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Natural disasters and their economic and social impact

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This paper identifies the effects of natural disasters on economic development and living conditions in the Latin American and Caribbean region. On the basis of quantitative analyses and undertaken to assess the damage caused by the main natural disasters which have occurred in the region during the past 16 years, the author justifies the undertaking of preventive, planning and preparedness measures to reduce the impact of disasters.

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Introduction

1. General

Disasters have negatively affected mankind since the dawn of civilization. They can be caused by natural phenomena or by the action of man, but it is natural disasters which are the subject of this paper.

A distinction is to be made between a natural phenomenon and its consequences. The first-named is "a natural event which threatens both life and property; a disaster is the realization of such a threat".¹ The severity of the damage suffered by the population in any given disaster depends on the intensity of the natural phenomenon, the proximity of human settlements to the location or path followed by the phenomenon, and the prevention measures taken and degree of preparedness achieved by the human group involved.

Mankind has no control over the location—in time and space—and the intensity of natural phenomena which may cause disasters. Short of relocating entire human settlements to safer areas, the only practical option—at a bearable cost—open to man to reduce the effects of disasters is to adopt the prevention and preparedness measures which are within his reach.

Given their high costs—in social and economic terms—and the frequency with which they occur throughout the world,² natural disasters should be recognized as development problems rather than as isolated events. Disaster prevention and planning and preparedness measures should be included in long-term development plans.

¹See John Whitrow, *Disasters: The Anatomy of Environmental Hazards* (Penguin Books Ltd, Harmondsworth, Middlesex, England), 1980.

²For a summarized, overall picture of the time and space distribution of disasters in the world and their direct consequences see R. Jovel, *Natural disasters and their impact on the social and economic development of Central America and the Caribbean*, International Congress on Urban Emergencies, Cancun (Mexico), 1982.

2. *Origin and characteristics of natural disasters*

Natural phenomena of meteorological and geological origin frequently cause disasters of varying intensity in the countries of Latin America and the Caribbean. On the one hand, tropical storms traverse the Caribbean every year and directly or indirectly affect the countries of that subregion; similar events affect —albeit less directly— the countries located in the tropical belt of the Pacific Ocean coast. Major modifications in the atmospheric circulation over the Pacific bring about changes in the sea-water characteristics off South America and floods and drought on the Pacific slope of the continent.³ Furthermore, the annual North-South displacement of the Inter-Tropical Convergence Zone over the continent causes frequent flooding in Central America and the northern part of South America. On the other hand, the presence of the "ring of fire" along the Pacific Coast of the continent, together with other lines of contact between tectonic plates, causes frequent and intense earthquakes and volcanic eruptions in the region.

The above-mentioned natural phenomena result in disasters of different intensity in the region. They cause loss of life and injury among the population, damage and disruption to essential services and to social and economic infrastructure, as well as losses of stocks and production. Furthermore, these direct and indirect losses have secondary effects on macroeconomic variables which hinder governments' efforts to achieve sustained growth.

Available information in regard to the major natural disasters which have occurred in the world from 1846 through 1978 indicates that 34 such events occurred in Latin America and the Caribbean and that they caused the death of around 1.2 million persons.⁴ More detailed information is available on major disasters in the region from 1972 to date.

While the mass media have provided extensive live coverage of the human suffering and destruction brought about by recent disasters, no accurate quantitative estimates of losses caused by disasters are available for the region on a systematic basis.

An attempt is made in this paper to present a preliminary estimate of the social and economic effects of natural disasters in Latin America and the Caribbean, with a view to justifying the undertaking of disaster prevention and planning activities in the region. This estimate is based on information collected in recent years by the United Nations Economic Commission for Latin America and the Caribbean (ECLAC).

3. *ECLAC's work on natural disasters*

During the past 18 years ECLAC has accumulated detailed quantitative information on the social and economic impact of selected natural and man-made disasters in the region, as part of its work programme on damage assessment and rehabilitation/reconstruction planning following disasters. Upon the request of a government affected by a disaster, ECLAC sends a special field mission to undertake an independent assessment of the direct and indirect damage, to estimate its effect on national economic development and its impact on social conditions, and to identify rehabilitation and reconstruction projects.

To undertake such work ECLAC has devised a methodology for the assessment of sectoral damage and for evaluating its impact on overall economic performance and on living conditions. The field mission is normally composed of specialists in damage assessment available at ECLAC, specialized agencies of the United Nations designate sectoral experts in their field of competence to participate in the mission.

This work assists the affected government in defining its post-disaster action priorities and in seeking the required international co-operation. The international donor community —individual governments and multilateral organizations— utilizes these assessments to orient their co-operation with the affected country.

³This event is called the El Niño Southern Oscillation (ENSO) phenomenon, and normally occurs once every three to 12 years.

⁴*Natural disasters and their impact* — op. cit.

I

Analysis of recent major natural disasters in Latin America and the Caribbean

1. *Definitions*

The effects of natural disasters must be viewed not only in humanitarian terms, but also —and primarily— in economic and social terms. These effects can be divided into the following main categories⁵

- the direct effects on the property of the population affected by the disaster;
- the indirect effects which result from the decline in production and in the provision of services, and
- the secondary effects which may appear some time after the disaster: decreases in economic growth and development; increased inflation; balance-of-payments problems; increases in fiscal expenditures and deficits; decreases in monetary reserves, etc

Direct effects include losses of capital stock and inventories and —in some cases— of production. Indirect effects include diminished production in the area affected, increased expenditures to provide services or to maintain a given standard of living conditions, etc. In a way, indirect effects can be considered as "losses in the pipeline" of the economic system

2. *Case studies*

Following the above-described definition of losses and using a damage-assessment methodology developed by ECLAC, detailed analyses have been made to determine the social and economic effects of selected major disasters which have occurred in Latin America and the Caribbean during the period 1972-1988.

Damage assessments were undertaken for a number of natural disasters of both geological

and meteorological origin. Earthquakes and volcanic eruptions are geologically originated disasters, whereas floods, winds and drought are caused by meteorological phenomena

Analyses were made of detailed information concerning the Managua, Nicaragua (1972), Guatemala (1976), Mexico (1985), San Salvador (1986) and Ecuador (1987) earthquakes, and the eruption and ensuing mudflow of the Nevado del Ruiz volcano in Colombia (1985). Similar analyses were conducted for the cases of hurricane Fifi in Honduras (1974), hurricanes David and Frederick in the Dominican Republic (1979), the floods and drought caused by the El Niño phenomenon in Bolivia, Ecuador and Peru (1982-1983), and the damage done by Hurricane Joan in Nicaragua (1988)

Tables 1 and 2 present summaries of the economic losses caused by each event. To facilitate comparisons between results of the different disasters, damage figures were adjusted, in order to take account of inflation, to 1987 values.⁶

a) *The 1972 Managua earthquake.*⁷ An earthquake which originated in shallow, localized tectonic faults destroyed most of downtown Managua in late 1972. The quake demolished or damaged most commercial and public administration buildings as well as housing and other social infrastructure. In addition, the industrial capacity was heavily affected

The main social effects included 6 000 deaths, or about 1.4% of Managua's population at the time, while more than 20 000 people were injured and 300 000 were left without shelter (70% of the total city population). In addition, some 58 500 persons were rendered temporarily unemployed or subemployed due to destruction or damage to their places of work.

⁶The damage figures for the case of Hurricane Joan are given in 1988 U.S. dollars

⁷See ECLAC, *Assessment of damages and repercussions of the Managua earthquake on the Nicaraguan economy* (E/CN.12/A.C.64/2/Rev.1), Santiago, Chile, 1973

⁵See Office of the United Nations Disaster Relief Co-ordinator (UNDRO), *Disaster prevention and mitigation: vol. 7 economic aspects*, United Nations, New York, 1979

Direct losses were estimated at US\$1 580 million (at 1987 prices). They included the destruction or damage to the social infrastructure (housing, health and education facilities) and losses in stock of the commercial and industrial sectors. Indirect losses were estimated at US\$387 million, including increased costs for the provision of essential services and production losses (mainly in the industrial sector). Total losses caused by this disaster were thus estimated at US\$1 967 million (see table 1).

Secondary effects in the years following the disaster included an increase of US\$687 million in the public sector deficit, due to the need to invest in reconstruction and to the reduction of tax revenues, and an increase of US\$186 million

in the balance-of-payments deficit, caused by the need to import equipment and materials for reconstruction purposes. Further secondary effects included the reduction in growth of the gross national product (GNP) and of per capita income in 1973. In addition, consumer prices increased and monetary reserves diminished.

b) *Hurricane Fifi*. In 1974, Hurricane Fifi swept mainland Central America. Its high winds and ensuing floods caused destruction or damage to housing and other social infrastructure in marginal urban areas, to transport and other physical infrastructure; to permanent plantations and annual crop production; and to the natural resources and environment.

Table 1

ECONOMIC LOSSES CAUSED BY RECENT NATURAL DISASTERS OF GEOLOGICAL ORIGIN IN LATIN AMERICA AND THE CARIBBEAN

(In millions of 1987 US dollars)^a

Losses and effects	Earthquakes					Volcanic eruption
	Managua 1972	Guatemala 1976	Mexico City 1985 ^b	San Salvador 1986 ^c	Ecuador 1987 ^d	Nevado del Ruiz 1985
Total losses	1 967	1 437	4 337	937	1 001	224
Direct losses	1 580	1 402	3 793	710	186	154
Capital stock	1 412	1 381	3 777	694	184	150
Inventories	168	21	16	16	2	4
Indirect losses	387	35	544	227	815	70
Production		35	154	71	704	17
Services ^e	387		390	156	111	53
Secondary effects						
Public sector finances	687	368	1 899	935	397	
Increased expenditures	673	368	2 025	974	55	
Decrease in revenues	14	-	(126)	(39)	342	
External sector	186	419	8 579	350	781	...
Reduction of exports	-	-	1 650	-	635	
Increase in imports	186	419	9 075	447	155	
Disaster-related income			(2 146)	(97)	(9)	

Source: ECLAC.

^a All figures adjusted for inflation through 1987 to enhance comparability.

^b Secondary effects estimated for 1985 to 1987, and projected thereafter through 1990.

^c Secondary effects estimated for 1986 and 1987, and projected thereafter through 1991.

^d Includes damages caused by ensuing floods and mudflows which represent a very high percentage of the total.

^e Losses of income due to reduction or disruption of services, and/or higher expenditures for the provision of services.

^f From emergency relief aid and reinsurance payments from abroad.

Table 2

ECONOMIC LOSSES CAUSED BY RECENT NATURAL DISASTERS OF METEOROLOGICAL ORIGIN IN LATIN AMERICA AND THE CARIBBEAN

(In millions of US dollars)^a

Losses and effects	Hurricanes			El Niño floods and droughts 1982-1983 ^e
	Fifi 1974 ^b	David and Frederick 1979 ^c	Joan 1988 ^d	
Total losses	588	1 057	840	3 970
Direct losses	388	842	745	1 311
Capital stock	329	506	668	1 060
Inventories	14	230	18	251
Production	45	106	59	-
Indirect losses	200	215	95	2 659
Production	175	185	15	1 284
Services ^f	25	30	80	1 375
Secondary effects				
Public sector ^g	224	303	605	...
Increased expenditures	214	264	605	
Decrease in revenues	10	39	-	
External sector	362	464	241	621
Reduction of exports	48	167	27	547
Increase in imports	314	296	223	74
Disaster-related expenditures ^h			(9)	...

Source: ICLAD, 1990, adjusted for inflation through 1987 in order to enhance comparability.

^aAll figures are in US dollars only, even though other countries were affected as well.^bDamages refer to the Dominican Republic only, even though other countries were affected as well.^cDamages refer to 288 US dollars. Secondary effects have been projected through 1993.^dThese figures refer to the Dominican Republic, Ecuador and Peru, although other countries were affected as well.^eDamages refer to the reduction of disruption of services and/or higher expenditures for the provision of services.^fLosses of money for the fiscal deficit occurred but no accurate estimates are available.^gSizeable increase in the fiscal deficit and reinsurance payments from abroad.^hFrom emergency relief and reinsurance payments from abroad.

In Honduras alone⁸ (other countries such as Nicaragua, El Salvador, Guatemala and Belize were also affected) 7 000 persons were killed. Nearly 15 000 more were rendered homeless, and although this figure represents only a small proportion of the population in the affected area, some small villages were entirely wiped out. Insufficient information prevented the estimation of the number of injuries and of the effects on employment.

Direct losses amounted to US\$388 million and included destruction or damage to housing,

health and education services; bridges, ports and roads, and the loss of some permanent plantations and arable lands which were eroded by the winds. This figure also included damage to domestic and commercial inventories. Indirect losses were estimated at US\$200 million and included losses in banana and annual crop production and higher costs of public sector utilities. The total losses caused by the hurricane in Honduras alone thus amounted to US\$588 million (see table 2).

Secondary effects included a US\$362 million worsening of the balance-of-payments situation, caused by reductions of agricultural exports and by imports of reconstruction equipment and materials. Public-sector finances suffered a nega-

⁸See ICLAD (1990) *El impacto de los daños y repercusiones del huracán Fifi en Honduras* (Lima: CEPAL A/C.67/2/Rev.1, 1990), Chile, 1975.

tive impact of US\$224 million due to the need to invest in rehabilitation and reconstruction and to a reduction of export tax revenues (see table 2).

A further secondary effect was the drop in GNP growth in subsequent years, which contrasts notably with the vigorous (5%) rate of growth in preceding years.

c) *The Guatemala earthquake of 1976*⁹ A severe quake caused by the displacement of the Caribbean, Cocos and North American tectonic plates, with epicentres located along a major geologic fault which traverses the country, caused extensive damage in many small villages and medium-sized towns in the interior and in Guatemala City.

It was estimated that 22 800 lives were lost, which makes this earthquake—together with the Nevado del Ruiz eruption in 1985—the most damaging to human life in the recent history of the region. Furthermore, 76 000 persons were injured, and over one million people—or nearly 19% of the country's population—were made homeless.

Direct losses were estimated at US\$1 400 million. They included the destruction to housing and other social infrastructure, transport infrastructure, and domestic and commercial inventories. Indirect losses of over US\$35 million were incurred due to the reduction of commercial and agricultural production and to brief interruptions of the water supply and electricity services. Total losses thus amounted to 1 437 million dollars (see table 1).

Secondary effects on the economy were estimated at US\$787 million. The fiscal budget was burdened by the need to increase expenditures to finance rehabilitation and reconstruction projects, and the balance-of-payments situation deteriorated due to the need to import materials and equipment for relief, rehabilitation and reconstruction activities (see table 1).

d) *Hurricanes David and Frederick*. In 1979 Hurricane David traversed the Dominican Republic; several days later, tropical storm Frederick—later to become a full hurricane—also

struck the island. Dominica, Haiti and Cuba were also affected.

The combination of very high winds and subsequent flooding resulted in widespread destruction or damage to housing, agricultural infrastructure and production, electricity and water supply services, physical infrastructure in general and the environment.

The main social effects included the death of a number of persons (only 2 100, thanks to the existence of a warning system and evacuation plan), while over 600 000 people, or 10% of the country's population, were left without a home. No complete figures were collected concerning injuries and unemployment.¹⁰

Direct losses were estimated at US\$842 million. They include losses of US\$506 million in the capital stock of (in decreasing order of magnitude) the agriculture and livestock sectors, housing, energy and water-supply systems, and transport infrastructure, US\$230 million worth of cattle stock, commercial and household inventories, and US\$106 million of banana and other crop production. Indirect losses amounted to US\$215 million and refer to decreased agricultural production and commercial output in subsequent years (US\$185 million), and to increased costs and diminished revenues in the services sectors. Total losses were thus calculated at US\$1 057 million (see table 2).

Secondary impacts on the economy included negative effects in the amount of US\$464 million on the balance of payments, caused by increased imports to attend disaster needs and by reductions in the exports of bananas and other crops, and a negative impact of US\$303 million on public-sector finances originated by increased spending to attend relief, rehabilitation and reconstruction and by the reduction in export tax revenues (see table 2).

The gross national product actually grew faster during the years after the disaster: a fact which was due, at least in part, to the economic recession of previous years caused by the rising oil prices. Only scant information is available

⁹See ECLAC, *Daños causados por el terremoto de Guatemala y sus repercusiones sobre el desarrollo económico y social del país* (CEPAL/MEX/76/Guat 1), Mexico City, 1976.

¹⁰See ECLAC, *República Dominicana: repercusiones de los huracanes David y Frederick sobre la economía y las condiciones sociales*, nota de la Secretaría (L/CEPAL/G.1098/Rev.1), Santiago, Chile, 1979.

regarding inflationary pressures and monetary reserve fluctuations after the disaster.

e) *The El Niño phenomenon of 1982-1983*¹¹ The modification of the general atmospheric circulation over the South Pacific in 1982-1983 affected Bolivia, Chile, Ecuador and Peru in different ways and intensities. Extensive flooding occurred in the coastal areas of Ecuador and Northern Peru, as well as in the Amazonian region of Bolivia, while a severe drought affected the Bolivian-Peruvian highlands. Sea-water temperature and salinity were adversely modified.

The death-roll and the number of injuries were not significant, but 298 000 persons in marginal urban and rural areas were rendered homeless by the floods, and a total of 3.7 million persons were directly affected by the partial or total loss of their means of production, absence of health and education services, insufficiency of food and declining nutrition levels, increased morbidity levels, and shortages of agricultural and food inputs.

The drought in the highlands brought the most impoverished population groups in the Continent to the brink of widespread famine, and originated further migration to other areas and countries. Pre-disaster conditions in that region were restored only recently.

Both individual fishermen and commercial enterprises were greatly affected by the severely diminished fishing production brought about by the changes in the sea-water characteristics. Some fish varieties emigrated elsewhere or died. The annual catch has only recently recovered pre-disaster levels.

Direct losses in Bolivia, Ecuador and Peru were estimated at US\$1 311 million. They included capital stock and inventory losses in the agricultural, transport, oil production, fishing industry and social infrastructure sectors. Indirect losses amounted to US\$2 659 million, including losses of production in the agricultural, industrial and fishing sectors, as well as increased costs and diminished revenues in the transport sector.

Total losses thus amounted to US\$3 970 million, making this the second most costly sin-

gle disaster in the region in recent history (see table 2). Furthermore, they represented about 10% of the countries' combined GNP, or 50% of their annual public sector revenues at the time. Bolivia, the weakest economy, was by far the most seriously affected.

Secondary effects on economic development were extremely severe. In the two-year period 1982-1983, the negative effect on the balance of payments reached an estimated US\$621 million, due to decreased fishery, agriculture and livestock exports and to imports of foodstuffs and agricultural inputs. Public sector deficits and their ratio to GNP increased notably. This was due to decreases in value-added and export tax revenues and to unforeseen expenditures to undertake relief, rehabilitation and reconstruction activities.

Gross national and per capita product growth decreased in the three countries at rates of up to -10%. Consumer prices rose up to 50% in some cases, due mainly to increases in food prices because of production shortages and speculation.

f) *The 1985 Mexico City earthquake*.¹² This earthquake of extraordinary magnitude (8.1 on the Richter scale) originated in the Michoacan Gap and its effects—magnified by special sub-soil conditions—caused extensive damage in a populous section of downtown Mexico City in September 1985.

The earthquake and subsequent aftershocks resulted in the death of more than 10 000 persons, 30 000 more were physically or psychologically injured, and around 150 000 people were rendered homeless.

Some 33 600 dwellings were destroyed and 65 000 more sustained substantial damage. Health sector facilities were seriously reduced as many hospitals and clinics were destroyed or damaged beyond repair. About one-fifth of the capital city's educational establishments were destroyed or badly damaged. Water-supply, electricity and communications services in the downtown section of Mexico City were also affected, albeit less seriously.

¹¹See ECLAC, *The natural disasters of 1982-1983 in Bolivia, Ecuador and Peru* (E/CEPAL/G.127.1), Santiago, Chile, 1983.

¹²See ECLAC, *Damage caused by the Mexican earthquake and its repercussions upon the country's economy* (LC/G.1367), Santiago, Chile, 1985.

Direct losses were estimated at US\$3 793 million. They included infrastructure and inventory losses in public administration buildings, housing, health and education facilities, communications, and small-scale industry and commerce. Indirect losses were estimated at US\$544 million, and reflect the decrease in revenues and/or increased costs in small-scale industry and commerce, and in the communications, tourism and personal services sectors. The total losses caused by the earthquake thus amounted to US\$4 337 million, making it the most damaging natural disaster of recent years in the region (see table 1).

However, even more serious than the impressively large absolute losses—which an economy the size of Mexico's would perhaps be able to absorb under normal circumstances, since total losses represented only 2.7% of GNP at the time—is the effect of rehabilitation and reconstruction needs on the main macroeconomic variables. It must be borne in mind that the disaster occurred at a time when the government was applying an austerity policy in public expenditures, when banks were short of liquidity to face the increased demand for credit, and when external restrictions were looming.

In the five years after the earthquake, the negative effect on the balance of payments is expected to reach US\$8 579 million in spite of considerable reinsurance income and donations from abroad. Furthermore, the public-sector deficit is expected to increase by approximately US\$1 900 million due to rehabilitation and reconstruction expenditure requirements (see table 1).

The requirements for reconstruction made the Mexican authorities revise their economic policy to accommodate the increased demands for public funds, credits and imports. Furthermore, priorities for public activities were reoriented to permit the reassignment of resources to reconstruction, leaving aside for the time being the solution of long-standing problems in the capital city.

g) *The Nevado del Ruiz volcanic eruption*¹³
In late 1985 mudflows originated by the melting of snow after the eruption of the Nevado del

Ruiz volcano in Colombia caused the death of 22 800 persons. That figure includes more than 90% of the population of the city of Armero, which did not have an appropriate early-warning system. In addition, 5 200 persons were injured and 10 000 more were left homeless. Some 200 000 people were directly or indirectly affected by the disaster.

In this most-atypical disaster, the dead exceeded the affected survivors by a 3 to 2 ratio. While the death-roll represented a great human loss, the tragedy of the survivors cannot be over-emphasized. They were rendered homeless, many were severely injured—some even lost limbs to enable their rescue—and many lost their entire families. In addition, they required physical and psychological rehabilitation yet lacked the essential permanent health and education services.

A preliminary estimate places total losses at US\$224 million. Direct losses of capital stock in social and physical infrastructure—including the total destruction of a city of 25 000 inhabitants—were estimated at US\$150 million, and US\$4 million worth of inventories were lost. Indirect losses were estimated at US\$70 million, they include production losses of US\$17 million and losses of revenue or the need for increased expenditures to provide vital services (see table 1).

The secondary economic effects were not estimated, but were small when compared to national macroeconomic variables, due to the small size of the affected region. It was estimated that the only measurable effect might be a slight increase in national public expenditure for emergency and immediate rehabilitation aid.

The true measure of this disaster lies, without a doubt, in the tragic loss of life and human suffering it caused.

h) *The 1986 San Salvador earthquake*¹⁴
This disaster caused the death of about 1 200 people, more than 10 000 were injured, and nearly 500 000 suffered partial or total loss of their homes and small shops. The living conditions of the poorest sectors of the population

¹³See United Nations, *The Nevado del Ruiz volcano natural disaster* (SG/SM 1/1). New York, 1985.

¹⁴See ECLAC, *The 1986 San Salvador earthquake: Damage, repercussions and assistance required* (LC/G 1443), Santiago, Chile, 1986.

were seriously affected through losses of housing, essential services and sources of income.

This earthquake caused considerable damage to housing and to the basic services of water supply and sewerage, electricity and telecommunications. It totally or partially destroyed a large number of buildings in the health and education sectors, as well as infrastructure, machinery and inventories belonging to the industry and commerce sectors. Moreover, the administrative functioning of the government was temporarily interrupted by the destruction of public buildings and by the loss or destruction of archives and communications systems.

A total loss of about US\$937 million was estimated. Direct damage, including capital stock and inventory losses, was estimated at US\$710 million, indirect losses amounted to US\$227 million more. The most serious material losses in infrastructure were those affecting housing, commerce and public buildings. Commerce was the sector most affected by production losses, while the basic services utilities suffered heavy losses due to higher expenditures and diminished income.

While other disasters in the region have caused higher material and production losses, the San Salvador earthquake had a greater relative economic impact. In this case, the total losses amounted to approximately one-quarter of the country's gross domestic product or about 40% of its external debt at the time.

The secondary effects on the economy will be felt for several years to come. Due exclusively to the disaster, in 1986 the growth rate of the gross domestic product went down by 2%, the fiscal deficit rose by more than 24%, the public administration was severely disrupted, and the external sector experienced the doubling of its current account deficit due to increased imports for reconstruction. In the five years following the disaster, the public sector is expected to suffer a negative impact of US\$935 million due to increased expenditures, despite increased tax revenues, while the external sector position is likely to suffer a deterioration of some US\$350 million, due to increased imports for reconstruction and in spite of reinsurance payments from abroad (see table 1).

The social impact is even more significant. The already considerable housing shortage

increased substantially and unemployment rose from 26 to 35% in the metropolitan area of San Salvador. There was also a drastic reduction in public health services and facilities. These social consequences of the disaster came on top of the hardships of a population suffering from the effects of an internal war.

i) *The March 1987 earthquake in Ecuador*¹⁵

This event caused the death of about 1 000 persons. More than 5 000 people had to be evacuated from the disaster area and re-housed in temporary shelters. About 3 000 dwellings were completely destroyed and 12 500 more had to be repaired. Several hospitals and health centres were also affected. Water-supply and sewerage systems were damaged, as well as many educational establishments.

Mudflows caused by the quake and subsequent rains destroyed more than 40 kilometres of the trans-Ecuadorian pipeline used to transport oil from the Amazon region to the refineries and export centres located on the Pacific Coast, as well as severely damaging the only highway connecting the Eastern provinces with the rest of the country. Moreover, agricultural production was affected by the erosion of arable land caused by landslides, and the floods carried away thousands of head of livestock and deposited silt over large areas of grazing land.

The total damage caused by this disaster was estimated at US\$1 000 million. Direct damage to the capital stock and inventories of the country's social and economic sectors was estimated at US\$186 million. Indirect damage—which include extremely large losses by the petroleum-exporting sector, together with the higher costs incurred to satisfy domestic energy demands, and production losses in the agricultural sector, was estimated at US\$815 million (see table 1).

Even though it affected a relatively small area, the disaster brought about a considerable fall in Ecuador's production and export capacity. It has been estimated that in 1987 there was a 3% drop in the gross domestic product, instead of the 2.5% growth foreseen before the disaster. The external sector suffered losses of about US\$790 million due to reduced exports of oil and

¹⁵See FCIAE: *The natural disaster of March 1987 in Ecuador and its impact on social and economic development* (LC/G 1465), Santiago, Chile, 1987.

other products (US\$635 million) and to increased imports for rehabilitation and reconstruction. The public sector finances experienced an increased deficit of about US\$397 million due to increased outlays and decreased revenues (see table 1). The projections indicate still further deterioration of these macroeconomic variables in the future as an effect of the disaster.

The disaster had harsh consequences for the welfare of some 100 000 people who were directly affected. The brunt of the disaster was borne by population groups living in rural and marginal urban areas located in a number of provinces where unemployment levels and rates of illiteracy are high and where the provision of basic social services—health, sanitation and education—is limited. In addition, approximately 75 000 persons living in the Amazon region were isolated from the rest of the country for several months; essential supplies needed by the population had to be transported by air and it was impossible to bring their produce to the markets.

1) *Hurricane Joan*¹⁶ In October 1988 the tenth hurricane of the Caribbean season gave rise to a major disaster in Nicaragua and also caused damage in neighbouring Costa Rica, Panama, and El Salvador. With sustained winds of up to 217 kilometres per hour, the hurricane entered Nicaraguan territory and destroyed several cities, after traversing the continental divide and causing extraordinary rainfall and floods; its winds lost force and it slackened to a tropical storm before petering out in the Pacific Ocean.

In Nicaragua, approximately 310 000 persons were evacuated from the danger areas before the hurricane struck; they were housed in temporary shelters to protect them from the winds, rain and floods while they awaited the re-establishment of minimum environmental and health conditions in their original settlements. About 230 000 low-income peasants and fishermen saw their homes and working capital destroyed or damaged. A total of 2.8 million people were directly or indirectly affected by the disaster.

Direct damages were estimated at US\$745 million. They included total or partial destruction of social infrastructure, especially housing, erosion of agricultural soils and devastation of extensive areas of tropical forests, destruction or damage to the economic infrastructure, particularly transport facilities, and damage to the agricultural and industrial infrastructure, as well as losses of products. Indirect losses were estimated at US\$95 million; they refer to the greater expenditure needed to supply health services and attend necessary emergency and relief operations, and to production losses in the near future. Total losses were thus estimated at US\$840 million (see table 2).

These losses constitute a very heavy burden for Nicaragua. They represent slightly less than 10% of the country's accumulated capital stock or about 40% of the gross domestic product for 1988. Furthermore, the disaster came at a time when the Nicaraguan economy was showing signs of growing weakness as it continued to undergo a state of semi-permanent crisis brought about, in part, by the marked deterioration of the external sector—which has been severely hurt by an economic blockade since 1985—and by the need, in recent years, to allocate to defence a large share of the country's scarce resources.

Secondary effects on economic performance will be felt for a number of years. In 1988 alone, the fall of the gross domestic product increased by 2 percentage points and per capita income was further eroded; in addition, the already large fiscal deficit will be increased due to the additional expenditure needed to meet emergency requirements. In 1989 and the following years, even though some recovery is expected in the productive and construction sectors, public sector finances will deteriorate further due to the new investments and expenditures required for rehabilitation and reconstruction, and the balance of payments will exhibit greater disequilibrium as a result of the need to increase imports and the inevitable fall in exports (see table 2). No doubt this will lead to a further speed-up of the hyperinflationary trend which existed before the disaster.

The government will be forced to revise its most recent goals for re-establishing macroeconomic equilibria. Moreover, the country does not

¹⁶See ILOAC, *Damages caused by Hurricane Joan in Nicaragua: its effects on economic development and living conditions, and requirements for rehabilitation and reconstruction*. Note by the Secretariat (ILO, C 154 D). Santiago, Chile, 1988.

have the capacity to undertake the necessary rehabilitation and reconstruction work on its own while at the same time continuing its long-term efforts to achieve sustained development and to improve the living conditions of the population. It may be necessary to postpone major economic and social development programmes which were underway or about to be initiated.

The above considerations are even more important in view of the fact that the people most affected by the disaster include about 62 000 low-income peasant families who lost their subsistence crops and their very limited belongings and who are now faced with the task of rebuilding their highly fragile family-based economy.

II

The effects of natural disasters

1. Region-wide estimates of losses

The following conclusions can be drawn after analysing the available information on the type and amount of the social and economic losses caused by selected recent major disasters in Latin America and the Caribbean:

Depending on the *origin* of the natural phenomena which caused the natural disaster:

- natural disasters of meteorological origin—such as floods, hurricanes and droughts—usually cover a more extensive geographical area than those of geological origin;
- due to population density, the number of victims caused by natural disasters of geological origin—such as earthquakes—is likely to be higher than in the case of those caused by meteorological phenomena;
- losses of capital stock in the physical and social infrastructure caused by earthquakes are usually much higher than those caused by floods;
- losses of production and indirect losses on the other hand, are likely to be much higher in cases of floods and droughts; and
- when a geological phenomenon gives rise to floods or mudflows, losses of production and indirect losses are much higher than in straight cases of geological disasters.

The following *general effects* are common to all types of natural disasters:

- a significant number of victims which reduces the already limited quantity of trained human resources in the affected countries;
- a substantial reduction in the availability of

housing, health and education facilities, thus increasing pre-disaster deficits;

- a temporary reduction in the income of the least-privileged social strata and a corresponding increase in already-high rates of underemployment and unemployment;
- temporary interruptions of water supply and sanitation, electricity, communications and transport services; and
- temporary shortages of food supplies and raw materials for agricultural and industrial production.

On the quantitative side, the analysis of the case studies described earlier gives an idea of the size of the losses caused by major natural disasters in the region. However, additional significant losses arise from less-severe natural disasters which affect the region on a more frequent basis.

In regard to the latter, ECLAC has estimated that during the 15-year period between 1962 and 1976, the Central American countries alone were affected by different types of natural disasters which inflicted 39 600 deaths and losses of capital stock, production and inventories amounting to about US\$8 500 million 1987 dollars.¹⁷

¹⁷ The following is the breakdown of losses:

Type of disaster	Deaths	Millions of 1987 US\$
Floods and winds	6 054	1 896
Drought, hail and cold fronts	-	163
Volcanic eruptions and earthquakes	33 500	6 453
Total	39 554	8 512

If the latter figures are combined with those of the case studies analysed and of other less-studied disasters, it may be concluded that in the Latin American and Caribbean region as a whole more than 6 000 lives and over US\$1.5 billion 1987 dollars are lost per year due to natural disasters.

2 *Economic and social effects*

Although the amount of direct and indirect losses indicated above is very large, the social and economic effects of natural disasters are even more striking.

Thus, depending on the size and degree of diversification of the affected country's economy, the secondary effects of natural disasters include:

- a reduction in economic growth and in the improvement of social conditions in general,
- an increase in the public sector deficit because of unforeseen emergency relief, rehabilitation and reconstruction expenditures and reductions in tax revenues,
- a deterioration in the balance-of-payments position due to the fall in exports and the increases in imports of equipment and materials for relief, rehabilitation and reconstruction; and
- an increase in the cost-of-living index due to shortages of essential goods and speculation.

The short-term effects of emergency relief and immediate rehabilitation activities have been absorbed thanks to the efforts undertaken by the affected governments, with generous assistance from the international community. The disasters have longer-term effects, however, whose solution has often called for great sacrifices by the affected country's population.

In fact, in the case studies analysed, rehabilitation and reconstruction have been made possible through a combination of the following measures, depending on the specific economic position of the affected country:

- reassignment of existing fiscal resources and internal savings,
- reorientation of existing bilateral or multi-lateral loans, and
- securing of additional external financing.

The above measures have resulted in the deferment or cancellation of development projects which had been included in already-approved long-term development plans, and in the delay of improvements in social conditions in general.

3 *The need to reduce losses and cushion their effects*

While the natural phenomena which give rise to these disasters cannot be avoided, it is possible to take measures to reduce their social and economic effects to more manageable levels and thus contribute to long-term development. Such measures, while costly in themselves, would represent only a small fraction of the present level of losses mentioned above. They include preventive, planning and preparedness activities or systems which are briefly described below.

Disaster prevention measures are designed to prevent natural phenomena from causing disasters or at least to limit their consequences.

A first group of prevention measures is related to the forecasting and warning of natural phenomena, and is based on a thorough scientific study of the intensity and chronological and spatial distribution of the natural phenomena which may originate disasters. They include the setting up of networks to monitor the development and evolution of meteorological events, and the implementation of early-warning systems in the vicinity of human settlements.¹⁸

The second set of prevention measures refers to the adoption of technical and legislative regulations, such as zoning laws based on vulnerability analysis and special building codes, to ensure that buildings are able to withstand the anticipated effects of natural phenomena. The education and training of the population to make people aware of disaster risks and of prevention requirements also comes within these measures.

There are two main areas of action in connection with *disaster-related planning*. First, physical planning should include disaster vulnerability analyses of all large-scale develop-

¹⁸No similar monitoring and early-warning systems have been developed as yet for disasters of geological origin, except in a few isolated cases of volcanic eruptions.

ment works—including human settlements—to decide their optimum location and anti-disaster characteristics. Second, long-term development planning should include potential disaster effects as a new variable—giving due consideration to the need for the adoption of emergency relief programmes and contingency measures in cases of disaster—as well as taking account of the rehabilitation and reconstruction requirements generated by a major disaster.

Finally, *disaster preparedness* involves the adoption of measures to organize and facilitate

rescue and relief operations in cases of disaster. They include the formulation of emergency plans, the setting up of effective relief organizations, the training of personnel for these activities, the stockpiling of supplies and the setting up of special funds for emergency relief.

In addition to its work on damage assessment, ECLAC is assisting its member countries in the design and installation of flood forecasting and early warning systems. Additional efforts are required, however, in order to reduce losses brought about by natural disasters in the region.