Geneva, Switzerland, 1999.

degradation, such as erosion and deforestation, are inextricably linked to population pressures and rapid urbanization.[25]

4. Climate Change and Global Warming

In the not so distant past, seasonal climates were so reliable that agricultural, environmental, and socioeconomic systems tended to be well adapted to them. But when extreme climate events disturb environmental or economic systems to a great degree, such as those that have been happening with increasing frequency over the past several decades, climate-related disasters can be expected to increase as well. As the world's population increases, the number of people exposed to climate-related risks will also steadily increase, thereby magnifying the impacts of future hazard events. Climate change, particularly global warming, could bring about drastic changes in the location of the world's agro-ecological zones and threaten to destabilize weather patterns. Such a scenario would undoubtedly lead to additional increases in the incidence of severe storms and droughts

This study is not focused on the causes of global warming and their affects on climate; however, it does recognize the pattern of change and the close connections to agriculture, the environment, and natural disasters. In addition to being the worst decade on record for natural disasters, the 1990s was the warmest decade in the last thousand years. Glaciers receded throughout the world, plants bloomed and birds laid their eggs weeks earlier than in previous decades, and damage from storms was up 800 percent from the 1970s. [26].

Global warming's effects on agriculture, the environment, and the people who experience natural disasters are not in dispute. Whether a result of natural climate variability –the minority opinion among scientific researchers–or variability caused by human activities, as the United Nations Intergovernmental Panel on Climate Change (IPCC) suggests, the world's changing climate and natural disasters seem to be on a collision course. During the eighth session of the Conference of the Parties to the United Nations Framework on Climate Change, which ended November 1, 2002 in New Delhi, the fact that the global climate is changing was not disputed. Delegates to the talks shifted attention to the effects of changes in global climate and how to deal with them.[27]

In addition, there is little doubt that climate change, whether it develops on a fast or slow track, will have far greater economic impacts on developing nations with their diminished capacity to adapt to changes as compared to the industrialized countries and their capabilities to respond to threats. That impact will be enormous on the natural

[25] Kreimer, Alcira and Margaret Arnold, Eds., *Managing Disaster Risk in Emerging Economies*. Washington DC, 2000.
[26] Stephen H. Schneider and Kristin Kuntz-Duriseti, " Facing Global Warming," News World Communications, Inc. World & I

[27] Andrew C. Revkin, "Climate Talks Shift Focus to How to Deal with Changes," New York Times, November 3, 2002, page 10.

environment and agriculture, as well as the individuals who depend on both. Two points illustrate additional problems. First, many of the most dramatic climatic changes are likely to occur in developing countries, once again placing these nations in the eye of the storm. Second, the speed and intensity of the changes are likely to render indigenous knowledge bases that have developed over generations about botany, weather patterns, and crop selection, for example, outdated and overwhelmed. In the Pacific, for example, traditional knowledge about managing natural resources ranging from fishing to plant selection held by older members of island societies is no longer useful as the climate in many islands has changed from tropical to semi-arid. The economic results, which include over-fishing, inappropriate land use, and environmental degradation, have been as devastating as the social ones, including the decline of traditional authority and respect for elders.

Impact on Agriculture

Agriculture is potentially the most vulnerable of all human economic activities to the effects of climate change, especially in developing countries, where technology generation, innovation and adoption have been slow to counteract the adverse effects of varying environmental conditions. For example, inappropriate management of agro-ecosystems, compounded by severe climatic events such as recurrent droughts in West Africa, have made the drylands increasingly vulnerable and prone to rapid degradation and desertification. Even in the high rainfall areas, increased probability of extreme events can cause increased nutrient losses due to runoff and water logging. A warming climate will also influence pest and disease dynamics causing crop losses. Improved adaptation of food production, particularly in areas where climate variability is large, holds the key to improving food security for the global population.

A global analysis of the potential agricultural impacts of global warming suggests that the developing countries will bear the burden of these changes. Developed country agricultural production is predicted to rise between 4- and 14-percent, while developing country output would fall by 9- to 12-percent. World food prices will increase. The number of people at risk of hunger, due primarily to higher prices, could rise significantly, perhaps by 50 percent.[28]

Advances in agricultural research for developing country conditions will be essential for future food stability in the world's poorest countries. Developing countries do not now and are not likely to have in the future, the ability to import food to meet rising needs. Food aid is unlikely to meet needs and is unsustainable. More importantly, farming is the basis of most rural economies; without a strong farming sector, countries have little hope of making the transition to broader based economies.

[28] C. Rosenzweig and M. L. Parry, "Potential Impact of Climate Change on World Food Supply," *Nature*, Vol. 367, pp. 133-138, 1994 January 13

The future of agriculture in developing countries requires crops that can withstand both a lack of and a surplus of water, that can grow at warmer temperatures, and that can withstand pests and diseases. Irrigation techniques will also need to be improved and irrigation expanded. The expanded use of trees on farms to provide fertilizer, crops, and fodder for domestic animals will also be essential. Integrated farming systems, new methods of crop rotations, reforestation programs, watershed management, and biodiversity conservation both on and off the farm will be critical. These activities do not "just happen." They require a concerted effort by the international, scientific, and policymaking communities. Without expansion of international agricultural research and efforts that are adapted to national and local needs, the situation in developing countries looks bleak.

Impact on Forests

Tropical forests are home to between 60- and 90-percent of all species. In addition forests supply livelihoods for 500 million people who live in and around them, providing products for use and sale as well as niches for agriculture. During the decade of the 1990s, approximately 14.6 million hectares of the world's 3.9 billion hectares of forest cover were lost. Although policies and programs to help promote sustainable forest management have been devised and have taken hold in many countries over the past decade, deforestation is continuing at a dramatically rapid rate, particularly in the tropical forests of Africa and South America. An increase in the earth's temperature will also affect its forests, increasing the likelihood of pests, pathogens, and fires. Dealing with these new conditions in addition to protecting forests from conversion to farmland, over logging, and other poor forest management, forest fires, and unsustainable harvesting of wood fuels and other forest products, which continues to occur today, will also require scientific and policy studies to serve as a basis of knowledge and action.[29]

Coastal forests also play a significant role in mitigating the impacts of storms by providing windbreaks and buffer zones. For example, deforestation was a significant factor in the extensive damage that resulted from recent hurricanes in Central America and the Caribbean. Sites with vegetative contour, rock walls and trees withstood the storms far better than those that did not and were devastated by massive landslides. Compounding this phenomenon is the fact that communities that have lost housing as a result of hurricanes and other severe storms tend to cut down large number of trees to rebuild, thereby making them even more vulnerable to future storms.

Impact on Biodiversity

[29] UNEP Global Biodiversity Outlook, *Making Markets Work for Forest Communities*, Sara J. Scherr, Andy White, David Kaimowitz, Washington, DC: Forest Trends, 2002)

Biodiversity-rich ecosystems are particularly vulnerable to global warming. Already, human interventions have imposed such extensive disruptions and fragmentations on them that they have lost many of their original adaptive mechanisms. Of greatest concern to scientists is the long-term, large-scale migration of animal and plant species and local shifting of the species balance. While the natural environment has often adapted to climate changes that have occurred gradually over many thousands of years, rapid changes, such as those resulting from sudden shifts in ocean currents, often cause widespread species extinctions and the collapse of natural ecosystems. If climate changes gradually, many plants might be able to "migrate" by spreading seeds into new areas where they can now grow. But if climate changes rapidly, many plants may not be able to spread their seeds far enough to reach the new area.

Agricultural biodiversity is also at risk. As growing conditions change, plant species will not necessarily be able to adapt. Ongoing collection of agricultural biodiversity for preservation in the world's genebank system will be critically important for scientists to continue to develop and adapt plants that can adapt to changing conditions. Some 5.4 million samples of crops grown in every climate and under all conditions are held in the genebanks in some 150 countries. Preservation and study of these collections as well as the continued collection and addition to them will hold the key to some of the agricultural challenges of a warmer planet. [30]

Impact on Coral Reefs

Coral reefs have much in common with forests. They sustain two-thirds of all marine fish species and support human communities by providing fisheries and storm protection. The valuable resources of coral reefs are also at risk of climate change. Adaptive research will be essential in dealing with these changing conditions.

Thus, improvements in agricultural and natural resource management practices in the developing countries that are already critical will become increasingly so as the effects of global warming are felt. Without them, the agricultural sector will suffer disproportionately as will the people who depend on them.

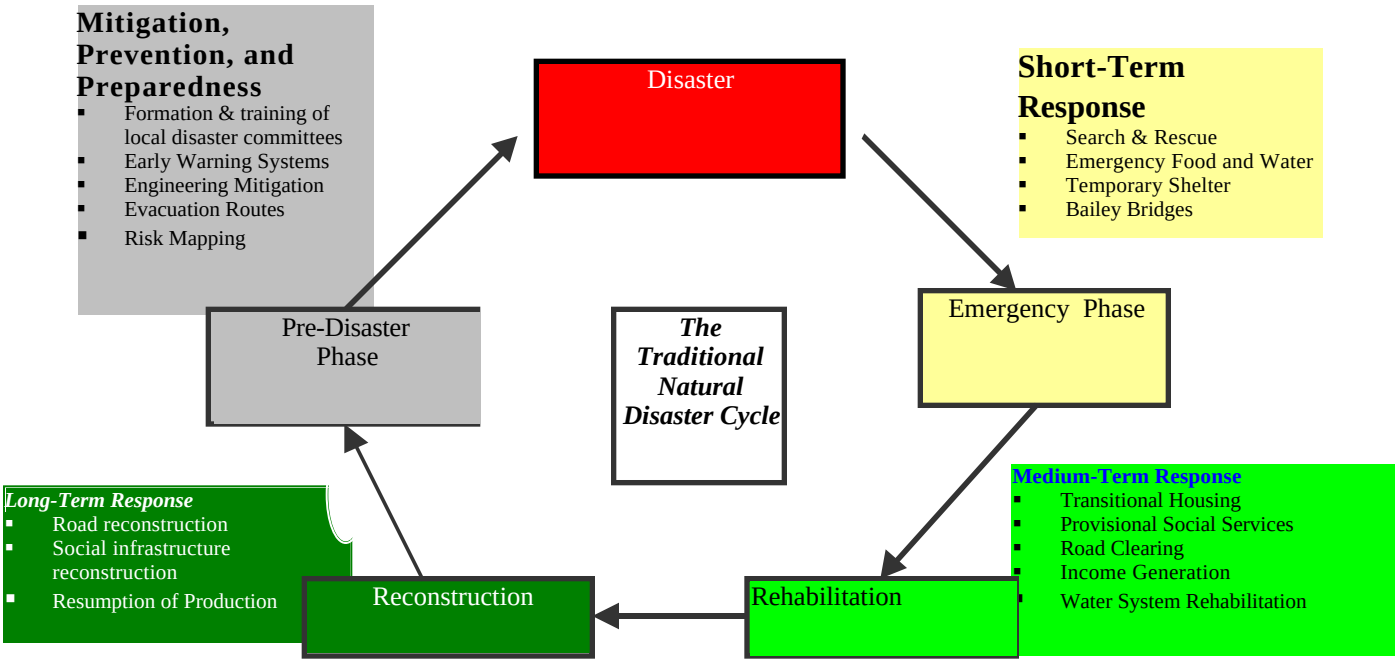
5. Structures and Cultures: The Historical Disconnect Between Development and Disaster Management

Relief organizations traditionally responded to each phase of the disaster cycle in discreet terms with specific types of interventions. The pre-disaster phase included preparedness and undertaking activities that could mitigate the affects of the disaster. During the emergency phase, disaster managers focused on search and rescue and other activities

[30] The Global Conservation Trust, **www.startwithaseed.org**

designed to save lives and alleviate suffering. Finally, during the reconstruction and rehabilitation phases, practitioners looked at the medium and long-term investments in rebuilding the social and physical infrastructure

Figure: The Traditional Disaster Cycle



Although the majority of disaster and development experts now realize the limitations of this type of closed model and are trying to work in a more fluid manner, the structures and cultures that it engendered remain. Within many relief and development organizations, there are structural barriers between relief and development. These include: funding linked to either relief or development areas, but not both, staffing with expertise that does not cross over from relief to development or vise versa, and a lack of incentive for relief to development collaboration and coordination. In addition, the cultural differences between relief and development workers often reinforce the gaps and inhibit structural change. The results have been that disaster management and development professionals have at times been working, unintentionally, at cross-purposes.

The major responsibility that relief workers have for managing disasters is responding to emergencies. Development planners work to help developing country communities use local capacity and resources to improve their lives. Disaster managers traditionally save lives and reduce human suffering—but they don't "do" development. They are traditionally not accountable for building development factors into their relief programs.

Failed relief - increasing vulnerability and ignoring local capacity

A classic example of the failures of traditional relief approaches occurred during the disaster response to Hurricane Georges in 1998. In their rush to respond quickly to the disaster in Haiti and the Dominican Republic, donor agencies decided to airlift both food supplies and emergency non-food items, such as clothing and bedding, to the region. While the resulting emergency provisions, including surplus military food in the form of MREs (Meals Ready to Eat), pre-packaged dinner rolls, and heavy winter coats, arrived quickly, they were inappropriate for the local population. Even worse, the reliance on external supplies and logistics capacities missed a very important opportunity for more developmental relief.[31]

The relief effort could have contributed to economic recovery if relief workers had been able to provision locally-available foodstuffs (such as beans and rice). The sale of such food supplies, widely available in neighboring provinces and countries, would have stimulated the agriculture and agro-processing sectors. Similarly, the use of regional or local logistics capacities, such as trucking and warehousing, could have further aided the return to economic normalcy. Instead, the relief effort further disadvantaged the local economy and perpetuated a pattern of dependence on foreign assistance. Even during the initial emergency phase, relief projects need not undermine local capacity.

Another failed opportunity for more developmental relief occurred in the Central American country of Nicaragua in the aftermath of Hurricane Mitch in 1998. During the reconstruction phase, many housing projects were completed in order to replace housing that was destroyed by massive flooding from the hurricane. In one area near Managua, a squatter settlement that had previously been located in a floodplain was moved to a higher elevation area. The new housing project, however, failed to consider how residents would make a living and did not provide for space for garden plots and small livestock. Further, they failed to consider the substantial transportation constraints associated with the new location. As a result, many residents quickly abandoned the new houses and returned to their previous, highly vulnerable, locations. To add insult to injury, the new homes were located in a high-risk earthquake zone but were not designed to be earthquake-resistant. In this case, the relief project actually increased the victims' vulnerability to future disasters.[32]

Another common relief strategy, the distribution of seeds and tools to farmers, can also increase local vulnerability to future disasters. The intention of these programs, designed as a substitute for the simple distribution of emergency food, is to decrease dependency and to promote rapid agricultural and economic recovery. Unfortunately, such an approach can backfire if relief efforts are not carefully thought out. All too often relief agencies assume that because farmers are short of food then they must also be short of

[31] Personal communication with OFDA/Latin America staff.
[32] Delaney and Shrader….. (based on field interviews)

seed, and they rush to procure and distribute seed. Too often the wrong ones are provided and late. Seeds of crops and varieties adapted to high-potential areas are sent to drought-prone districts, and hybrids are sent instead of varieties from which farmers can select seed from the subsequent harvest for future use.

In much of sub-Saharan Africa, the repeated distribution of free seeds to farmers has led to what has become termed the 'relief' seed system. Demand for seed comes from relief agencies instead of from farmers, and supply is met by commercial seed responding to the needs of relief agencies rather than that of farmers. In this system there is no incentive for commercial seed suppliers to invest time and money in discovering the preferences of farmers, and as a consequence farmers are not benefiting from the considerable research investments that have been made in developing new crops and varieties that could help farmers in increasing productivity and strengthening the resilience of their cropping systems.

The inappropriate use of food relief is one of the most frequent criticisms of non-developmental relief efforts. While the desire to provide life-saving food aid to starving people is a logical one, all too often food aid simply increases dependency and creates greater food emergencies in the longer term. In the famous case of Southern Sudan, for example, studies have shown that the massive distribution of food aid in the1980s had a number of deleterious effects. Food aid provided a disincentive for farmers to plant and grossly disrupted the still extant food markets and trading networks in the wider region.[33]

Failed development—increasing vulnerability by ignoring natural hazards

Development planners, on the other hand, don't "do" relief. They have been seen by some as somehow immune from or simply inattentive of the pervasive debilitating effects of natural hazards. In line with this thinking, these planners see development as being repeatedly "interrupted" by natural disasters. At the extreme, development has been described by some as even contributing to the erosion of people's coping skills and, in effect, contributing to 'failed development.'[34] In this view, as one recent study expresses it, there is a "message now that development is the prime medium of vulnerability and its reduction."[35]

A good example of the negative impact of some development activities can be found in the case of Nicaragua.

[33] Lautze: 1999
[34] Lewis, James. *Development in Disaster-Prone Places: Studies of Vulnerability*. London: Intermediate Technology Publications Ltd., 1999
[35] ibid.

Nicaragua's Unsustainable Agriculture and Environmental Degradation: Damage to agriculture varies by the type and intensity of natural disaster. In Nicaragua, a U.N. Food and Agriculture Organization (FAO) mission reported that 16 percent of the total production forecast for 1998-99, including a significant proportion of maize, rice, sorghum and pulses, was washed away by hurricane Mitch.[36] Heavy floods, continuous heavy rains, and high-force winds caused extensive damage. Emergency food assistance made up some of the deficit created by the storm.

Determining Nicaragua's food needs during the emergency and some recovery (recuperation, improvement, comeback) and rehabilitation (repair, reconstruction, rebuilding), measures was the aim of the FAO mission. It did not necessarily intend to assess longer-term agricultural vulnerability. Nevertheless, that mission made some clear allusions to vulnerability of Nicaragua's small farmer, as depicted in the following:

> *In Nicaragua small farmers often live below the poverty line. They cultivate small plots of marginal land with rudimentary techniques and lack the food reserves and capital necessary to face recurrent natural disasters such as drought, hurricane, and earthquakes.*

Nicaragua represented a "disaster waiting to happen" because previous development work in the country did not attempt to reduce vulnerability. Evidence of the vulnerabilities of Nicaragua's small farm system includes:

- Specific evidence for some of poor soil and water conservation techniques;
- weaknesses in the basic infrastructure (drainage, roads, erosion controls) of rural communities;
- poor quality of seeds of basic grains, horticultural and forage crops;
- limited food availability for 'coping' purposes;
- weak draught animal development; and
- poor local knowledge of disaster mitigation techniques.

While this inventory of weaknesses in the small farming system in Nicaragua may be incomplete, it gives a clear idea how the lack of appropriate agricultural development can contribute to disaster vulnerability.

Erosion, Deforestation, and other Poor Land Use Practices in India: A super-cyclone that struck Orissa on October 29, 1999 caused large-scale destruction of mangrove and *casuarinas* forests along 165 miles of that state's 317-mile coast. Twenty days after the disaster, rescue teams were still digging out hundreds of decomposed bodies from previously inaccessible villages. Local people began to look for explanations for the massive scale of death and destruction caused by the over 200-mile per hour cyclone.

[36] Food and Agriculture Organization/World Food Program, *Crop and Food Supply Assessment Mission to Nicaragua,* February, 1999.

One clue was the geographic location of the damage - it occurred mainly in new settlement areas along Orissa's coast where heavy deforestation had occurred. Specifically, a 65 mile denuded stretch, the Ersama block, through which the high tidal wave ripped, killing thousands of people in minutes.

By the time the cyclone hit the coast, the tide had risen to as high as 26 feet. "Backed by the strong gale and no forest to check it, it advanced menacingly into the mainland submerging everything that came in its path." In one district, reported deaths were 2,043 from a total of 5,700 inhabitants. A satellite survey showed that an average of 1.65 square miles of mangrove forest was being destroyed annually in Orissa state's coastal region.

Local reports provided one version of the events leading to the disasters. These forests along with sand dunes had historically served as barriers to cyclones. Illegal Bengali immigrants, who were allegedly encouraged by local politicians to settle in this area in order to gain their election votes, destroyed the sand dunes and the forest when they constructed their homes.

No government policies had been in place to prevent the environmental destruction and no disaster management plan was in place. The report found that "the extent of devastation is so vast that it might take generations to revive the agricultural economy in the affected areas." [37]

Trees and Famine in North Korea: North Korea, in the throes of a famine that may have taken the lives of two- to three-million between 1995 and 1998, is undergoing a disaster of significant proportions.[38] In addition, there is a disaster of even greater significance "waiting to happen." As news reports indicate, the essential problem is deforestation: "So many hills have been stripped of trees that [President] Kim plans to plant millions more." The problem is so serious that South Korean activists have sent seeds, fertilizer and greenhouse equipment for tree growing. The state news agency declared that North Korea had embarked on "nature remaking projects."

Even though coal burning is the main source of energy in North Korea, inhabitants have still stripped most forests for cooking or heating fuel. Eager for revenues, the country has even trucked in timber to sell in China. This clearing of forests has contributed to the famine, which quickly became a humanitarian crisis as of 1995, a crisis that continues today. Heavy rains have swept away topsoil, swelling floods that devastated crops. In the dry season, loose soil shed its moisture, leading to water shortages. Economic mismanagement, denuding of forests, soil erosion, water shortages, crop losses and poor

[37] Satapathy, Rajaram, "Deforestation Caused Cyclone Havoc," *The Times of India*, November 20, 1999.
[38] Korea Times, "North Korea Wakes up Slowly to Impact of Deforestation," Seoul, Korea, January 14, 1999.

crop terracing have all contributed to a situation in which North Korea's population is being kept alive by foreign food aid.

The historical pattern of division between relief and development is reinforced by a series of external factors, all of which need to be better understood in order to tackle the problem.

The "CNN Factor"

International news coverage of major events usually focuses on short-term relief needs and gives short shrift to the more complex issues of sustainable development. The so-called "CNN Factor" has meant that high profile disasters, particularly those with vivid video images, are the ones that are more likely to attract higher levels of donor resources in very short periods of time. This phenomenon – best captured by the searing image of a woman giving birth in a tree during the horrific flooding that occurred in Mozambique in 2000 – translates into increased pressure on donors to provide immediate food and shelter relief at the expense of finding more sustainable solutions. The "sound bite" mentality often precludes thoughtful discussion about long-term vulnerabilities and the underlying causes of the disaster. While an outpouring of such relief in the immediate aftermath of a disaster undoubtedly saves lives, the support needed to find ways to mitigate the impact of future disasters through more resilient development is usually not forthcoming as the donor community has already moved on to the next media-friendly disaster.

The Urgency Factor

Within the humanitarian relief community, there has long been a culture of urgency and immediacy in disaster settings. Unfortunately, this has created a situation in which many humanitarian actors are constrained by "urgency". Relief agencies feel compelled to do something quickly. As research by the Pan American Health Organization shows, becoming a slave to such concerns often results in ineffective, inefficient, often unnecessary, and sometimes harmful disaster relief.[39] What it means is that decisions about relief depend not on effective assessments of needs and vulnerabilities on the ground, but instead upon logistical capabilities and the existence of pre-positioned supplies. Disaster victims thus get what an agency has, and not necessarily what they need.

Political Constraints

Another major constraint to the effective integration of relief and development activities is the highly political nature of disaster relief itself. The political implications exist at a variety of levels. In donor countries, high profile disasters can lead to bureaucratic in-fights and turf battles as well as heightened issues with the tyranny of the urgent.

[39] Pan American Health Organization, "Myths about Relief" http://www.paho.org/english/ped/myths.htm

Domestic constituencies, and their perceptions of disaster events, can also politicize a response effort, making developmental relief more difficult. Politics also comes into play in the affected country itself, where the idiosyncrasies of national government policies can further complicate planning and response. Finally, the lack of political will to address basic development problems, such as poverty reduction and sustainable land use planning, can further handicap a more developmental approach to relief work.

The costs of inaction are quite clear. Development planning that fails to take disasters into account will lead further environmental degradation, greater vulnerability, and still greater natural disaster impacts in the future. Inappropriate disaster relief is no better than inappropriate development. Disaster prevention, reduction, and mitigation are more cost-effective, and more humane, than disaster response alone. Similarly, resilient development, the kind that takes disaster patterns into account, provides more sustainable development over the long-term.

6. Bridging the Development-Relief Divide: Overcoming Challenges

The experiences of relief and development professionals who struggled with the devastating disasters of the 1990s have convinced many that the international community needs to redouble its efforts to bridge the gap between traditional relief and development. It is not longer seen as appropriate to simply provide effective humanitarian relief. It must also be *developmental* relief, factoring in the long-term development issues. Similarly, development assistance must also enable communities to be more *resilient* to natural disasters. Neither of these activities will succeed in isolation from the other. Both developmental relief and resilient development are needed if programs are to be effective and sustainable.

In thinking about ways to bridge the previous divide between relief and development programming, focus has been placed on several priority areas:

- Preparedness and mitigation activities prior to the disaster
- Effective disaster responses that incorporate capacity-building and other long-term development strategies
- Reduction of the social, economic, and physical vulnerability of target populations.

According to J. Brian Atwood, former USAID Administrator, "a single natural disaster occurring in a country that has failed to take preventive measures, failed to develop effective forecasting and response mechanisms, and in which a large portion of the population remains vulnerable, places development investments at great risk and is likely to reverse years – even decades – of development."[40]

Overcoming the Obstacles

The key to redressing the relief-development divide is to deal with disasters and development as complex events that influence each other in an interconnected way. In order for this to occur, organizations will need to increasingly base their work on the new paradigm of developmental relief and resilient development. When such policies are implemented, the shocks of natural disasters are reduced and communities will require less time to get back on the road to recovery.

While there is wide intellectual agreement than an integrated approach to development and disaster response is clearly the key to any significant progress in this area, divergent mindsets remain. Development practitioners have been trained to think largely in terms of

[40] J. Brian Atwood, Former USAID Administrator (1998)

long-term programs and results. Disaster experts are conditioned to think largely in terms of logistics and short-term emergency response. As more public attention and research studies focus on the artificial separation of relief and development, agencies are beginning to embrace the integrated strategies required to bridge the divide.

The New Paradigm

The first step in the process has been to work toward a greater understanding of the complex relationship between natural disasters, changing weather patterns, and the impact of international development activities. A variety of different conceptual models have emerged to explain the processes and "feedback loops" between relief and development. Because these models are less segregated less one-sided, they help planners to visualize the extent to which disasters and development are intertwined.

The second key in this transformation has been a deeper theoretical understanding of the nature of economic, social, and cultural vulnerabilities that exacerbate natural disasters. Programs that target prevention, preparedness, and mitigation are the logical result of this enhanced understanding. Prevention projects seek to eliminate vulnerabilities altogether by, for example, designing engineering solutions to flooding. Preparedness activities seek to reduce vulnerability by informing local populations about their risks, thus empowering them to take pre-emptive action to reduce their vulnerability. Mitigation activities seek to minimize the impacts of future events by reducing the social, cultural, or economic vulnerability of affected populations.

The third important element in bridging the relief to development divide is the increased awareness that local people themselves must play a role in resilient relief and development efforts. Despite the tremendous vulnerabilities to natural disasters that people in the developing world face, they also have many strengths and resources (capacities), which can and should be utilized in both development and disaster management. Among these are:

- *Physical Capacities* - structures, roads, storage facilities, agricultural technologies, and infrastructure, water tanks, generators, transportation infrastructure
- *Human Capacities*- skills found among carpenters, nurses, women's organizations, farming cooperatives, as well as local knowledge of traditional crops and weather systems
- *Social/Cultural Capacities* – traditional technologies (e.g. cyclone resistant housing) and customary coping mechanisms (e.g. kinship networks)

Knowledge about and effective use of community capacities can lead to a far more effective disaster response and, ultimately, to the more efficient reduction of disaster vulnerabilities at the local level.

Relief efforts should not only target short-term disaster impacts, but should also simultaneously enhance local capacities, thereby decreasing the long-term vulnerability to future disasters. This means that disaster relief must go beyond simply getting things "back to normal" because "normalcy" often encompasses those factors that contributed to the disaster in the first place. In order for relief programs to truly reduce long-term vulnerability, they must be judged by the same standards as development projects. This will, undoubtedly, represent a departure from standard relief programs, which have traditionally been judged primarily by their logistical prowess and speed of delivery.

By definition, the work of socioeconomic development aims at long-term sustainability. In an ideal world, every development project or program should anticipate and be designed to mitigate, and where possible, prevent disasters. Furthermore, these projects and programs should forthrightly identify and address the vulnerabilities of the target population. Over the life of a project, a conscious effort would be made to ensure that these vulnerabilities are reduced. In order for any new model or approach to achieve success, the issues of "vulnerability" must be viewed not as a post-disaster issue, but rather as a priority to be considered and addressed from the inception of any relief or development effort.

During the last decade, there has been a growing awareness among relief and development workers that coordinating their efforts may indeed prove beneficial and begin to result in development that is resilient and relief that is developmental. Examples of where the development to relief gap is being bridged are particularly evident in the areas of agriculture and natural resource management. Because the majority of the people most at risk of weather-related natural disasters live in rural areas, their livelihoods are most often tied to agriculture and natural resource management. The advancement of research in these two areas has provided a growing array of tools and knowledge that can help to ensure that relief and development both produce sustainable and lasting results.

7. AN ARSENAL OF PROMISING AGRICULTURAL AND ENVIRONMENTAL APPROACHES TO MITIGATE NATURAL DISASTERS

The condition of the land, the level and success of farming activities, and the stewardship of natural resources help determine the severity of disasters and the ability of communities—with the help of relief agencies, to recover from them. Local, national, and international research on natural resource management, environmental services, farming systems, and the study of socioeconomic issues related to food and agricultural policies has greatly advanced in the last decade. This has been in part driven by advances in satellite, communications, and biological technologies. This research has provided new technology and tools such as new seed varieties, improved livestock, and knowledge of natural resources.

Tools and techniques have come from a variety of sources, including the laboratory, field trials, local knowledge, and disaster experiences. During the last four decades, a network of international research organizations known as the Future Harvest Centers of the Consultative Group on International Agricultural Research, has been undertaking food and environmental research to raise food crop yields and to help plants tolerate conditions of drought and flooding as well as resist insects and disease. In addition, they have been undertaking research on agroforestry techniques, fish farming, and socioeconomic policies. Working in concert with national partners, farmers, and local communities, this research is helping to bridge the relief-development divide by grounding these efforts in scientific research that can provide vital tools for long-term success.

In addition relief agencies such as CARE, Catholic Relief Services, World Vision, and Oxfam have been incorporating land use issues into their work. Conservation organizations have become more cognizant of development issues as they approach wildlife conservation projects.

One of the consequences of natural disasters, particularly floods, cyclones and prolonged droughts, is the loss of biodiversity in the affected ecosystems. CARE, through its Integrated Conservation Development Program (ICDP), has been implementing a global effort to link the biodiversity conservation with socio-economic welfare of indigenous people living in or around forests. In addition to the direct loss of biodiversity, resettlement of displaced communities may cause serious and cumulative losses of flora and fauna in newly settled areas. This is particularly true of disasters that encourage resettlement such as cyclones hitting coastal areas and earthquakes or landslides.

Worldwide, there are at least 250 significant areas of biodiversity that are threatened. Of these, at least 50 sites are vulnerable to natural disasters. CARE's approach links the conservation effort to rational and viable livelihood strategy. Twenty-three ICDP projects are currently being managed by CARE. Although only a few of these are located in the

disaster-prone vulnerable areas, the principles involved in conservation are common. These include: a) full involvement of communities, b) connecting conservation to livelihoods, c) emphasizing the value of natural resources to value-added products, d) reduced dependence of communities' livelihood on scarce biodiversity and e) conservation of biodiversity through indigenous effort and community consensus.

Building blocks for long-term recovery

Agricultural and environmental scientists and development experts have found a growing number of techniques, approaches, technologies, and systems to mitigate the damage done by natural disasters on the land and its inhabitants while building new systems capable of withstanding future emergencies. These are increasingly used by relief workers prior to or concurrent with the crisis, providing building blocks for longer-term recovery. These approaches are grounded in tools and technologies that help to make relief more developmental and development more resilient.

Long-term development programs can reduce agricultural vulnerability to storm-related disasters through land-use evaluations, vulnerability and risk assessments, inventory of traditional community land-management practices and exploration of local coping strategies, as well as an assessment and identification of crop, livestock, fisheries and forestry practices and farming systems suitable for vulnerable areas.

There are many examples of land-use planning and agricultural, forestry and fisheries practices that, if applied in an appropriate context, increase resilience and reduce susceptibility to storm damage. These planning techniques and practices include the following:

- Land use planning focused on improving soil fertility;
- Soil conservation and watershed management using conservation practices focused on protecting against wind and rain erosion;
- Seed systems and genetic resource collections to facilitate the selection, development, and multiplication of seeds for specific conditions and needs;
- Improved agricultural techniques related to crop diversification, irrigation, and biological control;
- Global Information Systems (GIS), Internet technologies, and improved communications,
- Risk mapping and disaster mitigation strategies, and
- Early warning systems that monitor changing land, weather, and socioeconomic conditions.

Land use and soil fertility

Land use planning ensures that production and conservation activities are appropriate to the characteristics of the soil and terrain and the capacity of the land. The soil's slope, depth, drainage, and rockiness determine what uses the land can sustain. For example, land use planning in eastern Guatemala was recently focused on two major watersheds affected by Hurricane Mitch in 1998.

Land use planning can include the targeting of agricultural technologies to land type "niches". This can foster system resilience while improving livelihoods. In large parts of Southern Africa, for example, farmers distinguish among "toplands," (poor soil and subject to drought), "home gardens" (more fertile because they receive organic household wastes), and "vleis" (fertile but flood-prone areas at the bottom of the landscape where water accumulates from lateral flows). In its work with farming communities and local partners such as CARE, CIMMYT (International Maize and Wheat Improvement Center) has been able to introduce drought-tolerant maize varieties and related soil fertility practices for the toplands, and bed systems that mitigate the effects of floods for the vleis. In addition, simulation models have been used to anticipate the riskiness of these technologies over time. Farm families participate in assessing model outcomes through a communication device known as the resource allocation map (RAM), a farmer-drawn map of a household that portrays nutrient flows within the farming system.

Better land use policies and practices have been combined with emergency preparedness and response in order to prevent large and damaging fires. Working toward forestry practices with community involvement is an important strategy to better conserve natural resources while reducing the impacts of wildfires.

As part of this effort, there is a movement to enlist the support of forest dwellers and farmers as part of the solution for more sustainable use and conservation of forest ecosystems. Some countries have adopted educational measures to gain the support of farmers and to ensure sustainable land use.

Efforts to modify current use of natural renewable resources in areas such as the Amazon, from the norm of extensive clearing and exploitation, to planned and sustainable resource utilization, require better integration of public policies aimed at promoting economic development.

A transition is underway with regard to ownership and control of developing countries' forests. Rural communities and indigenous people are successfully asserting control over forestland, now owning or officially administering at least 25 percent of the developing world's forests—nearly 300 million hectares (741 million acres). That trend is expected to accelerate over the next several years suggesting that working with forest communities will be essential to effective land use and management. Continued clarification of land

ownerships issues, training for local forest users, and supportive government policies will be essential.[41]

Through ICDP, CARE has been promoting the production and marketing of several non-timber forest products with communities living in the buffer zones of several national parks and forests. For example, honey production for markets has been found to be a valuable source of incremental income by forest dwellers in a number of national parks in Uganda, Burundi, Rwanda and Kenya.

Soil conservation and watershed management

The use of living barriers, rock walls, reduced or zero tillage plowing, contour farming, and leguminous crops to keep the soil covered to reduce rain and wind erosion are all approaches to soil conservation. Between 1990 and 1996 in one area of Honduras, 50,000 farmers participated in a project designed to improve farm income on marginal hillsides and in coastal areas. Staff from local private voluntary organizations, farmers, and rural organizations worked to improve agronomic practices and soil conservation and rural enterprise. By 1996, basic conservation technologies such as living barriers, mulching, and contour planting were being used to reduce erosion on the hillsides. With these soil conservation measures in place, the area was able to withstand the effects of Hurricane Mitch.[42]

The risk of landslides and flash flood damage in mountainous areas has been reduced by undertaking soil conservation measures, including the planting of tree and grass species, physical slope stabilization, and construction of drainage works where roads, settlements, and arable land are vulnerable to landslides and floods following heavy rain. In Haiti, development activities are encouraging farmers to use trees to stabilize the soil and prevent erosion. To ensure that the trees provide income and are not cut for fuel wood, they were encouraged to form mango marketing associations and cacao cooperatives. Both enterprises led to increased earnings for farmers and to more stable hillsides that resists hazards.[43]

Ongoing research regarding methods of calculating and predicting flash floods as well as on biological and hydrotechnical means of watershed restoration and torrent control to prevent landslide and large mass movements can also assist populations living in these

[41] Making Markets Work for Forest Communities, www.futureharvest.org/pdf/Final_Report.pdf
[42] This project was funded by USAID. Material also from correspondence from Daphne Hewitt, Assistant Project Manager, ARD, Inc.)

[43] John Dale Lea and Sarah Belfort, Haiti Productive Land Use Systems Project Semi-Annual Report. February 2000. South East Consortium for International Development and Auburn University.

areas. Scientists can also help establish strategies to protect arable and grazing land from flood and tidal bores in coastal areas by means of embankments, dams, canals, improved drainage systems and other works.

Orissa state in India has been called the land of disasters since the mid-90s. Ravaging drought hit this area in 1996, followed by a devastating super cyclone in 1999 and another drought in 2000. Again, in 2001, out of 30 districts in the state, 22 were seriously affected by a devastating flood.

Kantapada is a community development block, located 30 km from the Cuttack district. It is situated in the Mahanadi delta, rich in resources to maintain livelihoods. The main occupation of people is agriculture. Kantapada's only curse is its vulnerability to hydrological disasters.

Along with other local NGOs, CARE extended its support to the disaster victims with its two-fold approach of targeted and untargeted relief followed by rehabilitation measures.

Village Relief Committees were formed in every village to ensure a better co-ordination of relief work Activities undertaken were decided in consultation with the villagers in each village meeting. All the rehabilitation activities involved voluntary labor including: soil filling of breaches; road repairing, cleaning of ponds and water sources; tree plantations and nurseries; restoration of livestock; building of shelters; building of cross bunds and rebuilding of water harvesting structures.

Genetic resources and seed systems

During natural disasters, whether storm or drought related, seed supplies are often depleted either directly by storm damage or because families have no choice but to sell or eat their seed reserves.

When Hurricane Georges hit Haiti in 1998, well-developed informal bean seed and banana plantings systems were disrupted and seeds lost. However areas of the island closer to the Dominican Republic suffered less damage. CARE staff worked with farmers who needed bean seed and banana plantings by enlisting the aid of farmers in areas of the Dominican Republic with similar growing conditions. They identified and tested varieties, which were then replicated and distributed.[44]

[44] CARE- annual and country reports, 1998, 1999.

In that same year, Hurricane Mitch struck Central America, with devastating results. During its three-day rampage, the storm dumped millions of cubic meters of rain on Honduras' and Nicaragua's mountainous terrain. The hurricane's effects were most calamitous for the poor, often living below the poverty line and possessing scant cash or food reserves. Farmers lost their maize seed – as did the national institution charged with maintenance and production of foundation seed. As part of the "Seeds for Hope for Central America" program, the International Maize and Wheat Improvement Center (CIMMYT) sent Honduras nearly a half a ton of seed of diverse improved maize varieties and inbred lines. These varieties were known to possess high yields, regional adaptation, and stress tolerance from their performance in previously-conducted research trials in Honduras and neighboring countries. CIMMYT then worked with the Honduran government, regional networks, funding agencies, NGOs and other players to coordinate maize seed multiplication and seed relief. In a later ceremony, CIMMYT was formally thanked by the then Vice President of Honduras, Miguel Angel Bonilla.

Again in 1998, in Niger—a country where in a good year farmers can only hope to receive 8- to 10-inches of rainfall—farmers were in desperate need of seeds following a severe drought in 1997. An emergency seed delivery system put in place with the help of national and international organizations a year earlier ensured that needed seeds were delivered to more than 4,000 farm families. The new seed delivery program averted famine and also accelerated the adoption of improved varieties–seeds that were more drought-tolerant and disease and insect-resistant than those they replaced–by farmers, a process that usually takes a decade. Agricultural development and emergency relief workers believe that by providing seed rather than food aid, the cycle between drought and famine can be broken in the region.

The ongoing food emergency in Southern Africa reminds us that drought remains a threat in that region. A devastating combination of events, orchestrated by nature and by human beings, is forcing an estimated 14 million people into starvation. Given that maize is by far the most important food grain, it is clear that drought-tolerant maize would be a great blessing, potentially saving lives at the largest possible scale. Such maize is now available to farmers. Maize varieties have been developed and disseminated that – under harsh conditions of drought and low soil fertility – produce a full 30-50% more than any other alternative, whether local varieties or the best commercial hybrids. This breakthrough was developed by the International Maize and Wheat Improvement Center (CIMMYT) and numerous partners through the SADLF project (Southern Africa Drought and Low Soil Fertility). Through the combined efforts of CIMMYT, World Vision, Catholic Relief Services, Africare, CARE International, and public sector institutions these varieties have been released and disseminated in Angola, Malawi, Mozambique, South Africa, Tanzania, Zambia and Zimbabwe. Since 2000, this partnership has channeled more than 70 tons of seed into community-based seed production. Despite its current impact, it is often forgotten that this breakthrough was based on more than 20 years of research by CIMMYT, much of it in Mexico.

Similar breakthroughs have been achieved by CIMMYT with wheat, where varieties have been developed that maintain productivity under exceptionally severe drought stress. Other wheat varieties have been developed that, astonishingly, thrive even when waterlogged. These wheats will soon be released – unless, that is, financial resources for agricultural research continue to dwindle.

In other cases, it is often necessary to turn to genebanks that contain collections of seeds stored under refrigeration to replenish seed stocks. Working with organizations such as the International Plant Genetics Resources Institute, aid agencies, governments, and development organizations can find seed types located in genebanks of the Future Harvest Centers that meet specific growing conditions. In the case of Afghanistan, seeds located in the genebank of the International Center for Agricultural Research in the Dry Areas, which were collected in Afghanistan and stored decades earlier, are providing the foundation for restoring agriculture in that drought and war-torn country.

Storms have an immediate and visible impact on agriculture through damage to flora and fauna, including standing crops and livestock. The development and use of storm-resistant crops, such as ginger, pineapple, and tubers, and the planting of forestry windbreaks and shelterbelts are among the strongest measures farmers can take to mitigate storm damage. Conservation of forest biodiversity is equally important. In the disaster vulnerable areas of highly populated countries, such as India, special effort has to be made to catalogue, characterize, and conserve the forest biodiversity to help rehabilitate the forest land with suitable locally adapted seed materials after natural disasters.[45]

COCONUT: AN AGRICULTURAL MITIGATOR TO NATURAL DISASTERS

Coconut is an extremely important crop to many of the world's poorest people, particularly those in the humid tropics. Economists estimate that 96 percent of the crop is grown by resource-poor farmers in some 80 countries. The coconut palm is widely known as the "tree of life" because it provides more than 100 separate products, including food, drink, fuel, livestock feed, fiber and building materials. But in drought- and cyclone/typhoon-prone areas of India, Indonesia, Thailand, Sri Lanka, and Viet Nam, coconut is vulnerable, so scientists are collecting and conserving coconut genetic resources that could be used in breeding to confer resistance to the effects of these natural calamities. Scientists also see an increasingly important role for coconut in conserving the island environments of the low-laying atolls of the South Pacific, which are particularly vulnerable to such natural disasters as drought and typhoons, as well as to global warming. With a unique ability to conserve soil, coconut prevents overheating of soil; reduces evapotranspiration; reduces salt spray and storm surges; and grows in environments where many other plants would not survive. In the atolls,

[45] Nautiyal, S. and Kaul, A. K. Forest Biodiversity and Its Conservation Practices in India.Oriental Enterprises Press, 1999, pp.337.

for example, coconut contributes greatly to stabilizing the fragile farming systems on which their inhabitants depend for their subsistence.[46] Scientists are also developing intercropping systems in South Pacific countries that use root crops such as cassava, yam, and taro with coconut to build wind tolerance.[47]

Crop Diversification, Irrigation, and Biological Control

The resilience of farming systems to changing climatic conditions, including drought and the diseases and pests associated with it, as well as flooding conditions, declining soil fertility, and the declining availability of arable land requires the development and use of new varieties of crops that can grow under changing conditions and produce high yields. The use of a wider variety of crop types planted is also important, often spreading the risks associated with farming across a range of crops and crop characteristics, reducing the likelihood of total crop failure.

Drought tolerant tree species and agroforestry systems can provide protection for crops through shading and can reduce drought-induced erosion. Sylvi-pastoral systems can provide important fodder resources in arid and semi-arid areas. Planting of forestry windbreaks or shelterbelts which reduce wind-induced evaporation in crops and wind erosion of arable soils are also being promoted, as well as a range of forestry systems for sand dune stabilization and the control of desertification.

Providing sustainable irrigation opportunities in drought prone areas as well as biological controls that fight agricultural pests such as locusts during periods of drought are two additional techniques that bridge emergency relief and long-term development.

In the eastern Indo-Gangetic Plains of India and parts of Bangladesh, major floods during the monsoon season ("kharif") are not uncommon. These can destroy villages, kill livestock, spread disease, destroy monsoon crops, and lead to widespread hunger. It is now becoming apparent, however, that new land management practices in the post-monsoon season ("rabi") can lead to a dramatic turnaround. Just as excess water is the rule during kharif, so is water scarcity the rule in rabi. But rabi season production can be transformed from "marginal" to "hugely productive" through two simple innovations: zero tillage or related practices for rabi crop establishment, and simple low-lift pumps for irrigating rabi crops with groundwater. These innovations have the ability to transform the household economy of tens of millions of families in the most desperately poor areas of the subcontinent. These innovations are being developed and their use fostered by the Rice Wheat Consortium for the Indo-Gangetic Plains, an ecoregional program of the

[46] This program is supported by the Asian Development Bank and the Coconut Genetic Resources Network (COGENT) and IPGRI, and various collaborators.
[47] This project is funded by the International Fund for Agricultural Development (IFAD).

CGIAR. The RWC is convened by the International Maize and Wheat Improvement Center (CIMMYT) and features the active participation of four national programs, four other Future Harvest Centers of the CGIAR, and dozens of advanced research institutions, NGOs, farmer groups, and private sector entities.

In the Turkana district of Kenya, irrigation has played a major role in expanding opportunities for agriculture in an area that is arid and vulnerable to drought and famine. Irrigation was introduced to help the pastoralist Turkanan people who were facing diminishing land for grazing and shortages of forage and water. With the help of World Vision and support from the Government of Kenya, more than 600 acres will be irrigated and will support 80 percent of the households' grain requirements.

The communities also established water catchments and fuelwood production linked to the canal systems and created live fences to protect the canals. Intercropping, crop rotation, and integrated pest management techniques were also developed. This project received UNDP's first award for Environmental Conservation.

There have been a number of programs led by the International Institute of Tropical Agriculture for using biological controls of crop predators, including the use of parasitic wasps to control the cassava mealy bug, which devastated cassava crops in West Africa in the 1980s, the use of a mite to control another cassava pest in the mid-1990s**,** and the development and use of an environmentally safe, natural alternative to chemical insecticides in the fight against crop-destroying locusts and grasshoppers since early 2000.

Global Information Systems, Internet, and improved communications

The development of baseline information for disaster prevention would be an important step forward. A database that indicates the areas most vulnerable to storm-related disasters including descriptions of other factors would be useful to research, development, and relief workers. One tool being used to identify this data is an environmental indicators tool kit, *Rural Sustainability Indicators for Central America*, which reveals environmental vulnerabilities to assist Central American decision-makers in their analysis of the causes and impacts of past disasters, but also to prepare more effectively for future disasters. The indicators reveal that one-third of Central America is at risk of flooding and 60 percent of Honduras is vulnerable to flooding and landslides. The CD-Rom based toolkit has also found that nearly half of Central America's land surface is being used inappropriately and causing serious soil degradation problems. Other findings include that 14 percent of the land being used for agricultural production is better suited for forestry and nearly 30 percent of the region's forests are at high risk of being lost.[48]

[48] The toolkit was developed by the International Center for Tropical Agriculture, a Future Harvest Center based in Cali, Colombia, with the UN Environment Programme, and the World Bank.

Rapid Agriculture Disaster Assessment Routine (RADAR), a project supported by the United Nations Food and Agriculture Organization, emphases the development of a detailed reference databank on the immediate impact and long-term effects of natural disasters. These databases, combined with data from global information systems and remote sensing provide vulnerability mapping and now even identify areas vulnerable to natural hazards.

Risk mapping and disaster mitigation strategies

Other preventative measures include installing drainage works where roads, settlements, and arable land are vulnerable to landslide and flooding following heavy rains; constructing small-scale embankments, dams, canals, and drainage systems to protect arable and grazing land from flood and tidal waves in coastal areas; equipping ocean-going fisherfolk with radios to enable them to benefit from early warnings of storms and supplying them with life-saving equipment and improved boats.

In addition, disaster-preparedness programs and risk-assessment studies could be used to classify the nature of storm-related risks in vulnerable zones and identify mitigating measures. Flood-prone countries also need measures and practices to mitigate the impact of recurrent flooding, including information provided through databases of flood risks and maps detailing extent, depth, duration and frequency of flooding.

A team of researchers is currently assessing the feasibility of having financial markets offer new forms of insurance based on regionally defined indexes of natural disasters. By offering effective mechanisms to help people manage their own losses, a weather-based index insurance would reduce the burden imposed on governments by the costs of disasters.[49]

Early Warning Systems

Because early warning systems anticipate hazards before they become disasters, they are used in many different contexts. A Famine Early Warning System (FEWS) in Africa provides advance notice of potential droughts. In the greater Caribbean basin, improved early warning systems are associated with dramatic decreases in the number of fatalities, despite population growth and increase in the number of hurricane events. In East Africa, the Livestock Early Warning System helps pastoralists maintain their livestock herds during crisis.

[49] The team includes researchers from the International Food Policy Research Institute, a Future Harvest Center in Washington, DC; the World Bank; Instituto di Stdu Economici e Sociali, Italy; University of Rome; University of Kentucky; Ohio State University.

8. SNAPSHOTS FROM THE FIELD: HOW NATURAL RESOURCE MANAGEMENT AND AGRICULTURAL DEVELOPMENT ARE HELPING BRIDGE THE RELIEF- DEVELOPMENT DIVIDE

Coping with the Fury of Storms while Promoting Preventive Development in Central America and Asia

In 1998, Central America and Asia were devastated by storms and flooding. Hurricane Mitch was the deadliest storm to hit Central America in more than a century, killing some 10,000 people, leaving as many missing and almost 13,000 people injured.[50] An astounding 2 million people were displaced and close to 2.5 million evacuated. In Asia, storm surges, torrential rains, landslides, mudslides, and tidal waves affected more than 300 million people in China, Bangladesh, India, and Papua New Guinea. More than 10,000 of them died before the waters had even subsided. The impact of the storms and floods was most brutally felt by the poorest populations, primarily farmers. In the case of Asia, the majority of those affected were settled on flood plains near agricultural areas.

The ravages wreaked upon Central America in 1998 by Hurricane Mitch are still being analyzed and felt. Unprecedented amounts of rain washed away most of the crops, animals, and infrastructure in the region, resulting in damages estimated at more than US$6 billion.

Decades of environmental degradation such as deforestation and unsustainable agricultural practices had made the region extremely vulnerable, setting the stage for the massive devastation caused by Hurricane Mitch.[51] For instance, large-scale plantation agriculture and cattle ranges were fringed by hundreds of thousands of poor, rural subsistence farmers who had expanded further and further out on fragile, marginal lands that included steep inclines, river canyons, and floodplains.

The region generally was taken unaware by the storm. Some experts even went so far as to declare Hurricane Mitch an "unnatural disaster,"[52] due to the suddenness and violence of its onset.

Hurricane Mitch hit subsistence crop production and small and medium-size livestock production particularly hard. Crops were destroyed, livestock were lost or drowned and land stripped of soil. The incomes of tens of thousands were destroyed within a few hours or days, which meant that food assistance had to replace any local food producing

[50] CEPAL, *Special Edition,* February, 1999. Cited in Girot, op cit.
[51] Girot, Pascal O. *Vulnerability, Risk and Environmental Security in Central America: Lessons from Hurricane Mitch.* World Conservation Union (IUCN) Task Force on Security and Environment. Costa Rica, No date.
[52] Sierra Club of Canada. "Was Hurricane Mitch a Natural Disaster?" News release. November 6, 1998.

capacity. Equally problematic was the elimination of the local seed stock necessary for replanting.

Response phases to Hurricane Mitch included recovery and rehabilitation, followed by the resumption of development efforts. An example from Honduras shows the rapid shift of a development organization, World Neighbors, from long-term community development to immediate relief, followed by recovery and rebuilding.[53] This organizations works with more than 60 remote rural communities, consisting of 2,800 subsistence farming families, (almost 44,000 people) living in or near protected natural reserves, forests or national parks. Its program includes support to protect natural resources and programs to stabilize the spread of the agricultural frontier to prevent encroachment on biodiversity and forested lands.

First order of the day for World Neighbors' response to Hurricane Mitch was to provide food, water and medicines. For the recovery phase, the organization introduced specific natural resource management techniques. These included practices in terracing, natural pest management, and use of organic fertilizer. Also included was support to farmers to establish small poultry farms to provide a quick source of protein for their families. In the third phase, development, a micro-credit system was set in place to finance the re-establishment of agricultural systems in affected areas.

Although initial reports indicated that the devastation to the agricultural sector was uniformly awesome, on-site observers began to see a pattern emerge indicating that the farmers that had used more sustainable practices had suffered less damage than their neighbors.[54] These small farms were owned by participants in a multi-institutional movement that promotes agroecology and sustainable agriculture practices. Known in Central America as "Campesino a Campesino" (Farmer to Farmer), the movement advocates a wide range of soil conservation and sustainable cultivation methods that have been tested by small farmers over 30 years.

Because these circumstances provided an opportunity to compare the agroecological resistance of sustainable farms to the hurricane with that of conventional farms, there was considerable interest in undertaking an extensive participatory research project focused on the area hit by the hurricane based on a specific set of agroecological indicators. With support from a number of foundations, such a project was undertaken under the direction of World Neighbors, a leading NGO working in the region.

Over a six-month period, more than 40 NGOs trained and mobilized 100 farmer-technician teams and more than 1,700 farmers to carry out paired observations of specific agroecological indicators on approximately 1,800 sustainable and conventional farms.

[53] World Neighbors. "Hurricane Mitch: From Relief to Recovery." (Bulletin Board Posting). November 20, 1998
[54] World Neighbors. *Reasons for Resiliency: Toward s Sustainable Recovery after Hurricane Mitch.* 2000

Owners of the farms accompanied each team and signed off on the field sheets indicating measurements and observations had been free of bias. More than 360 communities and 24 government departments throughout the three countries affected by Hurricane Mitch were also involved.

The overall results were an overwhelming trend of higher agroecological resistance on the sustainable farms. Sustainable plots had been found to have 20- to 40-percent more top soil, greater soil moisture, and less erosion than their conventional counterparts. Sustainable farms also had fewer and smaller gullies and areas of rill erosion. All of these indicators were seen as contributing to both productivity and the conservation of the watershed. Because the sustainable farms grew diversified crops, they also averaged lower economic losses, with Nicaragua actually showing profits in spite of the hurricane.

Probably the most impressive result, according to observers, was the fact that more than 90 percent of the conventional farmers who participated in the study indicated their interest in adopting sustainable practices. Another important revelation that came from the study showed that many organizations and farmer groups at the local level had mobilized to respond to the humanitarian emergencies brought on by the disastrous hurricane. Many farmer to farmer groups had helped to motivate self-help efforts in their communities instead of simply waiting for outside emergency assistance; a further sign that resilience to natural disasters has a social as well as a technical dimension.

Drought Relief in Southern Africa

Erratic rainfall and drought are recurring problems in southern Africa, which is why the Swiss Agency for Development and Cooperation and the Rockefeller Foundation funded the Southern African Drought and Low Soil Fertility Project (SADLF), involving the International Maize and Wheat Improvement Center (CIMMYT) and national agricultural research programs of the Southern Africa Development Community (SADC) region.

Stress-tolerant, open-pollinated varieties (ZM421, ZM521, and ZM621) from the project have been released in Malawi, South Africa, Tanzania, and Zimbabwe, and they are also being used in Angola and Mozambique. In trials grown from Ethiopia to South Africa in 1999, ZM521 produced an average 34% more grain than other improved varieties farmers currently grow.

Since 2000, CIMMYT and partners from national programs and NGOs have channeled more than 70 tons of seed of these varieties into community-based seed production in Angola, Malawi, Mozambique, South Africa, Tanzania, Zambia, and Zimbabwe. The varieties are spreading. More than 500 tons of commercial seed of these varieties has been produced so far—enough to plant 25,000–30,000 hectares. The project is testing a newer

generation of drought-tolerant, open-pollinated varieties whose productivity exceeds that of ZM421, ZM521, and ZM621 by 15%.

The SADLF project's goal—to provide smallholder farmers with more appropriate stress-tolerant maize varieties—relies on a system in which any breeding program in the SADC region (CIMMYT, national programs, private companies) can test its maize for qualities important to resource-poor farmers. These include tolerance to drought and poor soils (low nitrogen, acidic, low phosphorus) and resistance to diseases and insect pests. Maize is tested in researcher-managed regional trials as well as farmer-participatory on-farm trials (called "Mother-Baby" trials), which are a collaborative effort between national agricultural research and extension programs, NGOs, and farmers.

Ministries of agriculture, NGOs, and private seed companies use the trial results to provide farmers with better varieties. Because of the drought, thousands of tons of maize seed are currently being made available to farmers by agencies such as World Vision, Catholic Relief Services, Africare, and CARE International. Marianne Bänziger, a maize physiologist based in Zimbabwe who leads the SADLF effort, points out that the trial results can help relief agencies make better decisions about which varieties to supply. "For drought relief in the Southern Province of Zambia, GTZ will support the purchase of only those varieties that have been previously tried and selected by farmers," reports Ortwin Neuendorf of the GTZ/ Small Scale Seeds Project, Zimbabwe.

Maize varieties that yield better under stress will not be sustainable if they take a toll on the environment. As stress conditions increase, maize plants increasingly fail to produce a cob, but they still use nutrients and water. Stress-tolerant maize varieties are efficient: they put those resources into grain production, but the overall uptake of water and nitrogen remains virtually the same.

The environment may also benefit indirectly when farmers experience better harvests. With less fear of crop failure, farmers may be more inclined to invest in their maize crop and purchase fertilizer, or take other steps to improve soil fertility and conserve water. Because of the high risk of drought, many farmers plant more maize area than needed to be sure their families will not suffer hunger if rainfall is poor. Drought-tolerant maize varieties ensure improved food security on a smaller area. Farmers can allocate more land and labor to legumes and cash crops, thereby improving incomes and soil quality.

A "Revolution" in Rice Research Brings Agricultural Stability to Flood-Ravaged Bangladesh

In early July 1998 the worst flood in its flood-filled history hit Bangladesh. At that point two-thirds of country was under water. Initial loss of life was relatively small, with several hundred dead, compared to 5,000 in a 1988 flood. At first, a lower death rate

from the immediate effects of flooding was attributed to the improved country response mechanisms. But as the flood waters began to recede, there were dire predictions of famine, epidemics of sickness, widespread unemployment, spiraling food prices, and as many as two million deaths.[55] *None of these things happened. There was no famine.*

The story of how people in Bangladesh escaped the dire predictions of calamitous famine is instructive, illustrating the powerful role agricultural research can play in mitigating natural disasters. Each year, like clockwork, the three great rivers of the region – the Ganges, Padman, and Brahmaputra–swollen with snowmelt or heavy rainfall from the Himalayas, collide with high tides or, even worse still, with cyclones, as they rush south to the Indian Ocean. They spill out over almost half the country, and sometimes, during years of extreme conditions, three-quarters of the country is under water.

Prior to the severe floods of 1974, the only way farmers of Bangladesh were using the floodwater for their annual crop was by growing deepwater rice. Their low yields of about two tons per hectare contributed to extreme poverty of the country. In the 1970s some 70 percent of Bangladeshi families were living below the poverty line. In the 1974 floods, more than 2.5 million hectares of deepwater rice was destroyed, and the land remained inundated with water beyond the planting season. As a result, agricultural workers lost jobs, wages declined, and with the next crop a year away, rice prices trebled. Although international relief and food aid saved thousands of lives, more than 30,000 people died.

The 1974 disaster was the culmination of years of unmitigated flooding disasters.. What emerged, with support and assistance from international agricultural scientists was a national rice research institute. Called the Bangladesh Rice Research Institute[56] *and staffed with more than 100 Bangladeshi scientists who had been trained at the International Rice Research Institute (IRRI), a Future Harvest Center based in The Philippines, the new institute set out to develop cutting-edge farming technologies that would benefit from abundant underground water.*

The scientists adapted modern high-yielding varieties of rice developed at IRRI for conditions in Bangladesh. Farmers began using these irrigated dry-season rice crops and increased their yields by as much as six tons per hectare while reducing the areas planted in the more vulnerable wet-season crops from 4.8 million to 1.6 million hectares. By the time Bangladesh was hit by the raging floods of 1998, its reliance on

[55] International Federation of Red Cross and Red Crescent Societies (IFRC), "Born in the Midst of Floods—Bangladesh," Sept. 29, 1998; World Vision, "Bangladesh—Life-Threatening Flood Fury Continues," Oct. 5, 1998.

[56] IRRI "A Few Case Studies," 2000; Christian Aid, "Catastrophic Floods in Bangladesh," Aug. 31, 1998; Australian Broadcasting Corp., "More Flooding Forecast for Bangladesh," Sept. 3, 1998 (WebRelief)

deepwater rice had been so significantly reduced, that the loss of two million tons of rice was quickly made up by the dry-season crops. Bangladesh's subsequent harvest was the best in the history of Bangladesh.

The triumph of agricultural research over the historical threat that had always accompanied the annual floods in Bangladesh was a "win-win" for all concerned. It not only spared the country the high cost of importing food, it also spared the international community the great cost of providing emergency food aid. A follow-up economic analysis of the remarkable turnaround that occurred in Bangladesh concluded that an $18 million annual investment in rice research, irrigation, and agricultural extension produced savings to Bangladesh over a 20-year period amounting to $229 million per year.

While these efforts were helping to offset anticipated famine following the 1998 flooding in Bangladesh, another important disaster mitigation project was also at work on another front. CARE was focusing its efforts on two flood-prone areas in order to test techniques that might further mitigate the impact of regular flooding on inhabitants.[57] *One was an area of sandbars in a river channel that was inhabited by poor, landless families who labored on nearby farms. These sandbars were extremely vulnerable to flooding and inhabitants were forced each year to seek refuge on their rooftops or abandon their homes altogether.*

Using participatory development program techniques, CARE staff worked with local communities to identify problems and potential solutions. From the beginning, the project was viewed as community-centered, and not merely an engineering process. Resulting interventions included elevating houses, schools, markets, and access roads to points beyond flood level. By the time the floods hit in1998, less than ten percent of the elevated houses were inundated and, of these, the waters only rose to a level six inches above the floor.

Markets that had been elevated were able to continue operating, thereby providing commercial services to the community throughout the 1998 flood. In the post-flood period, these markets have grown even more as a result of increased demand by new stallholders wishing to secure their investment against future risk. The markets also serve as high-ground shelters for affected families. In addition, tube wells were elevated and flood shelters built that can serve as schools or other public facilities during non-flood periods.

In a second area, CARE assisted communities in creating "islands" on a flood plane that is largely underwater for nine months of the year, There, relief workers helped to develop agricultural methods adapted to that environment. When wave action from

[57] CARE—Bangladesh. "Lessons learned for CARE – Disaster Response and Transition to Recovery from its 1998 Flood Response Experience." (Unpublished Notes) 1998.

floods began to cause the islands to shrink, CARE came up with a method of stabilizing the island perimeters so as to mitigate the effects of perennial flooding.

ZERO-TILL AND BED PLANTING IN SOUTH ASIA:

Rice-wheat systems are critical to South Asian food security. More than 150 million people support themselves by growing rice in rotation with wheat, but the sustainability of these systems is under threat on several fronts. Improved tillage and crop establishment practices, especially for wheat, show real potential for improving the sustainability and productivity of these systems. Reduced and zero tillage can improve yields, raise input use efficiency, reduce the intensity of machinery use in a sustainable way, and reduce production costs. These technologies also shorten the turnaround time between rice and wheat, helping farmers to plant wheat on time, obtain better yields, and improve the efficiency of input use.

Alternative tillage practices that reduce costs and raise productivity are being tested and promoted by the Rice-Wheat Consortium for the Indo-Gangetic Plains (RWC), an ecoregional program of the CGIAR. The RWC is convened by the International Maize and Wheat Improvement Center (CIMMYT) and features the active participation of four national programs, four other CG Centers, and dozens of advanced research institutions, NGOs, farmer groups, and private sector entities.

Reduced tillage practices are catching on quickly, simply because they are so attractive to farmers. For example, in zero-till farmers sow wheat in a single tractor operation after the rice harvest, planting the seed directly into rice stubble. The practice saves 75% or more fuel, obtains better yields, uses about half the herbicide, and requires at least 10% less water. Farmers save at least US$ 65/ha in production costs, which makes a big difference to their profit margins.

Because of its virtues, zero-till for is catching on quickly for sowing wheat in South Asia. From a modest 3,000-plus hectares in 1998-99, area of use among farmers in India and Pakistan is expected to surpass a half million hectares in the 2002-2003 wheat season. Manufacturers currently cannot make drills fast enough to meet the demand from farmers.

Another recently promoted technique—planting wheat on raised beds—improves yields, increases fertilizer efficiency, reduces herbicide use, saves seed, saves an average 30% water, and can reduce production costs by 25-35% when permanent beds are used. Bed planting is gaining acceptance in India for wheat, and is even being tested for rice. Widespread adoption of one or several of these reduced tillage methods will bring significant environmental benefits.

For example, current land preparation practices for wheat after rice involve as many as 12 tractor passes. Changing to a zero-till system on one hectare of land would save 60 liters of diesel and approximately 1 million liters of irrigation water.2 Using a conversion factor of 2.6 kg of carbon dioxide per liter of diesel burned, this represents about a quarter ton less emissions per hectare of carbon dioxide, a principal contributor to global warming.

These benefits increase dramatically if extended across even a portion of the rice-wheat region's 12 million hectares. Adoption of zero-till on, say, 5 million hectares would represent an annual diesel fuel savings of nearly 0.3 billion liters—equivalent to a reduction of nearly 800,000 tons in CO2 emissions each year—and dramatically increase the availability of water and the efficiency of its use in rice-wheat cropping zones

Relief and development working together to combat effects of drought coupled with war

Although this study examines natural disasters, there are cases in which natural conditions combine with external human-made emergencies that should be considered. Two of particular interest are the ongoing drought and wars in southern Sudan and the recently fought wars in Afghanistan. In both cases, the underlying conditions of drought are essential to each country's current emergencies and long-term future. They focus on linking rehabilitation of the agricultural sector with emergency relief and replacing food relief with locally produced food.

A blueprint for incorporating agricultural science into disaster relief efforts in Afghanistan

It would be hard to imagine a more compelling example of how war exacerbates an already-devastating agricultural disaster than Afghanistan. War conditions – intensified following the events of September 11 – coupled with the region's worst drought in more than 40 years has thoroughly devastated the country's once-enviable food-production capabilities and depleted critical seed stocks, leaving the nation heavily dependent upon food aid from international donors.

Not only is agriculture the largest and most important sector of Afghanistan's economy, it is central to the country's history and culture. Rich in agrobiodiversity, the region was the site of some of the most important plant collecting expeditions undertaken in the early part of the last century by the famous Russian plant explorer, N.I. Vavilov. Over the centuries, Afghan farmers domesticated 18 important food and horticultural crops, including wheat, peas, carrots, melons, apples, and pistachios. The superior fruits they harvested were sought and valued throughout the region. Afghanistan's national agricultural genebank had safeguarded the germplasm of these agricultural treasures until it was destroyed during the war. It is believed that much of the nation's agricultural heritage may have been lost as a result.

To further add to these troubles, a series of devastating earthquakes struck the same Hindu Kush region of northeast Afghanistan in 1998, taking an estimated 8,000 lives and affecting almost 200,000 people, 150 villages, and 26,000 houses. In the words of one Afghan from the region:

…Conflict, poverty, economic stagnation, harsh winters, regular flooding and then earthquakes—Afghanistan is used to natural and manmade disasters, but responding to an earthquake in a mountainous war zone provided fresh challenges.[58]

[58] Ibid, Page 48.

To address the increasingly serious situation now facing the ravaged country, a global consortium of research institutes, relief and development organizations, universities, and aid agencies agreed to undertake an unprecedented multi-million dollar recovery and reconstruction effort to rebuild Afghanistan's agriculture. The aim of the *Future Harvest Consortium to Rebuild Agriculture in Afghanistan* is to restore food self-sufficiency in Afghanistan by 2007. Included in the consortium is a wide range of organizations, whose participation underscores a growing and long-overdue recognition of how crucial scientific input is to the success of any long-term sustainable development effort. A recent strategy document on Afghanistan's reconstruction, drafted by CARE, has emphasized similar needs and issues.[59]

The consortium's overarching goal is to create the critical mass of seed needed for Afghan farmers to be able to produce enough of their own seed to achieve food security and eliminate the need for food aid. To achieve this, the consortium's first priority was to focus on the nation's devastated seed supply system as it forms the foundation for all farming activities. This component of the work – with the potential to be the largest-ever seed recovery effort of its kind. – will be directed at replenishing damaged seed and irrigation systems in order to restore critical farming activities, both for near-term requirements and for long-term sustainability. The consortium has provided farmers with seeds to plant for the spring and fall growing seasons and vaccines to prevent disease in Afghan livestock. The consortium is also focusing on the once-prosperous livestock and horticultural (fruits and vegetables) sectors, as well as land and water management.

Providing foundation seed—used to produce seed that will be planted by farmers—will be essential for replenishing the country's seed stocks, an important element in establishing domestic food security and market development. The consortium will not only reintroduce traditional wheat, maize, barley, chickpeas, lentils, and other seeds that have been used by Afghan farmers for centuries. It will also introduce seeds that have been improved through breeding to be more productive and disease tolerant, as well as new seed varieties that have been bred to grow in conditions similar to those in Afghanistan, thereby helping to introduce crop diversification.

The ambitious work plan of the consortium could serve as a blueprint for how agricultural research institutions and relief agencies can best work together to achieve long-term food self-sufficiency and economic security. With so much at stake, the work of the consortium is certain to be watched closely by the scientific, relief, and development communities.

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[59] Kaul, A. and Efaw, C. 2002, *Rapid and Appropriate Farming Technology for Afghanistan's Reconstruction.* CARE unpublished Report pp.48.

A press release distributed by the UN Food and Agriculture Organization (FAO) and the World Food Program (WFP) to the world press in Rome only a few months before the events of 9/11 puts in stark perspective the dire conditions facing Afghanistan today. Ed. Note

FAO SAYS MILLIONS OF AFGHANS FACE STARVATION AS CROPS FAIL

Rome, June 8, 2001 - Millions of Afghans are facing starvation because a third consecutive year of drought and intensifying economic problems have seriously undermined the food supply situation in Afghanistan, according to a joint Special Alert released today by two United Nations food agencies. The drought has resulted in near total failure of rainfed agriculture and has substantially reduced irrigated farm production. As a result, the alert warns that the food situation in Afghanistan is rapidly deteriorating and will continue to worsen.

The alert, produced by a joint Crop and Food Supply Assessment Mission, sent to Afghanistan by the UN Food and Agriculture Organization (FAO) and the World Food Programme (WFP), says: "There is mounting evidence of emerging widespread famine conditions in the country, reflecting substantially reduced food intakes, collapse of the purchasing power of the people, distress sales of livestock, large-scale depletion of personal assets, soaring foodgrain prices, rapidly increasing numbers of destitute people, and ever swelling ranks of refugees and internally displaced persons (IDPs)."

The issue of 'life saving' in Afghanistan is going to be even more crucial this year than it was last year," warns the alert. It is estimated that some five million Afghans have little or no access to food and will require international humanitarian food aid. The priority group is judged to be particularly vulnerable because its purchasing power has been seriously eroded by the lack of employment opportunities within and outside agriculture. This has been caused by a number of factors including abandonment of poppy cultivation, a decline in other cash crop production, low livestock prices, depletion of herds and other assets, as well as displacement due to conflict and drought.

According to the alert, the group will require emergency food aid for periods ranging from 3 to 10 months, at least until next year's harvest to prevent starvation and reduce the number people leaving the land to become IDPs and refugees. Substantial assistance is also needed to rehabilitate the collapsing irrigation system and infrastructure and the provision of quality seed. The alert says, that the "exceptionally positive development of the abandonment of poppy cultivation in 2001, which has rid the world of 3,000 to 4,000 tonnes of opium and derivates," comes at a time when intensifying economic problems limit the opportunities for alternative income sources for poppy farmers and workers.

Three years of drought have also dealt a serious blow to livestock with catastrophic consequences for Afghan nomads. During its extensive field visits, the Mission observed that rainfed wheat and barley crops had almost totally failed, except in a few pockets in different regions. The rainfed wheat production in 2001 is estimated to be about 40 percent less than even last year's extremely low output. The mission estimated the 2001 total cereal production at 2.03 million tonnes - about 12 percent larger compared to 2000 but smaller by 37 percent compared to 1999. As a result, the cereal import requirement in the 2001/02 marketing year (July/June) is estimated at 2.2 million tonnes, slightly less than last year's record high level of 2.3 million tonnes, but about double the volume of 1.1 million tonnes in 1999. The alert puts commercial cereal imports at some 760,000 tonnes, about 25 percent lower than the estimate for last year, leaving a gap of 1.4 million tonnes. WFP estimates emergency food aid needs at 386,000 tonnes, of which 156,000 tons are covered under current WFP relief commitments, leaving an uncovered gap of over 1 million tonnes. "A shortfall of this magnitude, coupled with seriously deteriorating purchasing power of the population, if unmet, could have disastrous consequences," says the alert.

Sorghum Seed Production in Southern Somalia

Somalia conjures up images of chaos and destruction in many people's minds, but in recent years some degree of peace and stability has returned despite the continued lack of a central government. Ever since the end of the civil war in 1992, humanitarian agencies have been purchasing grain from grain traders for distribution to households that are determined to be seed insecure. A recent study of the seed sector in S Somalia (Longley, Jones, Ahmed and Audi, 2001) found that relief seed distributions immediately post-conflict in 1992 were much appreciated, but since that time farmers have been able to access seed through the farmer seed system. In 1998 CARE decided that the conditions were right to initiate a community based sorghum seed production project with farmers who had access to irrigation along the Lower Shabelle River for supply to farmers in rainfed areas. ICRISAT was contracted to supply foundation seed of six sorghum varieties that had shown promise in on-farm trials both in Somalia and elsewhere, and this was then multiplied by farmers with the support of local NGOs working with CARE. Three of the sorghum varieties performed exceptionally well, and a total of 400 Mt of "certified" seed was produced. The next problem was how to market this seed. Similar schemes have relied on humanitarian agencies to purchase the seed for free distribution to farmers, but if farmers can access seed through the farmer seed system why continue free distributions that are not sustainable? An important finding of the Seed Sector Study in Southern Somalia was that a majority of farmers purchase seed from a network of small seed traders for cash. These traders who are predominantly women, purchase fresh seed from farmers after harvest and store it separately from grain. This is an important distinction in Somalia because farmers store surplus grain in underground pits, and this grain cannot be used for seed because it loses its viability when stored in this way. With this basic understanding of how farmers access seed traditionally, it was decided to see if these very same seed traders would be interested to market seed of the sorghum varieties multiplied by the farmers in Lower Shabelle. There was an enthusiastic response to this suggestion and small seed packs were sold to these traders on the understanding that any packs not sold after three months would be repurchased at the same price provided that the sealed packs were not opened. Within two weeks, 4,800 one-kilogram packs have been sold in the Baidoa market alone. The sale of small seed packs was designed as an experiment to test the market for seed of new varieties, and has clearly shown that farmers are willing to purchase seed. Through seed systems research, an understanding of how farmers access seed traditionally (farmer seed system) was developed, from which potential interventions were designed to strengthen such systems rather than undermine them. The continued purchase of grain from grain traders for distribution as seed by humanitarian agencies was not serving any useful purpose for farmers, but was potentially undermining the livelihoods of small seed traders whose business is to supply seed in a sustainable way to farmers. As a complement to this work, CARE is supporting nine local NGOs to carry out farmer-managed demonstrations of the sorghum varieties being marketed in small seed packs. The response of farmers to these varieties will be

carefully monitored so that the sorghum varieties being multiplied by the farmers in Lower Shabelle can be changed in response to farmer demand. Any production not required for seed will be sold as grain.[60]

Natural resource management approach works in tandem with emergency relief to restore agricultural productivity to Ethiopia's Antsokia Valley

At the height of a devastating famine that occurred in 1984-85 in Ethiopia, the Antsokia Valley–located 350 kilometers north of Addis Ababa – became known as a "valley of death," with 15- to 20-deaths a day.[61] Prior to the drought scourge, the region had enjoyed rich alluvial soil conditions that produced a bountiful and diverse harvest. The valley, which is 20 kilometers in radius and includes 16,000 hectares of land, is home to 45,000 people. It is also representative of the ten valleys stretching across the northern half of Ethiopia, an area with the potential to feed much of the rest of the country.

Following an initial emergency response effort, which included the simultaneous distribution of over 4,600 metric tons of grain and provision of health and medical services to approximately 68,000 people, World Vision Ethiopia (WVE) initiated a broad, longer-term program focused on natural resource management aimed at stemming the root causes of the famine. The Antsokia project, which lasted more than a decade, was one of the largest and most effective experiments in agricultural research, training, production and farmer participation funded through the U.S. Agency for International Development (USAID).

One report on the initiative recounts a conversation in which a 53 year-old farmer describes the conditions that led to the 1984 famine and the improvements that were made thereafter. Referring to a so-called "miracle spring" which he had known from his youth, but which had dried up and disappeared during the famine, the farmer recounted how the spring had "reappeared" several years after the farmers planted trees around it and constructed terraces above it." Arriving at the "reborn spring," the farmer told his visitor the following story:

> *When I was young, the valley was full of forests. Monkeys, porcupines and wild dogs lived there…We were scattered over the area and there were no villages. Then the number of residents grew and there wasn't enough land for harvest, so we turned to the malaria-ridden valley floor. Using slash-and-burn techniques, flooding began, washing away crops and soil. The annual tariff paid to the landlords of a quarter of the harvest dramatically declined. When the Marxists took over in 1974, the land suddenly belonged to the people and they plundered the mountainsides for firewood and building material. A dramatic drop-off in rain and harvests in 1980 resulted in farmers turning their cattle loose to feed on the barren stocks, even before reaping time, and this is when the spring*

[60] FAO 2001 State of Food Insecurity in the World
[61] Based on a report by Yilma Getachew, "Natural Resources Management and Sustainable Agriculture: Lessons from Antsokia Valley, Ethiopia," World Vision of Ethiopia. Addis Ababa: September 1996.

ceased to flow. The women had to wait longer and longer to fill their jugs until finally there was nothing. Nobody warned us about what we were doing to the land. We didn't connect the weather changes and the disappearance of the forests. My wife and I watched our seven children grow frighteningly thin. That was around the time the relief arrived.

By exploiting the land through deforestation, over-cultivation, and over-grazing, the inhabitants had also destroyed their sources of soil and water. The results: once-fertile soils were replaced by swamps and wetlands; mountains lost their soil cover; and fertile sloping croplands were lost. Water in the lowlands created a breeding ground for malaria and other diseases; moisture retention capacity was reduced; and as mountains and hills lost their vegetation, water sources dried up, leaving the rivers, which became seasonal sources of flooding.

The new approach was initiated by World Vision staff while food and health relief were still being provided to large numbers of people. The land was divided into seven "agro-ecological niches" (swampland, wetland, cropland, homestead, forest, upland plateau, and alpine meadow). Several resource-conserving technologies were introduced, including soil and water conservation; agroforestry; water harvesting; fertilizer production; and pest and disease control. With this technical help, Antsokia farmers began to redevelop their once-rich habitat. They planted forests and bio-intensive gardens, created small-scale water harvesting, and produced organic fertilizer.

World Vision encouraged the people of Antsokia to combine the best of traditional and modern methods and techniques. Ethiopian farmers traditionally have employed a number of their own resource-conserving technologies, including mixing different crop types, or intercropping; succession farming, where a different crop is planted following harvest; agroforestry, where economically and environmentally productive trees are incorporated with crops; terracing; and zero-grazing (cattle not allowed to graze for a period of time). Farmers with the knowledge and skills to implement these techniques lived in scattered localities, but until this time had never become part of a shared tradition for widespread use.

When Antsokia's farmers familiarized themselves with the root causes of famine, they were able to make an effective transition from relief to development. Their achievements included increasing agricultural productivity from a deficit to a surplus and thereby increasing per capita food crop productivity in an area of growing population with no land expansion. They rehabilitated springs (including the "reborn spring"), diminished the amount of erosion, and increased the growing season. With the help of WVE, these farmers essentially transformed their farming from an exploitative to a regenerative system, which puts most organic waste back into the system. Fruit and vegetable production also went from zero to export status. Most impressive as a measure of long-

term impact, migration out of the Antsokia Valley was reversed as people were attracted to the region by its improved productivity.

According to World Vision Ethiopia, the key to long-term mitigation and famine recovery was the community setting. World Vision's technical staff had to become sensitized to the idea that many of the best solutions were to be found in the knowledge and experiences of those being helped. This meant a reversal of the role of technical expert from a provider of information to one in which the technician learned from the farmers. While this was not the initial planning concept, it soon took hold. They also found that while it was relatively "easy" to treat the effect (the famine), it was much more difficult to find the cause. Using the model known as the "community based technical program" meant that the point of entry of World Vision staff was determined by the schedule of the farmers and that living among farmers was essential. Ultimately, the World Vision Ethiopia staff discovered that a people-focused approach was at the least equal in importance to technical resources when attempting to move the thinking from a relief to development mode.

Provisioned with a world-class genetic collection, potato breeders adapt to chronic drought and boost yields for Andean farmers

Agricultural scientists have succeeded in breeding a potato variety that can resist the chronic drought that has for centuries plagued the potato crops of poor subsistence farmers in the Andean highlands. Using the genetic collection safeguarded at the International Potato Center in Lima, Peru, scientists were able to breed a unique true potato seed variety that has thrived and is bringing a significant measure of food self-sufficiency to the people of the Andes.

The new variety Chacasina, named for the town where it was first introduced, incorporates the culinary qualities so highly prized throughout the Andes with a highly productive, early-maturing parent that provided resistance not only to drought, but also to mild frost and late blight disease–the scourge of potato farmers throughout the world. Adapted to these highland conditions and able to grow well in poor soils, potato scientists say the new variety can be grown in analogous regions on a world-basis

Potato, the world's fourth most important food crop, originated in the highlands of South America where agricultural historians say it has been consumed for more than 8,000 years. This variety was developed using varieties found in the genebank of the International Potato Center. With some 1,500 germplasm samples of more than 100 wild species collected in eight Latin American countries and 3,800 accessions of traditional Andean varieties, this international genebank is the largest repository of potato genetic resources in the world.

Potatoes are of paramount importance to the lives and livelihoods of subsistence farmers in the Andes, where more than 60 percent of the rural inhabitants still live in poverty. The farmers use nine Andean species with edible roots and tubers that serve as the foundation for the farming system of the entire region. Potatoes are often used as substitutes for expensive fruits and vegetables in the diet. One medium-sized potato can provide about half the daily adult requirement of vitamin C. When boiled, potato can provide more protein than maize and twice as much calcium.

In the late 1980s severe drought gripped the town of Chacas in the Andean highlands. Farmers in this mountain town and in many other similar potato-growing communities in the region had no more seeds left to plant. In 1992, a priest came to Lima to search for a potato seed to bring back to his famished parish. To address this deficit, CIP plant breeders first provided the priest with a supply of potato seed that would help stem the immediate crisis and then set about to create a variety that could thrive in the challenging environment of the Andean highlands.

By 1995, with the help of the Peruvian Government and donors such as the US Agency for International Development, CIP began assisting Chacas and five other villages in nearby provinces to rebuild seedbeds, nurseries, and warehouses. A year later, Chacasina was being grown in eleven test plots and more than 100 farmers' fields. Within only two years, the project was not only paying for itself, but had achieved such a level of success that the community required no seed from the outside.
The success of the new potato hybrid can be seen in Peru's mountainous Callejon de Conchucos region, 200 miles north of Lima, where Andean farmers who have planted the seed are growing crops that produce an average of 45 tons per hectare – roughly three times the national average and nearly equal to commercial yields in the United States and Europe. This is especially important in creating economic opportunities in an area where family incomes are less than US$300 per year.

CIP's plant breeders would not have been able to undertake the breeding research that produced this valuable seed if they had not had access to the reservoir of germplasm available to them through the CIP potato genebank. Many of the relief and development organizations working to stem the impact of natural disasters on agriculture are increasingly adopting the long-overdue view that world-class genebanks such as the one at CIP represent a significant, long-term investment in global disaster prevention and mitigation.

Regional coordination essential to control threat to Southeast Asia from fires and haze

This case differs somewhat from the others. It is focused not on the use of agriculture or management of natural resources *per se*, or as a means to prevent or mitigate a natural

hazard. Rather the case is about a cooperative regional approach to eliminate or reduce the disastrous effects of man-made and naturally caused fires and resultant haze on human health and natural resources. The country focus is Indonesia.

The potential devastation inherent in the trans-boundary or transnational character of some natural or human-induced disasters was illustrated by the devastating forest fires that began sweeping through Indonesia in 2000 and soon threatened the well-being of neighboring countries in the region. Pollution index readings were dangerously high over West Kalimantan and Sumatra, with the potential for months of choking haze as had occurred throughout Southeast Asia in 1997-1998.

Fortunately, an early warning system that was put in place through a cooperative regional association, ASEAN, combined with some improved weather conditions, contributed to ending the disaster. In addition, a legal framework that was established to deal directly with violators (polluters) was instrumental in at least reducing the practice of burning land and forests.

When the dry season began at the end of the February 2000, forest fires had already been spreading out of control in Sumatra and West Kalimantan in Indonesia.[62] By 5 March more than 780 fires or hotspots had been located over the island of Sumatra, according to the Association of Southeast Asian Nations Specialized Meteorological Centre (ASMC) in Singapore. Most of the fires were triggered by illegal burning of plantations and forests for purpose of land clearance. Many, environmental groups especially, faulted the oil plantation companies for illegally setting fires to clear land.[63]

Indonesia had experienced a devastating land and forest fire disaster previously in the autumn of 1997 and into 1998. That disaster, induced by El Niño, occurred during the dry weather period, when smog affected several Southeast Asian countries. Increasing numbers of hotspots coincided with the end of the rainy season, which occurred in late February. The resulting disaster caused loss of productive land and a wide range of health problems including haze-related illnesses. The destruction of forests and death of wild animals had devastating environmental consequences.

Following this first disaster, the Indonesian Government took steps to tighten its environmental laws, and in August 1999, ASEAN adopted a "zero-burning" policy, urging all countries concerned to implement the necessary laws and regulations. The intended effect was to enforce ASEAN's decision to control trans-boundary environmental pollution caused by land and forest fires.

[62] United Nations Office for the Coordination of Humanitarian Affairs (OCHA), "Indonesia – Forest Fires OCHA Situation Report. Report No. 1. (Press Release – Relief Web) March 14, 2000
[63] Reuters.. "Indonesia's Neighbors Help as Blazes Spread." (News Story—Relief Web) March 10, 2000.

By March of 2000, the Indonesian Government, which had been monitoring the development of the new disaster with the help of satellite data, declared a state of emergency. Investigations of companies owning land near fire sites were carried out. Based on the results of these investigations, the government threatened to revoke the licenses of errant logging and plantation owners.

Since April 2000, meteorological services from the four most affected ASEAN countries: Brunei Darussalam, Indonesia, Malaysia, and Singapore -- have met at the ASMC in Singapore to discuss regional climate forecasts and to address issues related to fires and smoke haze.[64] As the lead country for monitoring under ASEAN's Regional Haze Action Plan, Singapore provided satellite pictures indicating hotspot locations to Indonesia. This is part of ASEAN's effort to support Indonesian law enforcement against illegal burning practices.

ASEAN is also promoting a series of dialogue sessions with plantation companies to discuss these companies' experiences in implementing zero burning practices. It has also put Fire Suppression Mobilization measures into operation in priority districts in Indonesia.

On January 28, 2000, ASEAN signed an agreement with the Australian Government for a joint initiative to support the implementation of an Immediate Action Plan.[65] That Plan included a "Field Training Exercise for Prevention and Control of Land and Forest Fire and Haze in West Kalimantan (Indonesia), 2000-2001." It was designed to assist local government officials and the West Kalimantan community in their work to develop a comprehensive action plan for forest fire management and to increase their capacity in fire fighting activities. Furthermore, the joint initiative aims (1) to monitor forest fires so that they do not get out of control during the dry season, and (2) to develop a 'fire suppression plan.'

Australia had been quick to help Indonesia in fighting the serious fires of 1997-1998, mainly with water bombers and fire fighting support. But, as the head of Australian aid in Indonesia reported, "…reactive measures like this aren't enough to stop fires. Concrete measures in planning and prevention, such as the Immediate Action Plan for West Kalimantan, are very important."

Another approach to prevention and control in response to the forest fire emergency in Sumatra in March 1999, was undertaken in cooperation with the United Nations

[64] Association of Southeast Asian Nations (ASEAN). "Update on Fire and Haze Situation in the Region." (Relief Web). July 13, 2000 and ASEAN, "Summary Report on Recent Haze Situation." (Press Release – Relief Web) March 22, 2000.
[65] ASEAN. "ASEAN and Australia to Cooperate on Haze Control." (Press Release – Relief Web) January 28, 2000.

Environment Program (UNEP).[66] UNEP's concern was with the prospect of a repetition of the fires that caused months of choking hazed throughout the South East Asia region in 1997-1998. Based on Indonesia's plan to summon logging and plantation company owners to review their licenses, UNEP along with ASEAN, assisted the government in Sumatra with the development of a legal framework for the prevention of transboundary haze pollution. UNEP has also supported ASEAN governments in the regional application of an early warning system, using high-resolution satellite imagery to detect specific land holdings where hotspots exist as well as the mobilization of fire fighting teams to land and forest fire locations.

[66] United Nations Environment Programme. "United Nations Environment Program Welcomes Though Stance on Forest Fires by Indonesian Government." (Press Release – Relief Web) March 9, 2000.

9. WEATHERING NATURAL DISASTERS – THE ROAD TO RESILIENT DEVELOPMENT AND DEVELOPMENTAL RELIEF

Weather-induced natural disasters exert a terrible toll on the world's ecosystems, agricultural productivity and the millions of people who depend on them for their livelihoods. The price is disproportionately high for the poor, rural people, and those living in the global south. Future climate patterns, whether due to human-induced global warming or natural trends, are likely to exacerbate the trend and further increase both the intensity and frequency of devastating natural disasters. The cost of inaction, in both economic terms and in human lives, is simply too high to contemplate.

Fortunately, the international community has already begun to assemble a powerful arsenal of agricultural and environmental tools to mitigate the impact of natural disasters and to promote more resilient development practices. The lessons learned from this study support the conclusions drawn elsewhere in the extant literature – the current trend to bridge the relief to development divide must be supported and expanded.

Promoting the Paradigm Shift

Relief and development agencies alike need to redouble their efforts to break down the false divide between their areas of activity. Agriculture and natural resource management provide a natural mechanism to do so in a way that is sustainable, efficient, and fair to both the planet and the people who occupy it. As this study describes, there are a great variety of tools that have already been developed. The road to more resilient development, and more developmental relief, will be paved with many of these extant tools.

· Preparedness, Mitigation, and Planning Activities

The plethora of development and relief programs that fall under the rubric of preparedness, mitigation, and planning activities are among the best ways to reduce all types of vulnerability to disaster. Future work in both relief and development should look for ways to maximize these activities.

As we have seen, activities such as livelihoods programming succeed not only in addressing the short-term disaster, food insecurity, but also promote faster agricultural, economic, and social recovery in the post-disaster environment. They also result in fewer relief dollars being spent for future disasters.

The combination of traditional disaster relief with mitigation activities, such as the replication and distribution of drought-resistant seed, similarly results in the resolution of the immediate disaster. At no additional cost, it also reduces farmers' vulnerability to

future droughts. Environmental mitigation, in the form of watershed management and sustainable forestry, protects entire sub-regions from potentially devastating wind, rain, and other storm impacts.

Preparedness activities such as shelter construction for people and livestock and dyke and levy construction for agricultural fields also minimize disaster impacts and enable local people to resume productive economic and social lives very quickly after even a significant natural disaster.

Preparedness planning, in the form of early warning systems, hazard and risk mapping also enables communities to develop effective evacuation and reconstruction plans. Such planning is especially important in the many rural communities that face annual natural hazard events such as cyclical flooding or drought.

All of these activities exemplify the best of developmental relief practice and should serve as a model for future work in the area. Preparedness, mitigation, and planning activities should be mainstreamed within existing agriculture and natural resource management activities, especially in disaster-prone areas.

- **Resilient Development**

The nascent awareness of the symbiotic relationship between natural disaster cycles and ongoing economic development has led to the creation of a new, resilient, development approach. This approach, however, is far from mainstream, especially in areas where disaster events have been infrequent. The international community, and especially the development community, should seek to further mainstream understandings about disaster management into ongoing development projects.

The utilization of climate forecasting and other technology tools in agriculture and natural resource management projects enables development planners to consider the implications of extreme events, such as El Niño, on their development plans. The resulting activities are not only more appropriate and efficient, but also more resilient to the shocks of excessive rain, wind, or drought.

The consideration of risk mapping during the project design process can inform decisions about target populations and the geographic distribution of agricultural and environmental inputs. The resulting development activities are less likely to be devastated by subsequent natural disaster events.

In addition to incorporating more knowledge about potential hazards, development projects should go further to insure that they are truly resilient. In most projects, and especially in disaster-prone areas, vulnerability reduction itself should be a goal of long-term development. In the same way that poverty reduction minimizes the impact of

economic shocks on households, good development practice should minimize beneficiaries' vulnerability to future disasters. If people are less vulnerable, they are less likely to need relief assistance and more likely to return to productive development quickly after a natural hazard event.

Given ongoing climate change, there is no excuse for waiting until disaster strikes to think about making development more resilient.

· **Expand the set of tools and improve their applicability**

The international community should continue to develop, promote, and scale up the best practices in resilient development and developmental relief. While there are many existing tools, gaps and challenges to implementation remain.

New tools, from better communications systems that enable "real time" analysis of changing weather patterns to newer and better drought-tolerant seed varieties, will need to be developed and adapted to the rapidly changing context of the global environment. Such activities will need to combine the best of research and science with deeper understandings of the local culture and environment.

Existing tools, such as knowledge of plant genetics and soil science, will need to be taken out of the laboratory and into the field. Further, scientists and others accustomed to the slow pace of academic research will need to adapt to the rapid information needs of a post-disaster setting. Research institutions will need to develop mechanisms to make their work more applicable in an often chaotic disaster scene.

As the climate continues to change and natural disaster events continue to become both more intense and frequent, newer and better tools will have to be developed and adapted at an ever-increasing pace.

· **Employ local capacity, participation, and knowledge transfer**

The important contributions of science, research, and good development practice must be combined with the indigenous knowledge and capacities of local communities. Truly resilient development and developmental relief must take full advantage of local capacities such as markets, agricultural infrastructure, and indigenous knowledge of weather patterns. Even during the acute emergency phase, agencies should solicit the active participation of "victims" themselves, thereby promoting more sustainable solutions to disaster challenges.

· **Attend to the Macro-Level concerns**

Perhaps the most challenging, and most important, factor in weathering natural disasters is the need to attend to the macro-level constraints which inhibit the realization of all of the previous recommendations.

The international community should look for opportunities to address the structural issues that have created the relief to development divide in the first place – the CNN effect, the tyranny of the urgent, and the politicization of relief activities. Although these issues may prove to be the most difficult to tackle, failure to do so will likely slow, and might even hinder, the paradigm shift to more resilient development and more developmental relief.

Members of the international community have known the lessons articulated in this study for many years. Scholars and practitioners have repeatedly identified the need to take a more holistic look at the intersection of natural resource management, agriculture, and climate and weather patterns. This knowledge, however, has not been translated to action on a large scale.

The time to act is now. Agricultural systems must adapt to the rapidly changing environmental conditions, including the increase in natural disasters. The many tools in the disaster response toolbox and snapshots from the field presented in this study provide the foundation on which larger-scale action can and should take place.

Future Harvest would like to thank and acknowledge Ms. Deborah Strauss Lynch for her efforts at editing and analyzing the issues and text of "Weathering Natural Disasters—Refocusing Relief and Development through Improved Agricultural and Environmental Practices."