Box 3.4

EL NIÑO

In June 1982, scientists again began to observe a series of atmospheric and oceanic changes in the region of the equatorial Pacific, which were related to the phenomenon known as *El Niño*. This phenomenon causes floods and droughts at irregular intervals of between 3 and 16 years along the western coast of South America, as well as in many other areas of the world. This 1982 occurrence of *El Niño* caused widespread drought in western Bolivia, southern Peru, northeastern Brazil, Costa Rica, southern Mexico, Indonesia, the Philippines, Australia, New Guinea, parts of Africa, southern India, and southern China. It also caused floods in Ecuador, Peru, eastern Bolivia, southern Brazil, northern Argentina, eastern Paraguay, and the Polynesian islands.

In the housing sector in Peru, the urban slums in Lima were the most affected by this phenomenon. In total, 62,771 dwellings were partially damaged or destroyed by flooding. The transportation and drinking water and sewerage infrastructure were practically destroyed. The floods ruptured water and sewerage networks, causing severe shortages of services to most of Peru's coastal population, including the city of Piura, where 16,750 meters of pipe were destroyed.

The consequences of *El Niño* along the coast of Ecuador caused the country's marine reserves to virtually disappear, severely damaging the fishing industry. In addition, heavy rainfall in these coastal areas reached into the mountains in some parts, causing rivers to overflow.

Source: PAHO/WHO

US$16.6 million. The deterioration in the standard of living and the interruption of basic public health services placed the affected population at risk for outbreaks of communicable diseases.

Cuba, the Dominican Republic, Jamaica and Trinidad and Tobago are also subject to frequent flooding which impacts on the transportation sector, for example, destroying large numbers of bridges and roads. But the Caribbean is also prone to flash floods which cannot be predicted by the national meteorological offices. A number of these flash floods are the result of other hazards such as hurricanes or landslides.

The serious flooding in the Atlantic region of northern Nicaragua in May and June 1990 affected more than 100,000 people. The indigenous communities of Miskitos and Sumos, located along the Prinzapolka, Bambana, and Coco Rivers were the most affected, together with settlements in the coastal areas. The condition of the land made cultivation impossible, resulting in food shortages, which in turn, made the population more susceptible to endemic diseases in the region.

A flood's major effects on health are in four main areas: communicable diseases, environmental sanitation, food and nutrition, and vectors. As a rule, dramatic, well-defined outbreaks of diseases generally do not occur in the immediate aftermath of a flood. Instead, a slower, widespread deterioration of general health conditions takes place, which all too often becomes part of the chronic lowering of the affected community's health status.

In areas that are continually exposed to floods, a "disaster culture" has developed over time. The people of these regions have adapted to both the frequency and difference in intensity by constructing

their houses on stilts and elevating the floors with wooden boards as the flood waters rise. It is not uncommon, when water levels have reached a high point, to observe a boat tied to a window, which has become the door!

Drought

Drought is a phenomenon that has affected large areas of the Western Hemisphere, but perhaps the case whose causes and effects have been most studied is that of Brazil. Since the 1940s, an increase in the population, the large scale destruction of natural resources, and growing desertification have caused this country to suffer increasingly severe droughts. These periodic droughts destabilize the primitive economy of the region, deplete the natural resources, burn the grasses, decimate livestock, and demolish crops, converting the *sertão* into a desert landscape whose inhabitants, deprived of reserves, die from lack of food and water. Many migrate to the large cities, where they add to the growing number who inhabit the *favelas*, or slums circling the cities.

The effects of drought, always disastrous, grow in proportion to the extent of the territory affected. If the affected area is not very large, neighboring regions that are not affected can offer aid. According to the Brazilian author Luis Augusto da Silva Vieira, in his account of drought in northeast Brazil in the first half of this century, the crises occur in irregular patterns: partial drought usually occurs every 4 to 5 years, normal drought, every 10 to 11 years, and exceptionally severe cases are seen every 50 years. The great drought of the 1980s verified this, since the two previous large-scale droughts had occurred in 1877 and 1932.

Landslides

The impact of landslides depends on the specific nature of the event and its origins. For example, landslide failures of hillsides or mountain slopes obviously constitute a hazard to human beings and property, but in general cause damage in only a limited geographic area. By contrast, volcanic-triggered slides, avalanches, mudflows and lateral blasts can affect larger areas and can cause greater life and property loss. The large majority of landslides are caused or intensified by geologic and hydrometeorologic factors. The case of Armero, Colombia, in 1985, demonstrated one of the most destructive consequences of a volcanic eruption: volcanic mudflows descended from the summit of Nevado del Ruiz at great speeds following the paths of several rivers in the area.

However, the most severe landslides are those caused by the gradual displacement of large areas of the earth's surface, since their effect on buildings and other infrastructure is slow but dangerous. This type of landslide is triggered by extreme hydrometeorological conditions or by earthquake shaking.

Road and highway construction can cause slope failures: limited budgets often dictate where and at what angle a slope is cut rather than what is most stable. When severe rains occur, the roads collapse, not only claiming lives and interrupting important lines of communication but also placing severe demands on the limited institutional resources available to rebuild them.

Human activity, particularly deforestation of watersheds, pollution, and other impacts can result in landslides with extreme economic and social impacts. A landslide dam on the Paute River in Ecuador flooded most of the fertile land

Box 3.5

LANDSLIDES

Photo: Vycarra, PAHO/WHO

Medellín, Colombia. In September 1987 a major landslide estimated to contain 20 000 cubic meters of earth descended on the neighborhood of Villatina in the city of Medellin, Colombia. An uncovered open channel, located in the upper part of the neighborhood, which had deteriorated because of a lack of maintenance, overflowed and added to the mass, destroying 100 dwellings, killing 20", leaving 300 missing, and nearly 2,000 affected The Villatina neighborhood was located in an appropriate area for urbanization, given the topographical conditions and was not thought to be susceptible to such hazards.

Source Bustamante, 1987

Rio de Janeiro, Brazil. In February 1988 a strong cold Arctic air mass passed over southern Brazil, triggering torrential rains in the state of Rio de Janeiro and depositing 279 cubic millimeters of rain on the city of Rio de Janeiro and neighboring areas. The rains caused rivers to overflow and flooded the poorer neighborhoods that surround the city, destroying hospitals and dwellings and leaving 289 dead, 734 injured, and 18.560 affected The drinking water services, sewerage, electric energy and telephones were interrupted for several days The direct cause of the landslides was the rainwater that saturated the steep slopes of unstable soil and insufficient drainage for the large volume of water

Source UNDP PAHO/WHO

La Josefina, Cuenca-Ecuador. In March 1993 a landslide containing 20 million cubic meters of earth blocked the Paute River with a dam of rubble and dirt 100 meters high and one kilometer long, causing a reservoir of 200 million cubic meters of water to form upstream from the blockage. Warning had been given about this hazard, but measures needed to avoid the disaster had not been taken. It occurred because of heavy rainfall at the site of a previous landslide, and was brought on as well by inadequate road construction

Following the landslide, a channel was constructed to drain water from behind the blockage, thereby reducing the flooded area upstream But 26 days after the original landslide, the drainage channel itself collapsed, and due to the erosion brought on by continual rains, the dam failed one week later. This failure resulted in flash floods damaging an area that extended 100 km below the dam. Although inhabitants in the floodplain had been evacuated, a total of 35 people lost their lives, and economic losses were estimated at US$140 million

The flooding and impending dam collapse threatened the Paute Hydraulic Project, located 50 km downstream, which provides 65% of Ecuador's power. The dam failure was simulated so that contingency plans could be prepared for that occurrence

Source Zevallos 1994

upriver of the slide. Population centers downriver were threatened by the catastrophic failure of the landslide dam (see Box 3.5).

Photo facing page:

Housing destroyed by landslide in Rio de Janeiro, 1988.

Landslides caused by strong rains and flooding have had devastating effects in the Region, particularly in deforested areas and in areas where housing has been constructed on unstable soils. One tragic failure occurred in the Bolivian goldmining camp of Llipi, north of the capital city, La Paz. Torrential rains on 8 December 1992 caused a landslide that buried the entire village; 49 people were killed. Deforestation contributed significantly to the disaster; tunnels used for mining collapsed. A similar landslide occurred in Ecuador in May 1993, in the goldmining region of Nambija, claiming 140 lives.

In early August 1993, Tropical Storm Bret raced through the eastern Caribbean, causing severe structural damage in Trinidad and Tobago before striking Caracas, Venezuela, with full intensity. The storm's rains and winds triggered landslides in poor neighborhoods located in the outskirts of the capital and in the States of Miranda and Aragua. At least 100 people died, 400 were injured, and approximately 5,000 were left homeless.

VULNERABILITY

A close relation exists between vulnerability to disasters and socioeconomic development. For example, the accelerated rate of urbanization in Latin America contributes to its vulnerability, and also leads to environmental degradation and to poverty, which in turn lead to the use of inadequate construction techniques. Other factors such as population growth and low levels of education are related closely to the problem of vulnerability.

The Accelerated Rate of Urbanization

Most developing countries worldwide have witnessed a rapid rate of growth in their urban population, while in developed countries, it has declined This growth is not only due to birth rates, but to the trend to migrate from rural to urban areas, especially among population groups of limited resources that look to the cities for better access to services and greater sources of income. The result is often the creation of perilously situated settlements on the fringes of large urban areas.

Poverty

Natural disasters in Latin America and the Caribbean have invariably shown that those with little income and a poor quality of housing suffer disproportionately when disaster strikes. The poor, with lower levels of education, often live in improvised settlements in highly vulnerable locations, such as the slums on the landslide-prone hills of Rio de Janeiro, the slopes of volcanoes, or riverbanks. During periods of drought, the most affected are those who cannot acquire food. Most often, hunger results from a lack of money to purchase food rather than from the lack of food itself. Poverty is also the greatest cause of both internal and international migration, which poses serious challenges in terms of immediate assistance, as well as in long-term development efforts.

A study by UNDRO (1988) estimated that 95% of the deaths caused by disasters occurred among 66% of the population of the world's poorer countries. In Japan, for example, an average of 63 per-

sons die each year because of natural disasters. In Peru, a country with a similar incidence of disasters, the toll is 2,900.

Latin America and the Caribbean share a problem common to many parts of the world: not only do the poor receive a disproportionate share of the impact of the disaster itself, but they also are at a disadvantage during the rehabilitation and reconstruction phases. Prior to a disaster, this group depends on their limited income, often generated at home, for their daily survival. A disaster not only robs them of their source of income, but they cannot absorb the additional expense of purchasing materials for reconstruction. This accelerates the poverty cycle, which, in turn, heightens vulnerability to disasters.

Vulnerability of Constructions

The type of construction, as well as population density in the areas of greatest hazard, increase vulnerability. It is estimated that almost 90% of the victims of earthquakes are injured by the collapse of buildings, as was the case in Nicaragua in 1972 and in Guatemala in 1976. A similar situation occured in Dominica in 1979 and Montserrat in 1989, where an estimated 90% of the housing that collapsed was due to non-compliance with hurricane or wind-resistant codes

Most old constructions in Latin America, both housing and institutions, are made of adobe and unreinforced masonry. Adobe houses do not resist earthquakes in the same way as wood structures, which are lighter and more flexible. The weight of the clay tile roofs of many of these structures also contributes to their instability, as was the case in the earthquake of Guatemala, where many died as a result of collapsed buildings.

To a great extent in the Region, the infrastructure of basic services such as water and energy is old, and many countries lack the resources to maintain it properly. Weak infrastructure poses a great obstacle to providing uninterrupted services. In times of disaster, hospitals and educational facilities, which over decades have undergone structural modifications without taking into account safety considerations, put already vulnerable groups—children, the sick, and the poor—at greater risk.

Environmental Factors

The environment surrounding human settlements contributes to disasters. In some cases, these surroundings cannot be modified and people must learn to adapt to avoid the serious consequences inherent to the location. For example, soil type is a determining factor as to why earthquakes cause more damage in some places than in others. The earthquake of 1985 in Mexico had its epicenter off the coast of the state of Guerrero, 350 km to the southwest of Mexico City The coastal city closest to the epicenter, Acapulco, suffered only minor damages, but the capital was devastated. Mexico City was constructed on the site of the ancient Aztec capital of Tenochitlán Over the centuries, the lake which surrounded the Aztec capital as a moat had shrunk, leaving deep layers of clay, sand, and gravel beneath the surface. Unlike solid rock, Mexico City's soil transmitted seismic waves as rocking motions, similar to ocean swells, which many edifices could not withstand (see Box 3.6).

In other cases, man's attempts to modify his surroundings contribute to disaster situations Deforestation, environmental degradation, and the irrational use of land create precarious conditions that

Box 3.6

THE 1985 EARTHQUAKE IN MEXICO

An earthquake of extraordinary magnitude, 8.1 on the Richter scale, caused extensive damage in a densely populated area of downtown Mexico City on 19 September 1985. The earthquake and its aftershocks caused the deaths of more than 10,000 persons; tens of thousands were injured and left homeless.

Approximately 33,600 dwellings were destroyed and 65,000 more suffered considerable damage. The health sector facilities were especially hard hit, with many hospitals and clinics destroyed. Nearly one fifth of the schools in the city were destroyed or seriously damaged. Also seriously damaged or destroyed were the water, electrical, and telecommunications systems in the central city

Photo: Vizcaíra, PAHO/WHO

Search and rescue teams work to free those trapped when Hospital Juárez collapsed in Mexico's 1985 earthquake. At this site alone, 561 persons—medical and administrative staff, patients, and visitors—lost their lives.

The direct losses were estimated at $US3.8 billion. These losses included the urban infrastructure, public service facilities and their equipment, housing, heath and educational facilities, communications, small industry and businesses. The indirect losses were estimated at $US544 million and included the decrease of income and the increase in costs to small industry and business, communications, tourism, and the personal services sector. The total losses caused by the earthquake amounted to $US4.4 billion, making this natural disaster one of the most damaging in recent years in the Region.

More serious than the absolute losses is the effect which the rehabilitation and reconstruction had on the macro economics of Mexico. The effects are especially significant considering that the total losses represented only 2 7% of the GDP of Mexico. However, the disaster occurred at a time when the government was applying a policy of austerity in public expenditures, thus, banks had limited assets to meet the increased demand for credit and more external restrictions were foreseen.

In the five years following the earthquake, the negative effect in the balance of payments reached US$ 8.6 billion in spite of considerable income from insurance and foreign donations. The fiscal deficit increased approximately $US1 9 billion due to the expenses of rehabilitation and reconstruction

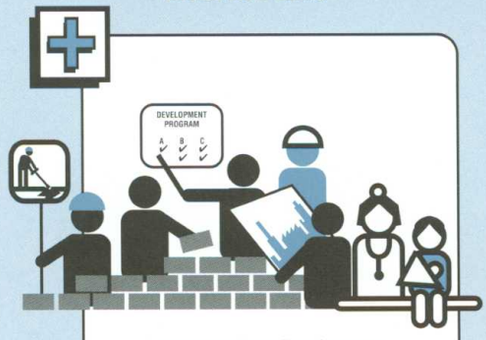
The demands of the reconstruction required the Mexican authorities to revise their economic policy to accommodate greater needs for public funding, credits, and imports. The priorities for public expenditures were reoriented to reconstruction projects leaving many of the pre-disaster problems of the city unattended.

Source: Jovel, ECLAC, 1985. Reprinted from *Disasters and Development*, UNDP/UNDRO, 1991

Box 3.7

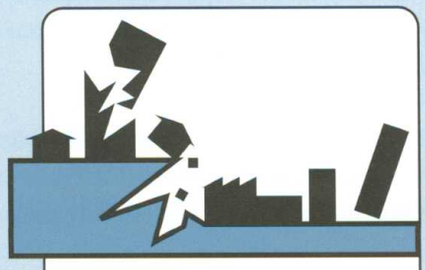
NATURAL DISASTERS AND DEVELOPMENT OFFER BOTH OPPORTUNITIES AND OBSTACLES

DISASTERS



Reconstruction offers important opportunities for creative development programs, involving the active participation of the community and local authorities.

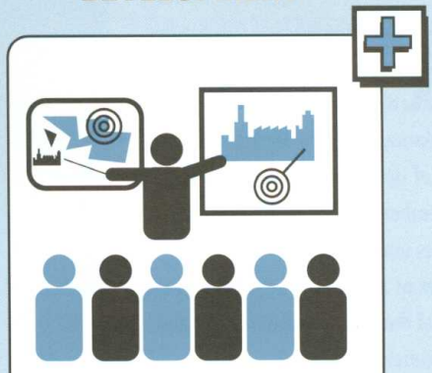
Disasters can provide unique windows of opportunity in development. In the wake of the 1986 earthquake in El Salvador, the health sector took advantage of the severe damage to the large Children's Hospital to restructure and decentralize services so that the nation would not be dependent on the services of one "megahospital."



Disasters can interrupt development, causing enormous delays in stabilizing fragile economies, and can divert investment programs.

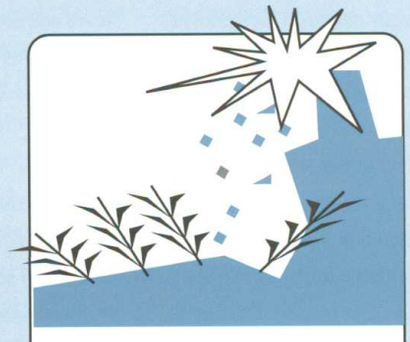
The El Salvador earthquake also had extreme social and developmental consequences: scarcity of housing, high unemployment (26-35%), and a reduced capacity in public health facilities. Hurricane Joan, which ravaged the Atlantic coast of Nicaragua in 1988, also had serious effects on an already failing economy during a difficult political and economic period.

DEVELOPMENT



Development programs can and must lessen vulnerability to disasters.

Housing or infrastructure projects built in accordance with construction safety codes are less vulnerable because they have been designed to better withstand disaster impact. Research into construction of adobe dwellings in Peru, for example, aims to improve the performance of old and new dwellings in future seismic events.



Development programs can increase the vulnerability of an area to disasters.

Activities related to development projects—such as quarrying for construction materials or indiscriminate clearing of forests for agricultural purposes—can degrade soil conditions, thereby increasing the risk of disasters. Other projects designed as income-generating opportunities can accelerate urban growth and force low-income workers to seek housing in marginal, hazard-prone areas.

Source: PAHO/WHO; IDNDR Regional Office.

multiply the effects of disasters. For example, deforestation leads to water runoff which contributes to flooding and landslides: the destruction of mangroves reduces the ability of coastal regions to resist tropical winds and high waves

The use of advanced technology in commercial agricultural production can be harmful. When machines are used to farm fertile areas of a country, the rural labor force loses its source of employment and has no recourse but to move to more marginal areas.

Drought conditions often are exacerbated by inadequate growing patterns, excess of pasture lands, indiscriminate exploitation of natural resources, deforestation, or inappropriate land conservation techniques Deforestation in Haiti, due partially to the exportation of fine woods, and to the lack of fuel, contributed to drought conditions in this country In Latin America, approximately one fifth of the territory is threatened by desertification, which can leave in its wake social unrest, conflicts, and mass migrations, in addition to hunger and disease.

THE RELATIONSHIP BETWEEN DISASTER AND DEVELOPMENT

Nations increase their capacities and decrease their vulnerabilities through development. Development planning is used by governments to draft plans to guide economic and social development. The concept of sustainable development is widely recognized by international agencies and by governments, although its definition is not universally agreed upon. Sustainable development is the outcome of comprehensive planning that incorporates considerations of disaster risk (reducing hazards and vulnerability) as well as strategies designed to protect the environment and to improve economic growth, levels of education, and living conditions of the entire population (see Box 3 7)

Economic losses caused by a disaster of great magnitude often exceed the annual gross income of a country. It is not surprising then that these events can paralyze the affected countries and cause social and political disturbances. The World Bank has estimated that in developing countries, the economic losses due to disasters, as percentages of the gross domestic product (GDP), are 20 times higher than in industrialized countries.

According to the Economic Commission for Latin America and the Caribbean (ECLAC), disasters have three types of economic repercussions: direct effects on property, indirect effects caused by losses in economic production and services; and secondary effects that are manifested after the disaster in a reduced national revenue, increased inflation, problems of foreign trade, increased public spending, the resulting fiscal deficit, and reduced monetary reserves.

Table 3.2 presents estimated economic losses caused by selected natural disasters in Latin America and the Caribbean Although these losses are not devastating for industrialized countries with strong economies, they have serious and lasting effects on the susceptible economies of developing countries. For example, drought and floods in Bolivia, Ecuador, and Peru associated with *El Niño* reduced the per capita income by 10% and elevated some retail food prices by 50% Although the direct losses caused by the Mexico earthquake were equivalent to only 2.7% of the GDP, the expenditures for reconstruction and rehabilitation of basic services wreaked havoc on the

Table 3.2

ECONOMIC LOSSES CAUSED BY NATURAL DISASTERS IN LATIN AMERICA AND THE CARIBBEAN

(in millions of 1987 US dollars)[a]

Photo UN IFRC

LOSSES & EFFECTS	EARTHQUAKES		HURRICANES	FLOODS/ DROUGHTS
	Mexico City 1985[b]	Ecuador 1987[c]	David & Frederick 1979[d]	El Niño 1982-1983[e]
Total losses	**4,337**	**1,001**	**1,057**	**3,970**
Direct losses	3,793	186	842	1,311
Capital stock	3,777	184	506	1,060
Inventories	16	2	230	251
Production	0	0	106	0
Indirect losses	544	815	215	2,659
Production	154	704	185	1,284
Services	390	111	30	1,375
Secondary effects				
Public sector finances	1,899	397	303	..[g]
Increased expenditures	2,025	55	264	..[g]
Decrease in revenues	(126)[f]	342	39	..[g]
External sector	8,579	781	464	621
Reduction of exports	1,650	635	167	547
Increase in imports	9,075	155	296	74
Disaster-related income	(2,146)[f]	(9)[f]	–	–

a All figures adjusted for inflation through 1987 to enhance comparability
b Secondary effects estimated for 1986 to 1987, and projected thereafter through 1990
c Includes damages caused by ensuing floods and mudflows which represent a very high percentage of the total
d Damages refer to the Dominican Republic only even though other countries were affected as well
e Damages refer to Bolivia, Ecuador and Peru, although other countries were affected as well
f Figures in parentheses refer to income gained from insurance and foreign donations
g Produced significant increases in the fiscal deficit exact figures are not available

Source Jovel 1989 Reprinted from *Disasters and Development* UNDP/UNDRO, 1991

economy, at a time when Mexico was operating under a policy of fiscal austerity.

RISK IN LATIN AMERICA AND THE CARIBBEAN

While risk is concrete and measurable, it is also relative and depends on how communities view it. People constantly attempt to diminish their vulnerability to hazards, while at the same time maintaining a balance between the risk and the benefits attached to them. For example, living near a volcano presents the threat of an eruption, but provides the advantage of fertile lands for agriculture.

Calculating to make risks measurable makes them seem controllable. But it is one thing for planners to calculate risks and another for people to accept the calculations, want to act on them, and then have the means to do so. Many families who live in areas prone to the periodic flooding of rivers rebuild their dwellings on the same sites while awaiting the food, clothing, and building materials from agencies in charge of the emergency response. Planners view this risk of living on the river bank as unacceptable; for them, the ideal solution is to relocate these people. But the people themselves are attached to familiar areas, may be more afraid of unknown hazards than familiar ones, and may insist on staying.

In Latin America and the Caribbean, important relationships exist between natural hazards, the particular vulnerability of each community or population group, and the risks each faces of suffering the effects of disaster. To convince people that they should take steps to become less vulnerable, and then give them a way to overcome the risk, is the vision of all who work in the field of disaster reduction. ◆

To convince people that they should take steps to become less vulnerable, and then give them a way to overcome the risk is the vision of all who work in the field of disaster reduction.