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GUATEMALA: ASSESSMENT OF THE DAMAGE CAUSED BY HURRICANE MITCH, 1998

Implications for economic and social development and for the environment

99-4-31

CONTENTS

PREFACE

This study forms part of United Nations support for Central America following the disaster caused by hurricane Mitch, which struck the region in October 1998. A request for this social, environmental and economic impact assessment was submitted to the Economic Commission for Latin America and the Caribbean (ECLAC) by the Planning and Programming Secretariat of the Presidency of the Republic (SEGEPLAN) through the United Nations Development Programme (UNDP).

The study carries out a sectoral analysis leading to an overall assessment of the damage; it appraises the macroeconomic and environmental effects and proposes guidelines for rehabilitation and reconstruction programmes; it complements other sectoral or partial assessments conducted by national and international institutions, and financial and bilateral cooperation agencies.

National authorities, coordinated by SEGEPLAN, UNDP and other United Nations agencies, as well as international institutions and agencies, collaborated in the preparation of the study. Officials and consultants of the Pan American Health Organization (PAHO/WHO) and of the United Nations Children's Fund (UNICEF) joined the mission. Valuable contributions were also made by the United Nations Verification Mission in Guatemala (MINUGUA). This assessment complements the data collected by the Office of the United Nations Disaster Assistance Coordinator (UNDAC) through the Office of the Coordinator for Humanitarian Assistance (OCHA).

The direct and indirect damage has been assessed in accordance with the methodology developed by ECLAC. The results are based on the mission's estimates; the study incorporates the information available and evidence collected in interviews and visits to affected locations. It is estimated that the magnitude of the losses exceeds the country's capacity to address reconstruction needs on its own, particularly if the aim is also to reduce the impact of similar events in the future, and therefore international cooperation is considered essential.

This appraisal is designed to provide the government and the international community with guidelines for setting national and regional priorities in rehabilitation and reconstruction programmes. An economic approach would be very limited, and such programmes should therefore include actions of a social nature designed to alleviate the suffering of broad segments of the population who were already in a situation of poverty and vulnerability before the disaster occurred. Special attention and priority should be placed on including sustainability and increased-governance criteria in making social and productive investments, and on allocating resources to the reconstruction and replacement of infrastructure.

Guatemalan society and government face the opportunity of undertaking the reconstruction with renewed values and criteria, consolidating the peace process and embarking at the same time on institutional, legal and structural reforms to reduce economic, social and environmental vulnerability. An important aspect of such reforms will be to strengthen the country's savings, investment and management capacity as part of the reconstruction.

I. BACKGROUND

Hurricane Mitch was one of the most violent hydrometeorological phenomena to have struck Central America this century, owing to its force on reaching the region's coasts, its diameter, the accumulation of humidity and rain it carried, and the erratic path it followed for several days. In Guatemala the hurricane occurred when the country was resuming a path of sustained growth and development after a long period of violence and armed confrontation which had caused setbacks and stagnation in society.

Natural disasters, whether climatic, seismic or volcanic, are frequent in the region. In Latin America, annual losses caused by such phenomena are estimated at more that US$1.5 billion and almost 6,000 lives.[1] These effects are exacerbated by structural disparities in societies, which place population segments already living in precarious economic and social conditions at greater risk.

The extent of the damage and the enormous efforts required for the recovery point up the need for the country —and the region as a whole— to receive cooperation from the international community. This involves the creation of more favourable conditions for its integration into world trade and access to its principal markets. International funds will be needed to complement national efforts —both public and private— to carry out the reconstruction programme. The attached project profiles show the magnitude of the efforts involved and indicate the degree of urgency and the priorities to be set, with the participation of the international community

1. The mission

UNDP requested ECLAC's cooperation in carrying out a project to assess the environmental, social and economic impact of hurricane Mitch on the countries of Central America. [2]

Two technical teams coordinated by ECLAC were established to carry out the assessment in the four countries most affected; one of the teams was entrusted with the work in Honduras and El Salvador and the other in Guatemala and Nicaragua. The mission had the full support of the UNDP national offices and representatives of various United Nations agencies, and of three international financial institutions: the Inter-American Development Bank (IDB), the World Bank and the International Monetary Fund (IMF). PAHO/WHO and UNICEF provided officials or consultants to support the mission.

The work was carried out as a contribution to Guatemala and the United Nations in response to bilateral and multilateral cooperation initiatives to enable the countries of Central America, and Guatemala in particular, to address the challenges of rehabilitation and reconstruction.

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[1] See, for example, Jovel, R. and R. Zapata (1993), *Macroeconomic effects of natural disasters in Latin America and the Caribbean,* a paper presented at the Fortieth North American Meeting of the International Association of Regional Science, Houston, 11-14 November.

[2] Project RLA/98/020, "Socio-economic impact assessment of natural disasters (hurricane Mitch)".

The mission visited Guatemala from 15 to 21 November 1998. The team was made up of the following ECLAC officials, external consultants and officials of other international organizations who joined the team:

- Jorge Máttar, coordinator.
- Óscar Zamora, consultant, commodoties sector (agriculture, livestock, fisheries, forestry).
- René Hernández, macroeconomic effects and industrial, trade and services sectors.
- Oriel Olivares, consultant, transport infrastructure sector.
- Ruth Urrutia, population affected, education and health sectors, with the support of UNICEF and PAHO/WHO, in the health sector and dealing with the emergency.
- Daniel Bitrán, consultant, housing and health sectors.
- José Javier Gómez, environmental impact.
- Jaime Baraqui, consultant, design of reconstruction projects.
- Hugo Ventura, energy sector.

Additionally, consultants Roberto Jovel and Antonio Tapia reviewed the assessments and were instrumental in making damage estimates more precise.

The mission followed a previous visit by ECLAC officials in which liaisons with government entities and technical collaboration with various multilateral agencies and the United Nations were established, with the support of the government and the Resident United Nations Coordinator in Guatemala.

This document contains an independent and objective assessment of the disaster which sets forth the overall magnitude of direct and indirect damages and their effects on the behaviour of the economy as a whole. It will serve as a basis in drawing up proposals for reconstruction priorities and needs, one of which should be the explicit incorporation of measures to reduce the country's high social, economic and structural vulnerability to such disasters.

2. Description of the phenomenon and its effects

The hurricane season in the northern hemisphere and the Atlantic Ocean (July to November) was unusually strong in 1998 and caused enormous devastation, loss of life, and economic, social and environmental damage. The concentration of very violent meteorological phenomena between August and October was historic: [3] a dozen tropical cyclones were given names during that period and affected densely populated areas throughout the Caribbean basin, including both the island countries [4] and the States of the Central American Isthmus. Table 1 shows the dates on which they occurred and their wind velocity. Their effects heighten and form part of other climatic disturbances affecting the

[3] National Hurricane Center (NHC) (1998), Monthly Tropical Weather Summary, prepared by the US National Weather Service (NWS) and posted on the Internet for October and November.

[4] For an assessment of the damage caused in the Caribbean islands, see ECLAC (1998), *República Dominicana: Evaluación de los daños ocasionados por el huracán Georges, 1998. Sus implicaciones para el desarrollo del país* (LC/MEX/R.668), 29 October.

region, such as the droughts and floods resulting from the El Niño phenomenon in the Pacific Ocean, [5] all of which have caused major damage throughout Latin America and the Caribbean.

Table 1

MAIN HURRICANES IN THE ATLANTIC OCEAN, 1998

Name	Dates	Maximum wind velocity (kilometres per hour)
Danielle	24 August-3 September	170
Earl	31 August-3 September	160
Frances	8-13 September	105
Georges	15-29 September	240
Hermine	17-20 September	75
Ivan	20-27 September	145
Jeanne	21-30 September	170
Karl	23-28 September	170
Lisa	5-9 October	120
Mitch	21 October- 4 November	290

Source: ECLAC, based on US National Weather Service (NWS-NHC) data, October and November 1998.

Hurricanes Lisa and Mitch originated in the Atlantic basin in October. Lisa moved north-east from 5 to 9 October and became a minimum-level extra-tropical system with winds of 140 kilometres per hour, but did not touch land. Mitch, in contrast, arose from a tropical front between Monday 19 and Tuesday 20 October. In Guatemala there was a north wind due to its cyclonic movement, and the atmosphere became unstable. The phenomenon developed into a low-pressure zone and, at noon on 21 October, was classified as the thirteenth tropical depression of the season. At that time, it was located in the south-western Caribbean, some 580 kilometres south of Jamaica, with steady 50 km/h winds, moving west-north-west at 15 km/h.

On Thursday 22 October, it was upgraded to a tropical storm (named Mitch); its centre was located 704 kilometres south-east of the Nicaraguan city of Bluefields, with sustained winds of 72 km/h and gusts of more than 90 km/h. From then on, it followed an apparently erratic path, varying in intensity and changing course several times between 23 October and 4 November (see Table 2 and figures 1 and 2).

[5] These climatic disturbances have affected Latin American and Caribbean countries, such as Mexico, which has been afflicted by droughts and floods at different times, and the consequences of the El Niño phenomenon have been felt in the Andean countries and Central America. See ECLAC (1998a), *Ecuador: Evaluación de los efectos socioeconómicos del fenómeno El Niño en 1997-1998* (LC/R.1822/Rev.1 and LC/MEX/R.657/Rev.1), 16 July, and ECLAC (1998b), *El fenómeno El Niño en Costa Rica durante 1997-1998. Evaluación de su impacto y necesidades de rehabilitación, mitigación y prevención ante las alteraciones climáticas* (LC/MEX/L.363), 3 November.

Table 2

PATH AND EVOLUTION OF HURRICANE MITCH

Date (day and local time)		Wind velocity (Maximum sustained km/h)	Category (Saffir-Simpson Scale)	Location		
				Latitude (north)	Longitude (west)	Barometric pressure (BM)
23 October,	10 a.m.	95	Tropical storm	12.7	77.9	999
	10 p.m.	95	Tropical storm	13.0	78.1	997
24 October,	10 a.m.	160	2	14.9	77.9	987
	10 p.m.	195	3	15.7	78.4	965
25 October,	12 a.m.	200	3	15.9	78.9	953
	12 p.m.	235	4	16.4	80.3	929
26 October,	12 a.m.	240	4	16.3	82.0	922
	12 p.m.	273	5	17.0	83.2	906
27 October,	12 a.m.	285	5	17.4	84.5	918
	12 p.m.	250	5	16.9	85.4	928
28 October,	12 a.m.	220	4	16.5	85.6	933
	12 p.m.	195	3	16.4	85.6	948
29 October,	12 a.m.	160	2	16.3	86.0	970
	12 p.m.	120	1	15.9	85.6	990
30 October,	12 a.m.	65	Tropical storm	15.3	86.5	997
	12 p.m.	85	Tropical storm	14.0	87.0	1,000
31 October,	8 a.m.	55	Tropical depression	14.5	88.7	1,001
	8 p.m.	55	Tropical depression	14.6	90.5	1,002
1 November,	8 a.m.	45	Tropical depression	14.9	91.6	1,005
3 November,	5 p.m.	70	Tropical storm	20.0	90.6	997
	8 p.m.	65	Tropical storm	20.2	90.2	997
4 November,	12 a.m.	65	Tropical storm	20.3	89.9	997
	2 a.m.	55	Tropical depression	20.8	89.4	998
	8 a.m.	75	Tropical storm	21.8	88.3	998

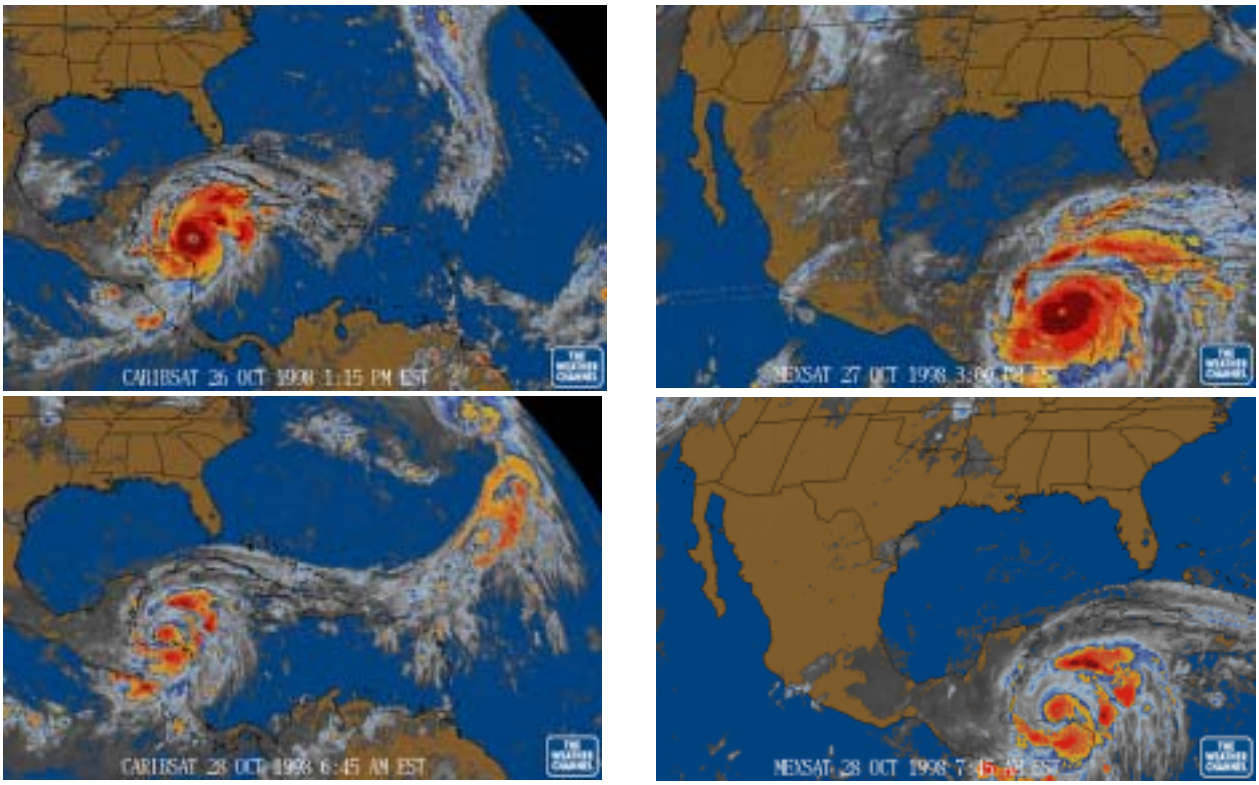
Source: ECLAC, based on Internet data, http://dyred.sureste.com.

As a result of the presence of two high pressure fronts —the anticyclone in the Gulf of Mexico and the inter-tropical convergence zone (ITCZ)— Mitch slowed down and gradually took a south-westerly path. On Friday 23 October the centre of the storm was 660 kilometres south-east of Puerto Cabezas and 785 km north-west of Bluefields, Nicaragua, moving slowly north at an estimated 11 km/h, with steady 95-km/h winds and 108 km/h gusts. On Saturday 24 it was upgraded to hurricane —in less than 24 hours the pressure in the eye fell 52 millibars to reach 924—, with steady winds of up to 150 km/h, moving at 9 km/h in a north-north-westerly direction. That day it was located at a point south-south-west of Jamaica (415 km) and to the east of Puerto Cabezas (600 km).

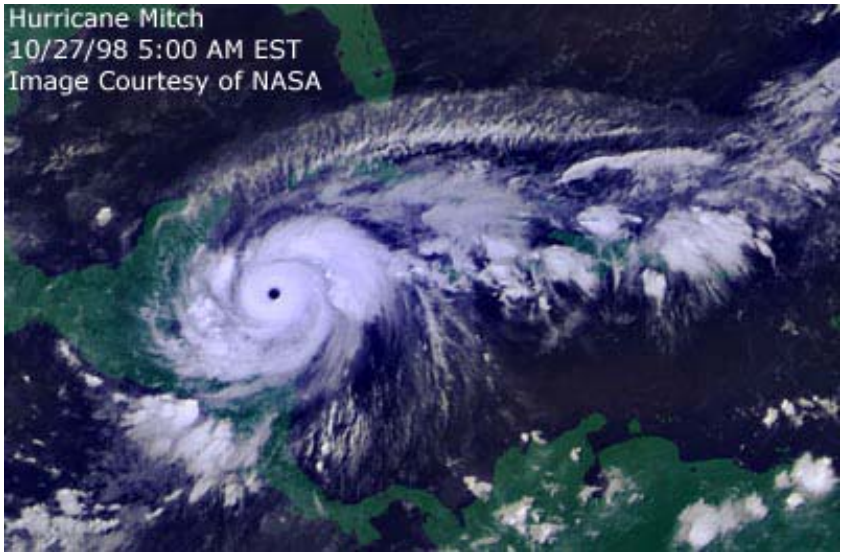
Figure 1

IMAGES OF THE PATH TAKEN BY HURRICANE MITCH

(Between 26 and 28 October 1998)



Source: The Wather Channel, Internet.

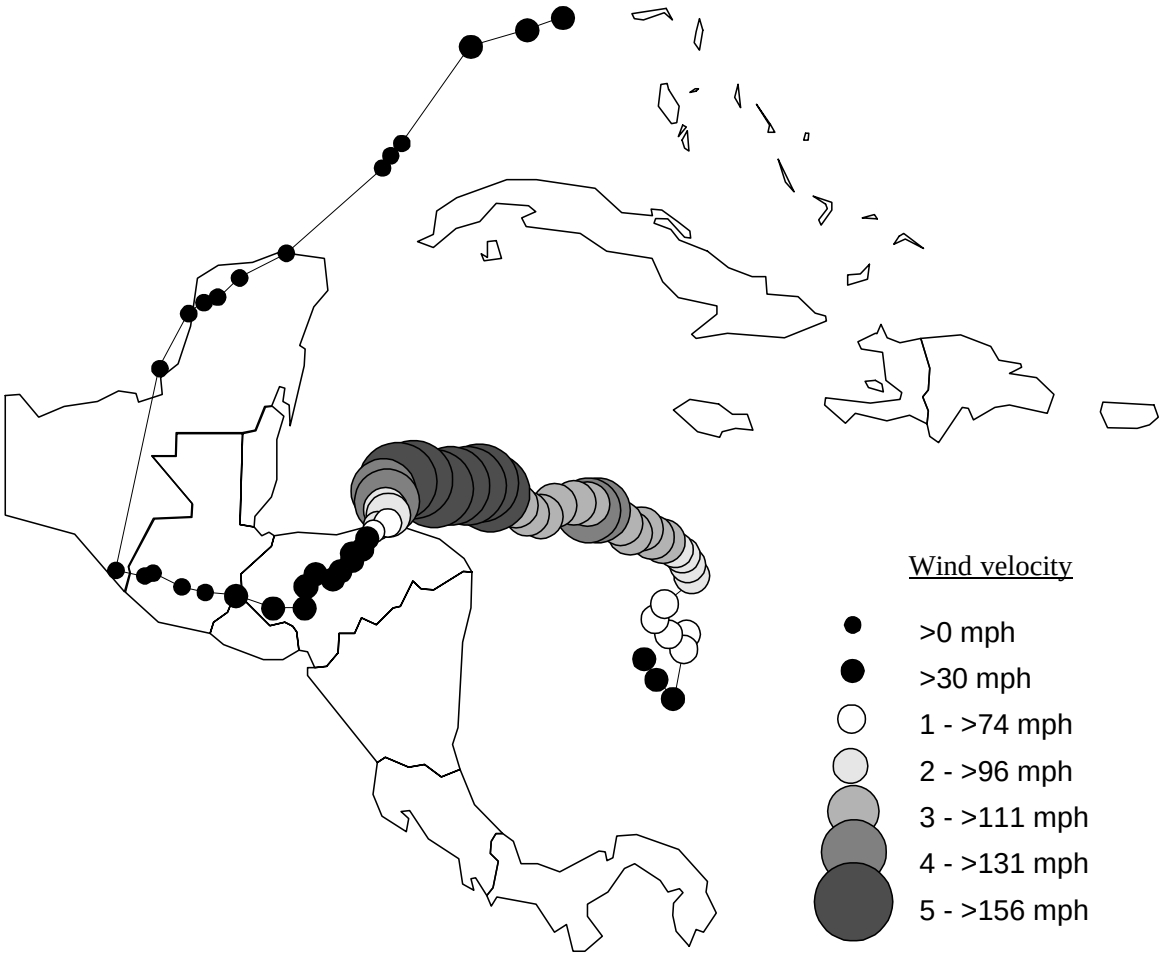


Source: NASA image, taken from the Internet.

Figure 2

ROUTE OF HURRICANE MITCH

(Between 22 October and 5 November 1998)



Source: Johns Hopkins University Applied Physics Laboratory. Copyright 1998 Ray Sterner and Steve Babin.

That same day (24 October), Guatemala's National Institute of Seismology, Vulcanology, Meteorology and Hydrology (INSIVUMEH) initiated the alert phase by issuing the first bulletin on the hurricane, which reached category 2 on the Saffir-Simpson scale. The alert was coordinated with the National Disaster-Reduction Committee (CONRED); all assistance units, relevant institutions and the public at large were notified through the media.

Mitch gained strength (category 3) on Sunday 25 as the pressure fell to the fourth lowest level recorded for Atlantic hurricanes so far this century. It began to affect the coast of Honduras and

warnings for Guatemala's Caribbean coast were intensified. With maximum steady winds of 221 km/h that afternoon, it was upgraded to category 4. On 26 October Izabal, El Petén, Alta Verapaz, Chiquimula, Zacapa, north of El Quiché and Huehuetenango were alerted; the hurricane was then 55 km south-east of Swan Island (off the northern Atlantic coast of Honduras), moving west-north-west with steady 288-km/h winds, as a result of which it acquired category 5.

The following day it followed the same path and at 21:00 hours came close to the coast of Honduras, reducing its wind speed. On 28 October it remained stationary and weakened progressively, dropping through categories 3, 2 and 1 and becoming a tropical storm on the following day, with winds under 100 km/h, moving west. Heavy rains were recorded in Petén, Izabal and Cobán. On 30 October it entered Honduran territory, became a tropical depression and moved rapidly into Guatemala on October 31, with its centre approximately level with Morazán and El Progreso; it caused very heavy rainfall in Puerto Barrios, Cobán and Zacapa. The Puerto Barrios station recorded 319 mm of rainfall between 28 and 30 October (see Chart 1).

On 1 November the depression moved slowly across the country from east to west, causing heavy rains on that day and the following day. On 3 November its intensity increased again and the depression became a tropical storm; its path was north-easterly, towards Campeche, Mexico, and on 4 November it left Guatemalan territory. The heaviest rainfall was registered between 1 and 3 November in the Department of Guatemala (308 mm on days 1 and 2) and Escuintla (799 mm on 2 and 3 November, see Graphs 2 and 3). During that period rainfall was higher than the total for the entire year.

The damage caused by Mitch is extensive as regards loss of life, infrastructure (highway, health care, housing and education), agricultural output and the environment. The severe effects of the rains were magnified by man's previous actions: deforestation, intensive land use, and human settlements on hillsides or riverbanks and lake shores. As frequently occurs in such disasters, the poorest and most marginalized groups were the most affected, since they tend to live in precarious dwellings in the high-risk areas mentioned above. This highlights the pressing need to adopt measures to alleviate poverty and marginalization on the one hand, and to prevent and mitigate disasters on the other.

3. Population affected [6]

An estimated total of almost 750,000 people were affected by the hurricane; more than 106,000 had to be evacuated and were left homeless. There were 268 deaths and a similar number of injured. At the end of November 121 people were reported still missing. The districts with the greatest number of people in shelters were Alta Verapaz, Escuintla, Guatemala, Izabal and Zacapa. During the second week of November almost 55,000 people were staying in shelters all over the country.

[6] This section is based on the preliminary report prepared by UNICEF "Impact of hurricane Mitch on Guatemalan children", November 1998.

The number of victims might have been higher if warning systems had not urged communities to evacuate two days before the hurricane hit. Damage to communication routes due to flooding left over 16,000 people completely isolated for several days.

The municipalities where the hurricane caused the greatest damage were Los Amates (Izabal), Morales (Izabal), Panzos (Alta Verapaz), and the Amatitlán Valley (Petapa, Amatitlán, Villa Canales). Less badly hit, but also at great risk were the municipalities of El Estor (Izabal), Puerto Barrios (Izabal), Cahabon (Alta Verapaz), Chisec (Alta Verapaz), Sayaxche (Petén), Gualan (Zacapa), Chiquimulilla (Santa Rosa), Guazacapan and Taxisco (Santa Rosa) Nueva Concepción and La Gomera (Escuintla), San José and Iztapa (Escuintla).

Damage in Izabal (Morales and Los Amates) and Panzos is particularly serious because of the risks faced by their inhabitants. The destruction of banana plantations has not only caused economic problems and unemployment but has also affected housing and social services, because the main settlements in the area were situated within the plantations. In the municipality of Panzos pollution of the water supply is posing serious threats to health; it is the only area covered by UNICEF field visitors where children have died of diarrhoea (particularly infants under one year of age); high levels of malaria-carrying mosquito larvae have also been recorded in the area.

Of the 750,000 people affected, an estimated 120,000 are children under five and 37,500 are pregnant women. Nearly 54,725 people were housed in temporary shelters initially, but the number subsequently decreased as many families returned to their homes or were received by friends or relatives. By the fourth week of November 14,000 children were reported to be in temporary shelters, mainly in the districts of Guatemala and Izabal. At the end of the month UNICEF field visitors reported that the number of people in temporary shelters had decreased substantially in all districts except Izabal.

The thousands of dwellings partially or totally destroyed are mainly in Izabal, Zacapa (Gualan), the Polochic Valley (Panzos, El Estor, Cahabon), and on the Pacific coast (Escuintla and Santa Rosa). The destruction of water supply systems and latrines, pollution of wells and accumulation of stagnant water has become a serious health problem. Water pollution has caused severe cases of diarrhoea, and stagnant water is an ideal breeding ground for carriers of malaria and dengue, which are endemic diseases in the lowlands of Izabal and the South Coast.

The greatest damage to crops for on-farm consumption was in areas where they had not yet been harvested (Chisec, for example). Fishing for family consumption has also been affected in coastal areas. In the lowlands of the Motagua and Polochic rivers the worst hit were banana plantations and cattle ranches, with the resulting unemployment (an estimated 10,000 people in banana-growing areas). Basic grain crops were not seriously affected (losses in corn and bean crops were under 2 per cent), so the cost of a basic food basket should not increase significantly. The most negative effects on family economy will be caused by unemployment and food shortages in certain low-lying areas, which may lead affected families to migrate to urban areas.

a) Poverty and the risk of disaster

As mentioned above, low-income groups are among the most affected. At least four factors increase the risks they face when natural disasters occur.

First, some of the areas in which they have settled have little or no commercial value due to their high risk: these include mountain slopes or ravines, river banks, and plains frequently subject to flooding in the rainy season, which place communities at great risk due to landslides and overflowing rivers. The rains caused by Mitch brought into evidence this structural problem, which has built up over decades.

Secondly, due to the characteristics of plots and limited sanitary infrastructure, many areas inhabited by the poor favour the propagation of pests and diseases. Malaria, dengue, diarrhoea, severe respiratory infections and skin problems are endemic diseases that place burdens on health services. Morbidity (and eventually mortality) levels resulting from this situation are even greater due to the poor nutrition of most of the population, particularly small children (under five) and pregnant or nursing mothers.

Thirdly, the poor do not have access to the social services required to address their vulnerable health conditions. They are particularly affected by the limited availability of drinking (or at least safe) water supplies and proper waste disposal systems. The hurricane highlighted the fragility of infrastructure to remedy these deficiencies, which was built in the same high-risk areas. Many latrines and water mains were destroyed by floods or landslides, and water supplies (wells and water mains) were polluted at the same time.

Finally, the poor lack information on the risks they face. Some communities have traditional ways of dealing with disasters, based on previous experiences, which are inadequate when faced with a situation such as that caused by Mitch.

Vulnerability of women and children. Poverty and environmental deterioration increase the risks stemming from natural disasters, and women and children are usually the most affected. The destruction of their homes, worse health conditions and loss of jobs and crops have a direct effect on their living conditions. Children are exposed to higher health risks, which can even lead to death; greater economic risks, as their education is cut short by their need to enter the labour market at an early age, and greater psychosocial risks, since they are highly sensitive to changes in their surroundings. Women face greater challenges in the day-to-day running of their homes, as the task of organizing family resources becomes all the more difficult. Pregnant and nursing mothers suffer the effects of their deteriorated environment (particularly affecting their nutrition), which places them at great risk of contracting lethal diseases.

b) Short and medium term risks to the population

The risks faced by the population not only refer to their health conditions but also to other factors which affect their normal development. A balance of the problems they face as a result of the hurricane follows below.

i) Health and sanitary risks. Health and sanitary conditions in the most affected areas have led to a morbidity profile characterised by acute respiratory infections (over 50 per cent of the diseases reported to health centres and brigades), diarrhoea (approximately 20 per cent), and skin diseases (20 per cent). A month after the hurricane struck, the greatest risk of mortality was from cases of diarrhoea among children under five, and particularly those under a year old in the Polochic (Panzos) basin. Polluted and stagnant water have increased the possibility of outbreaks of cholera, malaria and dengue over the medium term, and these tend to be more fatal than acute diarrhoea. The destruction of latrines and other waste-disposal means has also increased health risks in affected areas.

ii) Nutritional risks. Malnutrition and micronutrient deficiencies (particularly iron and vitamin A) are chronic, particularly among children and pregnant and nursing mothers in poor rural areas, and are further increasing the risk of morbidity and mortality. The problem has been aggravated by the effects of Mitch, as the destruction of small crops for on-farm consumption and the loss of jobs has placed many families in a state of high nutritional risk. Here again, children are the most vulnerable group, particularly those in temporary shelters (especially in Izabal) and groups living in isolation on the right bank of the Polochic and Motagua rivers.

iii) Educational risk (school drop-outs). Approximately 37,500 children have been affected by damage to schools. Some 3,000 boys and girls attended schools that have sustained partial damages, and 2,500 were in schools that were completely destroyed. Apart from these infrastructure-related problems, there is also a risk of children not returning to classes at the beginning of the new school year due to the economic pressures arising in homeless families; this is one of the most serious dangers facing these children, since they are unlikely to return to school once they join the labour force. UNICEF has calculated that about 20,000 boys and girls could be affected in this way. [7]

iv) Housing and psychosocial risks. Destruction of dwellings, temporary abandon of small towns and villages and loss of loved ones have had a strong effect on psychosocial welfare. In Izabal, for example, stress-induced migraines were the second cause of morbidity during the days following the tragedy. At present, the greatest psychosocial risk is suffered by families still in shelters. Apart from overcrowding, children suffer from changes in their daily routines and a lack of expressive and recreational activities common to their age. Their families can also be affected by emotional stress resulting from a lack of employment prospects and the daily need to meet basic necessities such as food.

v) Unemployment. In banana-growing areas, the destruction of plantations has meant loss of employment for thousands of women, many of whom are unmarried mothers. An estimated 40 per cent of the total work force (13,000 people) in the banana industry are women, who clean, select and pack the fruit. Their chances of finding employment in agricultural activities are remote, as these are mainly men's jobs.

[7] Estimates based on the number of families whose homes were affected by the hurricane. All these families are considered have at least one 10-13 year-old child (the group at the greatest risk of leaving school to take up paid employment).

c) Programmes to deal with the effects of hurricane Mitch on the population

Actions to support disaster victims should focus on the areas at greatest risk, placing particular priority on immediate needs in the lower reaches of the Polochic and Motagua rivers (municipalities of Panzos, El Estor, Morales and Los Amates). Suggestions for programmes to complement the actions contained in the government's 100-day Agenda follow below. Of prime importance are the initiatives aimed at the most vulnerable sectors of the population.

i) Prevention of school attrition. Families should receive assistance for their children to remain in school. Apart from logistic support to schools, direct aid is needed in the form of school materials and even small monetary subsidies (grants) to families in exchange for allowing their children to continue their studies.

ii) Psychosocial recovery. Girls and boys need to recover from the trauma caused by the hurricane; a central factor in this process is the reconstruction of their play areas. This is particularly important for children who are still in temporary shelters and will probably remain there for several months.

iii) Attention to unemployed women. As they are particularly at risk, women who lost their jobs in banana plantations should be helped through a job-creation programme.

iv) Support for very isolated areas. Many small communities on the right bank of the Polochic and Motagua rivers have been practically cut off. A logistical support programme should be implemented to establish ongoing communication with them.

v) Provision of drinking water and cleaning of wells. Drinking water needs in the worst affected areas will have to be met as long as water supplies remain polluted, to reduce children's morbidity and mortality rates from diarrhoea. The most urgent need for support is in the Polochic area and the municipalities of Los Amates and Morales (Izabal). It is also important to continue to extend support to communities in cleaning wells and restoring water systems.

vi) Fortified food. As well as distributing food to victims, it is also important to check the population's nutrition levels to assess malnutrition risks (particularly among boys and girls). This could be complemented by providing them with food supplements to overcome nutritional deficiencies.

vii) Strengthening communities' disaster-preparedness capacity. In order to deal with the emergency more efficiently, a community organization primarily responsible for implementing programmes locally should be promoted. An organization of this kind could subsequently be used to establish local disaster-prevention committees, thus creating capacity at the local level for future emergencies.

Dealing with the consequences of the hurricane does not merely involve rebuilding destroyed social infrastructure, but also stepping up social investment to address the vulnerability condition of low-income groups, so as not to leave them as exposed as they were prior to the hurricane.

4. Emergency actions

a) Government actions

Through a decree issued on 31 October 1998, the government declared a national state of emergency and a two-day cease of normal activities, in order to organize emergency relief and reduce pressure on the demand for certain goods, such as food, gasoline and other fuels. The decree established sanitary cordons to prevent epidemics, restricted unnecessary road travel and authorised the obligatory evacuation of people living in high risk areas.

Once the danger represented by hurricane Mitch had been confirmed, on 1 November CONRED evacuated nearly 6,000 people from areas considered to be of high risk (mainly on the Atlantic coast), thus helping to save lives and mitigate the effects of the hurricane. The government's response was timely and efficient; acting in coordination with the private sector, it took emergency actions which were decisive in helping to mitigate the impact of Mitch.

Various ministries and public, civil and military organizations participated in dealing with the emergency. As a result, electric power was restored in a matter of hours, the road network was rehabilitated and the injured and homeless attended, among other actions.

The government requested aid from the international community to cope with the emergency and with repairs and reconstruction. Financial organizations were requested to negotiate debt interest-payment terms and redirect the funds made available to emergency-related areas.

Distribution of food and other aid was carried out by the Social Investment Fund (FIS) and the National Fund for Peace (FONAPAZ). FIS soon redirected its funds and was extending credits for repairs in rural areas by mid-November. This Fund has set itself the goal of repairing damaged schools in 100 days, and has already allocated 131 million quetzals to rehabilitation projects within the framework of the 100-day Agenda. Mention should be made of the extensive participation of civil society in various phases of the emergency and, more recently, in rehabilitation. Aid reception and distribution was efficiently organized; FONAPAZ tackled the emergency by extending its coverage from the area originally planned to emergency zones. Rapid action in each of the affected municipalities made it possible to establish contact with victims and distribute materials to enable communities to begin repairing their homes immediately.

On 18 November, the government announced the creation of a rehabilitation and reconstruction programme, with three basic objectives: normalising victims' living conditions, repairing the damage caused by Mitch, and restoring and developing productive capacity. The aim is to accomplish the first two objectives within 100 days, as of 12 November 1998, whereas the third is expected to be completed over the medium to long term. [8]

[8] See SEGEPLAN, *Programa de reconstrucción "Huracán Mitch"*, Guatemala, 18 November 1998, and Government of Guatemala, *Programa de reconstrucción, report prepared* for the Meeting of the Emergency Advisory Group for Central America, Washington D.C., 10 - 11 December 1998.

b) International cooperation

The magnitude of the disaster and the rapid dissemination of information sparked an immediate response from the international community. Humanitarian aid was soon on its way, in cash and in kind, from countries, multilateral organizations, civil groups, non-governmental organizations (NGOs) and individuals.

i) International organizations. The office of the United Nations Resident Coordinator took on the task of coordinating UN response, supported by a team from UNDAC. Daily reports were issued on the emergency and helped direct the actions of the international community.

According to OCHA, by the end of November donations in cash and in kind from international organizations totalled US$60 million, [9] and by 12 November the World Food Programme (WFP) had delivered 120,000 food rations in affected departments. Other cash contributions from international organizations are as follows: UNDP: US$100,000, UNICEF: US$86,000, WFP: US$200,000, Organization of Petroleum Exporting Countries (OPEC): US$100,000, IDB: US$50,000. International financial organizations, such as the World Bank and the IDB began to re-channel previously allotted resources towards the emergency and to negotiate extra lines of credit. The Central American Bank for Economic Integration (CABEI) provided funds to begin rebuilding the Pan American highway, which crosses Central America.

ii) Foreign governments. The Office of US Foreign Disaster Assistance (OFDA) of the United States' Agency for International Development (AID) donated US$1 million to NGOs to create relief programmes for the water and drainage sectors, emergency shelters, medicines, hygiene and agriculture. At the beginning of December, the total aid received from USAID/OFDA was estimated at US$1.257 billion. During his official visit to Guatemala, the President of France, Jacques Chirac, announced the cancellation of Guatemala's US$55 million debt with France.

By mid-November, cash aid and other types of support totalled US$1.4 million, not including material aid —the value of which has not been calculated— from the governments of various countries which sent human resources (doctors, rescue teams, engineers, brigades, among others) and materials such as light aircraft, helicopters, food, medicines, blankets, clothes, etc.

iii) Civil organizations. In response to the Government of Guatemala's appeal for assistance, numerous civil organizations from many different countries came to the aid of victims. Apart from uncalculated donations, they sent rescue equipment, material for shelters, medicines, drinking water, food, clothes and blankets.

[9] According to official figures, foreign aid received by 31 December totalled US$20.8 million (6.5 million in cash and 14.3 million in kind), not including other donations in kind, the value of which has not been calculated

II. ASSESSMENT OF THE DAMAGE

This chapter contains an assessment of the damage caused by hurricane Mitch to the social (housing, education, health), infrastructure (energy, transport and communications, water and sewerage) and production sectors (agriculture, fisheries, industry and services), and to the environment. The assessment was carried out on the basis of information available during the mission and incorporates aspects that became known soon afterwards.

Direct damages or effects were assessed, i.e., to physical infrastructure and the country's capital reserves, and indirect damages or effects, such as lower production of goods and services and emergency outlays. Direct damages have been assessed on the basis of capital assets prior to the disaster; i.e., taking into account depreciation and normal use of capital goods.

In keeping with ECLAC methodology, the loss of crops, either about to be harvested or stored for distribution, is calculated as direct damage, and damages to inventories and production under way in the industrial sector are classified as direct costs.

The cost of rebuilding damaged assets has also been calculated. If the aim were to return to the situation prior to the hurricane, the value would be the same as the direct cost according to this methodology. However, for the purpose of a reconstruction programme, the assessment should also take into account the **value of improved replacement**, including disaster prevention and mitigation criteria, such as better technology and quality and more resistant structures. The country now has an opportunity to rebuild on sounder economic, social and environmental bases while simultaneously reducing its vulnerability to natural disasters.

The ECLAC mission interviewed representatives of the government, the private sector, international organizations, UNDP and other United Nations agencies, who frequently provided information and valuable suggestions for the preparation of this document.

The figures used in this chapter were calculated in local currency and in US dollars, based on the exchange rate at the time: 6.6 quetzals to the dollar.

1. Social sectors

a) Housing

The overall damage sustained by the housing sector totals 233.2 million quetzals; this compounds the country’s housing deficit, estimated at 1.4 million units in 1995, including construction, extension and improvement. [10]

[10] Ministry of the Economy, Under Ministry of Housing and SEGEPLAN, *Estrategia de desarrollo del sector vivienda, 1996-2000*.

The situation is exacerbated by a long-standing problem: many settlements (some 200,000 families) are located in inappropriate, vulnerable sites, with 6,000 in very high-risk areas. The sector's medium-term programmes are designed to address this problem. The government's priority over the short term and during the emergency has been to restore families' minimum living conditions prior to the disaster. Nevertheless, families living in particularly unsuitable sites, such as the banks of the Polochic River, will have to be relocated as soon as possible.

According to SEGEPLAN information, corroborated by other sources (victims in shelters), around 6,000 dwellings were totally destroyed, of which approximately 1,100 were in the capital and the Department of Guatemala. Some 20,000 additional homes were damaged to differing degrees.

Judging by the number of people living in shelters, the provinces with the greatest damage to housing were, in their order, Alta Verapaz, Escuintla, Guatemala, Izabal, Zacapa and Sacatepéquez.

The dwellings destroyed completely were generally made of flimsy materials and very precariously built. Their estimated average area ranged between 15 and 20 square metres, with an average value of under 10,000 quetzals. [11] If this value is accepted as representative, the 6,000 dwellings completely destroyed caused direct losses of some 60 million quetzals. If we add 12 million —20 per cent of the value of housing so as roughly to include lost household goods— the direct damage for destroyed dwellings totals 72 million quetzals (see Table 3).

Using these same parameters for partially destroyed housing (20,000) and also assuming that the damage amounted to an average of 30 per cent of the value of dwellings, including household items, these damages reach 90 million quetzals, which, added to the above 72 million, bring total direct losses in the sector to 162 million quetzals (see Table 3).

Indirect damages were mainly calculated on the basis of the expenses generated in shelters while the homeless victims remained there.

On the basis of information from FONAPAZ, the budget for shelters housing an estimated 25,000 people, who will take between 30 and 60 days to gain access to housing, totals 70 million quetzals (50 million for resettlement, 10 million for equipment and 10 million for logistic support).

An estimate of rent paid or attributed and lost for some 60 days corresponding to destroyed housing was included as indirect damage (see Table 3).

An average area of 100 square metres per lot has been estimated for rebuilding the 6,000 dwellings that must be relocated in less risky areas; each lot will cost US$3,000, making a total of US$18 million for the land, in addition to 25 million for the cost of building the new housing.

[11] From January to September 1998 the Guatemalan Housing Fund (FOGUAVI) had financed some 16,500 housing solutions valued at 10,800 quetzals each on average.

Table 3

GUATEMALA: DAMAGE TO THE HOUSING SECTOR

	Damage			Cost of reconstruction
	Totals	Indirect	Direct	
Total (thousands of US$)	**35,333**	**10,788**	**24,545**	**38,000**
Total (thousands of quetzals)	233,200	71,200	162,000	250,800
Destroyed dwellings	60,000		60,000	
Furnishings and household goods	12,000		12,000	
Damaged dwellings a/	90,000		90,000	
Spending on shelters b/	70,000	70,000		
Attributed rent c/	1,200	1,200		
Reconstruction of 6,000 dwellings				99,000
Cost of land				118,800
Fixtures				33,000

Source: ECLAC, based on official figures and own estimates.

a/ An average loss of 30 per cent of the value of the dwelling was assumed, plus 10 per cent of the value of the dwelling for furniture and fixtures.

b/ According to FONAPAZ information, some 25,000 persons will remain in shelters for 30 to 60 days. The total budget assigned to that end includes resettlement (50 million quetzals), equipment (10 million) and logistic support (10 million).

c/ Refers to estimated losses for real and attributed rents —100 quetzals per dwelling— for 60 days in the case of destroyed housing.

Although many settlements had been declared vulnerable areas (more than 200,000 dwellings) by FOGUAVI prior to the disaster, the government does not have the capacity to address that problem and the disaster simultaneously. The initial actions contained in the government's "100-day Agenda" therefore placed priority on normalising the situation of the homeless and returning them to their places of origin, where their employment sources are, leaving their relocation to comparatively risk-free areas for the following stage.

The Ministry of Communications, Transport, Public Works and Housing provides direct subsidies to low-income families through FOGUAVI. Each subsidy consists of a 12,000-quetzal loan, to which the beneficiary must add 4,000 quetzals, to be repaid over a period of up to two years, in order to acquire homes built by the private sector to standard specifications, with a value ranging from 16,000 to 60,000 quetzals.

Furthermore, in keeping with the Agreement on Socio-Economic Aspects and Agrarian Situation adopted within the framework of the peace process, the government pledged to "assign the equivalent of not less than 1.5 per cent of the Tax Revenue Budget to housing development policy, giving priority to the demand for low-cost housing solutions". [12]

[12] Ministry of the Economy, Under Ministry of Housing and SEGEPLAN, *Estrategia de Desarrollo...*, op. cit.

One of the programme's priorities is to promote private-sector participation in housing construction and financing, together with the legalisation of State lands and their systematic registration in a land-use databank through FOGUAVI. [13]

b) Education

Education infrastructure, which includes archaeological sites and churches, suffered considerable losses as a result of the hurricane. Of a total of 13,500 schools, 311 (2.3 per cent) were affected. According to Ministry of Education information, 27 schools were completely destroyed, 175 semi-destroyed (destruction of roofs and other damages), 111 were flooded and 73 school premises were adapted as shelters. Direct losses were estimated at 51.8 million quetzals (US$7.851 million), 35 million of which accounts for partly or totally destroyed classrooms; the remainder includes school materials, furnishings and cultural sites (see Table 4).

The minor damage to Guatemala's cultural heritage was concentrated in the Quiriguá archaeological site and the Alameda del Calvario complex in Antigua Guatemala. Stelae, zoomorphs and altars at Quiriguá were covered in mud but not damaged. The flooding caused by a water conveyance ditch that overflowed in one of the sector's banana plantations affected the administrative area, store rooms and researchers' living quarters.

The amount of total damage corresponds mainly to direct costs; indirect costs were lower, as many of the schools used as shelters were vacated two weeks after the disaster. Damage to infrastructure centred on semi-destroyed schools (68 per cent).

The departments with the most damage to educational facilities were Izabal, (19 per cent of the total), Sololá (16.3) and Guatemala (10.6), followed by Alta Verapaz (7.9 per cent) and Santa Rosa (7.2). The departments with the least damage were Huehuetenango and Baja Verapaz (see Table 5).

Irrespective of the damage to infrastructure in the education sector, the impact of Mitch has other connotations. The impairment of 311 schools will place added pressure on the already deficient coverage and could leave thousands of children and youths out of classrooms. Loss of materials and equipment could affect educational quality.

Numerous rural families who lost their croplands and other means of livelihood and production may be forced to emigrate to other communities, and this could raise the school drop-out rate. Survival concerns may lessen the importance of children's school attendance even further, thereby increasing illiteracy rates in rural areas and reducing school enrolment.

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[13] Guatemalan Housing Fund, Ministry of Communications, Transport, Public Works and Housing, *Juntos para dar soluciones habitacionales.*

Table 4

GUATEMALA: DAMAGE IN THE EDUCATION SECTOR a/

	Damage			Cost of reconstruction	Imported component
	Total	Direct b/	Indirect		
Total US$ (thousands)	**7,851**	**7,368**	**483**	**12,250**	**2,917**
Total quetzals (thousands)	51,816	48,631	3,185	80,850	19,252
Damage to school infrastructure	35,125	35,125		64,791	16,033
Classrooms totally destroyed (135)	7,484	7,484		24,052	6,013
Classrooms with severe damage (865)	23,978	23,978		34,767	8,692
Classrooms with slight damage (555)	3,663	3,663		5,971	1,328
Damage to texts and furnishings	11,753	11,753		12,723	2,545
Damage to cultural and recreational facilities	1,752	1,752		3,336	674
Damage caused by use of schools as shelters c/	858		858		
Higher operation costs in affected schools	2,327		2,327		

Source: ECLAC, based on Ministry of Education figures and own estimates.

a/ Includes cultural sites and churches.

b/ Direct damage was calculated on the basis of 311 affected schools and 135 classrooms totally destroyed. A unit cost per classroom of US$4,400 has been assumed; 865 semi-destroyed classrooms at US$4,200 each and 555 slightly affected classrooms at US$1,000 each. Finally, 54,425 desks at US$18.80 have been included, and 10 per cent of texts destroyed.

c/ 73 school premises were fitted out as shelters.

Efforts must therefore be redoubled and the national and international community called upon to rebuild the educational system from a new perspective. School is more than just a facility; it should be a focal point to strengthen communities. The aim should be to improve what was already in existence, while taking advantage of education as an essential factor in reconstruction.

c) Health sector

i) Evaluation of the damage. Health sector infrastructure did not sustain significant damage, according to reports from international and national organizations and ECLAC inspections. Most of the damage was to furnishings and equipment. The hurricane affected seven health centres, among them one with maternity facilities, and 48 rural clinics, which served some 50,000 people in total. These facilities are in poor areas, some of which are hard to reach, and far away from larger population centres.

The main damage to infrastructure consists of partial destruction of sewerage systems and damaged walls, floors and ceilings in some health centres. There are no reports of facilities totally destroyed.

Table 5

GUATEMALA: DAMAGE IN PUBLIC SCHOOLS BY DEPARTMENT

Department	Schools destroyed and partially damaged a/				Direct costs (thousands of quetzals) b/
	Total	Destroyed	Semi-destroyed	Flooded	
Total	**311**	**27**	**173**	**111**	**35,125**
Jalapa	20	1	16	3	2,594
Izabal	45	18	6	19	6,725
Santa Rosa	41	-	11	30	2,515
Alta Verapaz	45	-	12	33	2,752
Quiché	8	-	8	-	1,109
Guatemala	27	-	27	-	3,742
Escuintla	26	-	9	17	1,808
Zacapa	8	-	8	-	1,109
El Progreso	2	-	2	-	277
Jutiapa	16	-	12	4	1,795
Chimaltenango	15	1	14	-	2,217
San Marcos	5	-	5	-	693
Retalhueleu	2	1	1	-	416
Sololá	40	2	37	1	5,716
Huehuetenango	1	-	1	-	139
Baja Verapaz	1	-	1	-	139
Petén	9	4	1	4	1,379

Source: ECLAC, based on Ministry of Education figures and own estimates.

a/ The information supplied by municipalities does not specify the type of damage reported.

b/ Direct costs were estimated on the basis of the unit costs in Table 4, assigning an average of five classrooms to totally destroyed schools and 3.5 to semi-destroyed and flooded schools.

The country's chronic epidemiological situation worsened in the areas most affected by the disaster, all of which reported cases of respiratory infections, diarrhoea and pneumonia. Sixty-seven per cent reported suspected outbreaks of cholera and 59 per cent confirmed such cases. In 78 per cent there were instances of animal bites from potential rabies carriers, and 56 per cent notified cases of hepatitis and malaria; 44 per cent of all affected areas registered cases of dengue.

The main impact on the health sector concerns its operation, which was complicated by the extra tasks it had to take on to address the emergency; the main challenge lay in sanitation. The sector's institutions took action to deal with decomposing animal carcasses and plants left by the devastation in fields and the proliferation of disease-carrying vectors due to flooding and partial damage to drinking water systems. These actions were carried out with the assistance of external cooperation.

Timely action by the health authorities to control epidemics and vectors, in conjunction with foreign medical brigades, made it possible to lessen their potential sequels. Epidemiological monitoring measures remained in place until the end of November. Outlays in this area, which may be considered indirect effects, amounted to some 25 million quetzals (see Table 6).

In regard to direct damages, flooding and mud caused damage to structures, equipment, furnishings and installations, with losses estimated at 7.1 million quetzals. Total damage has been calculated at over 32 million quetzals (US$4.9 million, see Table 6).

Visits by the mission to damaged units revealed that the San Pedro Carchá health centre in the Department of Cobán was completely paralysed owing to the total destruction of equipment by the mud and water that inundated the premises. The centre has 10 hospital beds and serves a population of 140,000 people. It deals mainly with maternity cases and general outpatient visits. Around 90 per cent of its clinical laboratory equipment was severely damaged and the dentistry equipment was totally destroyed; both had been operating for about 18 years.

According to the three doctors in charge, the centre frequently suffers from partial and slight flooding problems even in normal rainy seasons, since it stands on a low piece of ground close to the main river, which carries outflows from three municipalities. Bearing in mind the almost complete destruction of its furnishings and equipment, this would be a good opportunity to relocate it. The municipal mayor has offered a piece of land for the centre's new installations.

The Ministry of Public Health and Social Welfare sent brigades to make a more precise assessment of direct and indirect damage to hospitals in the most affected departments. Aside from the San Pedro Carchá hospital and probably one in Puerto Barrios, most of the damage registered was to non-structural components, i.e., installations and medical equipment seriously damaged or rendered useless by flooding. Such damage was registered in 11 health centres.

Table 6

GUATEMALA: DAMAGE IN THE HEALTH SECTOR

	Damage			Cost of reconstruction (thousands of quetzals)
	Total	Indirect	Direct	
Total US$ (thousands)	**4,868**	**3,790**	**1,078**	**1,928**
Total quetzals (thousands)	32,120	25,000	7,120	12,710
Structures and equipment	7,120		7,120	
Epidemiological campaigns, emergency tasks	25,000	25,000		
Recovery programme				12,710
Rehabilitation				8,900
Reconstruction				500
Expansion				550
New hospital, San Pedro Carchá				2,000
Equipment				600
Sololá Hospital				160

Source: ECLAC, based on Ministry of Public Health and Social Welfare figures and own estimates.

ii) Rehabilitation and reconstruction programme. [14] The Ministry of Health, in close conjunction with provincial and district authorities, is in charge of infrastructure and human-resource planning, coordination, transport and support for rehabilitation and reconstruction tasks. As a general health-sector strategy, greater emphasis will be placed on health prevention rather than on clinical treatment.

After dealing with priority health issues stemming from the hurricane (care of traumas, deterioration of water supply systems and basic sanitation, and control of epidemics, among others), the Ministry of Health turned to the task of evaluating damage to infrastructure and equipment, with a view to designing a rehabilitation and reconstruction programme. Hospitals, small clinics and health centres in 107 communities were assessed to make an estimate of the needs involved.

The communities covered are located in the regions of Alta Verapaz, Izabal, Zacapa, Jalapa, Jutiapa, Santa Rosa, Escuintla, Suchitepéquez, Retalhuleu, San Marcos, the municipalities of Amatitlán and Villanueva in the Department of Guatemala, and the municipalities of Sayaxche, Poptún and San Luis in the Department of El Petén.

The aim of the Ministry of Health's programme is to restore health care infrastructure to optimal operating conditions as regards water-supply and electricity systems and other aspects related to health system operations. The programme has six components: rehabilitation, reconstruction, expansion, new buildings, equipment and reconstruction of the wall surrounding Sololá Hospital. [15]

The component that requires the highest investment is rehabilitation (an estimated 8.9 million quetzals), which will be allocated to meeting the needs of 50 health centres evaluated by Health Ministry brigades. The reconstruction component refers to two buildings with damaged roofs, structures, and water and sanitation systems, among others. The breakdown of investment for each component is shown in Table 6.

Overall investment for the programme totals an estimated 12.7 million quetzals (US$1.9 million), 2.9 million of which will be provided by the Ministry of Health itself, with the remainder to be financed with other funds.

2. Infrastructure

a) Transport and communications

Hurricane Mitch affected Guatemala as an atmospheric depression, with heavy, prolonged rainfall that caused flooding in rivers, estuaries and gullies.

Due to Guatemala's irregular relief, most highways and roads are located on slopes, and their cuttings and embankments are highly vulnerable. Traffic flow was interrupted in many places by

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[14] See Ministry of Public Health and Social Welfare (1998), *Programa de recuperación física de la infraestructura de salud capaz de dar respuesta a la demanda de la población ocasionada por desastres naturales*, Guatemala, 11 December.

[15] For a description of each component, see Ministry of Public Health and Social Welfare (1998), op. cit.

landslides on the most unstable banks, and on high embankments, especially those built beside river banks with no adequate protection. Other vulnerable points are highway bridges, generally built too short for economic reasons, with embankments to make up for deficiencies. These rarely have adequate river defences to resist extreme conditions.

Assessment of the damage to highways and roads was complicated by the institutional situation: responsibility for infrastructure work is not concentrated in a single body, but divided among several government agencies. Within the Ministry of Communications, Transport, Public Works, and Housing (MCTOPV), roadwork is carried out by the Directorate of Roads and the Executive Road Maintenance Unit (COVIAL), which is independent of the Directorate and was created to administer the Road Fund. Secondary and tertiary roads are the responsibility of FIS and FONAPAZ.

The first reports provided by government authorities described the damage to road infrastructure, including 121 bridges, 90 sections of roads and 34 sections of rural roads. As information was collected from each of the bodies mentioned above, it became clear only 37 of these bridges were totally destroyed, whereas 60 suffered damage to access embankments. Twenty-two of these 97 bridges are on main roads; the other 75 are located on secondary and tertiary roads. This should be taken into account on assessing indirect damage. Initial reports did not include pedestrian bridges or footbridges, a total of 57 of which sustained damages.

On assessing direct damage, a current value of 60 per cent of the reconstruction cost was assigned to destroyed or collapsed bridges. For bridges with damaged accesses, the replacement cost of the embankments at market prices was taken into account. Pedestrian bridges were assessed at 10 per cent of the cost of a vehicle bridge. An average cost per kilometre was used to determine direct damage to main roads, based on a percentage of the reconstruction cost, since damage only occurred on certain stretches rather than on the entire sections reported. This is the case with the Ruta CA-9 Norte, one of the worst affected roads, which sustained damages at the accesses to six of its bridges (the bridges themselves were submerged but structurally unharmed). Direct damage amounts to 265 million quetzals, or US$40.2 million (see Table 7).

The indirect-damage assessment for bridges only includes the cost of building provisional crossings and of replacing embankments, since the cost stemming from interrupted traffic flow was included in the section on indirect damage to roads and calculated on the basis of increased operating costs due to traffic suspension, using figures for annual average daily traffic (AADT) and the type of traffic (cars, trucks, and buses). It also includes the extra operating costs of using roads in poor condition or unpaved detours while repairs are being made. Indirect damage totals 327 million quetzals (US$49.6 million; see Table 7).

The cost of rebuilding destroyed bridges was determined on the basis of local unit costs and estimates of at least twice the original bridge length. An average per-kilometre investment was used to calculate costs for highways and roads. This is lower than the replacement cost, because damage was partial.

Table 7

GUATEMALA: DAMAGE IN TRANSPORT AND TELECOMMUNICATIONS

Sector and subsector	Damage			Reconstruction cost	Imported component
	Total	Direct	Indirect		
Total (thousands of US$)	**89,785.1**	**40,191.9**	**49,593.2**	**60,430.0**	**15,602.7**
Total (thousands of quetzals)	592,581	265,266	327,315	398,838	102,977
Bridges destroyed (37)	18,790	14,478	4,312	43,794	13,138
Bridges with damaged accesses (60)	14,042	10,500	3,542	11,904	2,381
Footbridges (57)	2,445	2,445		4,075	407
Main roads (633 km)	406,948	136,095	270,853	205,725	61,717
Secondary and tertiary roads (718 km)	110,355	61,748	48,607	93,340	9,334
Railways	40,000	40,000		40,000	16,000

Source: ECLAC, based on figures from MCTOPV, COVIAL, and own estimates.

A railway reconstruction cost for the Guatemala City-Puerto Barrios line was included to cover the severe damage to bridges and track, reported at an estimated US$6 million and included as direct damage, which will have to be paid by the government, despite the recent concession of the line to Compañía Desarrolladora Ferroviaria (CODEFE, S. A.). Indirect damage was not assessed because trains were not in operation when the hurricane struck. Reconstruction costs are estimated at almost 400 million quetzals, or US$60.4 million (see Table 8).

Table 8

GUATEMALA: ASSESSMENT OF RECONSTRUCTION COSTS IN TRANSPORT INFRASTRUCTURE

	Length/volume/ area	Unit cost (quetzals)	Total (quetzals)
Total (US$)			**60,430,037**
Total (quetzals)			398,838,250
1. Bridges on main roads:			
a) Bridges destroyed (12)	600 m	35,750	21,450,000
b) Bridges with damaged ramps (10)	10,000 m^3	30	3,000,000
Repaving of accesses	360 m^2	65	234,000
2. Bridges on secondary and tertiary roads:			
a) Bridges destroyed (25)	625 m	35,750	22,343,750
b) Bridges with damaged ramps (50)	5,000 m^3	30	7,500,000
3. Footbridges (57)	1,140 m	3,575	4,075,500
4. Main roads	633 km	325,000	205,725,000
5. Secondary and tertiary roads	718 km	130,000	93,340,000
6. Railways			40,000,000

Source: ECLAC, based on figures from MCTOPV, COVIAL and own estimates.

No major damage was reported to telecommunications. Direct damage was minor and absorbed by the TELGUA telephone company. Installation works for the fibre optic network suffered some damage, but no information was available in this regard.

b) Energy [16]

i) Electricity subsector. In the energy sector the electricity industry suffered the worst damages, caused by intense rainfall, floods, and landslides; hydroelectric power stations, distribution lines and networks and, to a lesser degree, transmission lines, were the most affected. Direct and indirect damages amount to 66.1 million quetzals (US$10 million; see Table 9). Losses in each area of the electricity subsector are described below.

1) Distribution. Electricity distribution is managed by public, municipal, and private companies. The central region (departments of Guatemala, Sacatepéquez, and Escuintla, including the metropolitan area) is the most heavily populated and has the most complete electric power coverage. Services in this area are provided by the recently privatised Empresa Eléctrica de Guatemala, S. A. (EEGSA). With the exception of 11 cities that have their own municipal companies, the rest of the country is supplied by the National Electrification Institute (INDE); however, the electricity industry is being restructured and INDE distribution will be privatised in mid-December 1998.

Table 9

GUATEMALA: DAMAGE IN THE ELECTRICITY SUBSECTOR

	Damage			Reconstruction cost b/
	Total	Indirect a/	Direct	
Total (thousands of US$)	**10,012**	**4,263**	**5,749**	**8,026**
Total (thousands of quetzals)	66,081	28,139	37,942	52,968
Distribution	32,702	11,270	21,432	28,814
Transmission and transformation	5,605	1,511	4,094	6,298
Generation	26,758	15,358	11,400	16,840
Others	1,016	-	1,016	1,016

Source: ECLAC, based on official figures from INDE, EEGSA and own estimates.
a/ Indirect costs for distribution (unbilled power); calculations for transmission include power not conveyed on binational interconnections, and for generation, excess production costs.
b/ Part of this expense has already been paid.

The main damage occurred after 1 November, when several departments and towns were left without electricity. Distribution lines and networks were most commonly downed by undermined structures and substations, collapses, damage to posts, cables, fuses, and transformers, and trees and branches falling onto installations.

[16] Assessments are for the electricity and oil subsectors. Information was based on reports and interviews with Ministry of Energy officials (Directorates of Energy and Oil) and the National Electrification Institute (INDE and its distribution, transmission, and generation affiliates). A report prepared by the private distribution company EEGSA was used for the central area.

In the central region 40 major failures were reported in 69 kV transmission lines, 13.8 kV primary distribution networks, and substations. In the region served by INDE damage was reported in the departments of Zacapa, Chiquimula, Izabal, Santa Rosa, and Alta Verapaz, with losses of long stretches of 13.8 and 34.5 kV primary distribution lines and damage to many structures. Only one municipal company reported major damage to its distribution networks, and was assisted in repair work by INDE.

Repairs were made to distribution networks in the first three weeks of November, after which time supplies were almost completely restored; this was the result of a major effort by the personnel involved and of inter-institutional coordination, which made it possible to secure the cooperation of the different distribution companies. Many permanent repairs are still provisional, and temporary solutions such as re-routing between substations have been adopted. No shortages of materials were reported and the emergency was handled using stocks in warehouses and supplies from the local market; nevertheless, some distribution works could be delayed by up to two months.

In short, given the size of Guatemala's distribution system, damages, although considerable, were on a relatively small scale, so they should not affect the privatisation process unduly.

2) Transmission. The main problems in this segment were caused by landslides and overflowing rivers, which brought down several high-voltage electricity pylons. The main failure was over an approximately 110-km stretch of the 230 kV Guatemala–El Salvador interconnection (the damage was mostly on the Guatemalan side), where steel pylons were destroyed by the swollen waters of the river María Linda and a collapsed bridge. Repairs have already been made and service was restored around 20 November. The 138 kV Escuintla-Jutiapa line (from Escuintla to Chiquimulilla and El Progreso) also suffered pylon damage.

3) Generation. The problems reported are mostly due to overflowing rivers and silting, which limited water-conveyance capacity and substantially reduced output at various hydroelectric power stations (despite open dam gates). Major damage only occurred at one plant, where the turbine room was flooded.

The Jurún Marinalá hydroelectric power station (60 MW) was damaged by the silting of the Michatoya river bed, which made it impossible to operate the gates to lake Amatitlán (the station's natural reservoir) and reduced generation capacity substantially. The rains raised the level of the Zanjón Malena considerably and saturated the soil, causing major landslides; mud, refuse, trees, and rocks were dragged along by the Zanjón and the river Mico, completely blocking three km of the river Michatoya, into which they flow. Since lake Amatitlán's outlet was blocked, it rose above the reservoir's operating level and flooded homes on the banks.

The damage described above goes beyond the electricity subsector and has increased flooding in the towns around the lake and in the Michatoya river basin as described in the section on environmental damage. Nevertheless, it is important to stress the need for inter-institutional coordination in watershed management and recovery. In the case of the lake Amatitlán and river Michatoya basins, at least 10 municipalities and institutions are directly involved, including the National Environmental Commission (CONAMA) and the Authority for Sustainable Lake Management (AMSA). Some two million inhabitants live in the basin but insufficient resources have been assigned to protect it and INDE has done the most to address the silting of the Michatoya river.

Other hydroelectric stations affected included Los Esclavos (13 MW), Río Hondo, (4 MW) and Chixoy (300 MW). Los Esclavos suffered silting in the reservoir, intake, and desanders, which has reduced output capacity. According to reports, access roads were undermined and the regulation reservoir was damaged by landslides. At Río Hondo, the turbine room was also affected, putting the station out of operation for around four months. At Chixoy no physical damage was reported but the station cut back production for a few days because the outlet level rose almost to the height of the turbines. Minor damage was reported at the Chichaíc (0.5 MW) and El Salto (2 MW) hydroelectric power stations.

4) Others. Buildings and warehouses were damaged; an INDE storehouse was flooded, as were two recreational centres for EEGSA workers.

5) Indirect costs. In the electricity subsector these costs stem from the need to resort to more expensive power, generated by thermoelectric power stations, to compensate for lost or unavailable hydroelectric power, and losses due to energy not supplied or invoiced because of a reduction in electricity sales.

The costs to users stemming from power outages have not been included. These are assessed globally and included as indirect costs incurred by different sectors of the economy, mostly due to failures in different services, for example roads and communications.

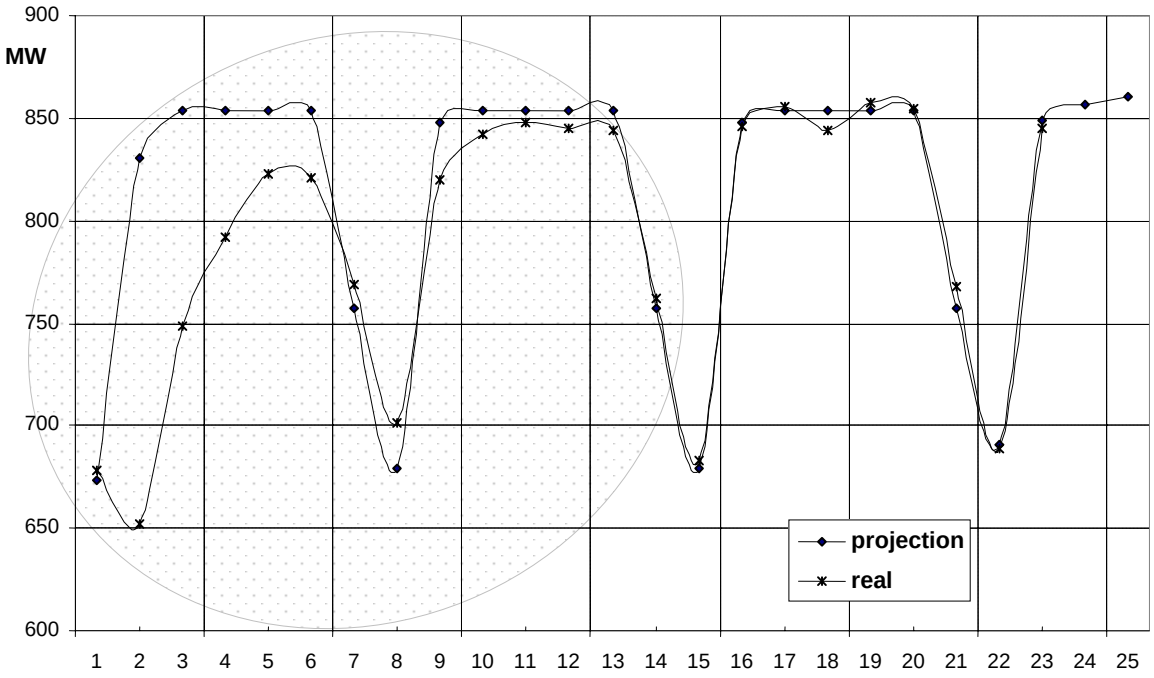
The greatest indirect cost is due to lost energy sales. The drop in consumption in November 1998 is estimated at 23 GWh on average, and is included as an indirect cost from distribution failures, pricing power at 0.49 quetzals/kWh. This represents a 6 per cent drop in electricity consumption for November. Graphs 4 and 5 show how demand quickly picked up again in the 20 days after Mitch struck.

The second largest indirect cost under generation stems from the use of more expensive power, estimated at 36 GWh, mostly for November, and has been included at the marginal price of the most expensive plant (0.065 dollars/kWh) in the country's wholesale electricity market.

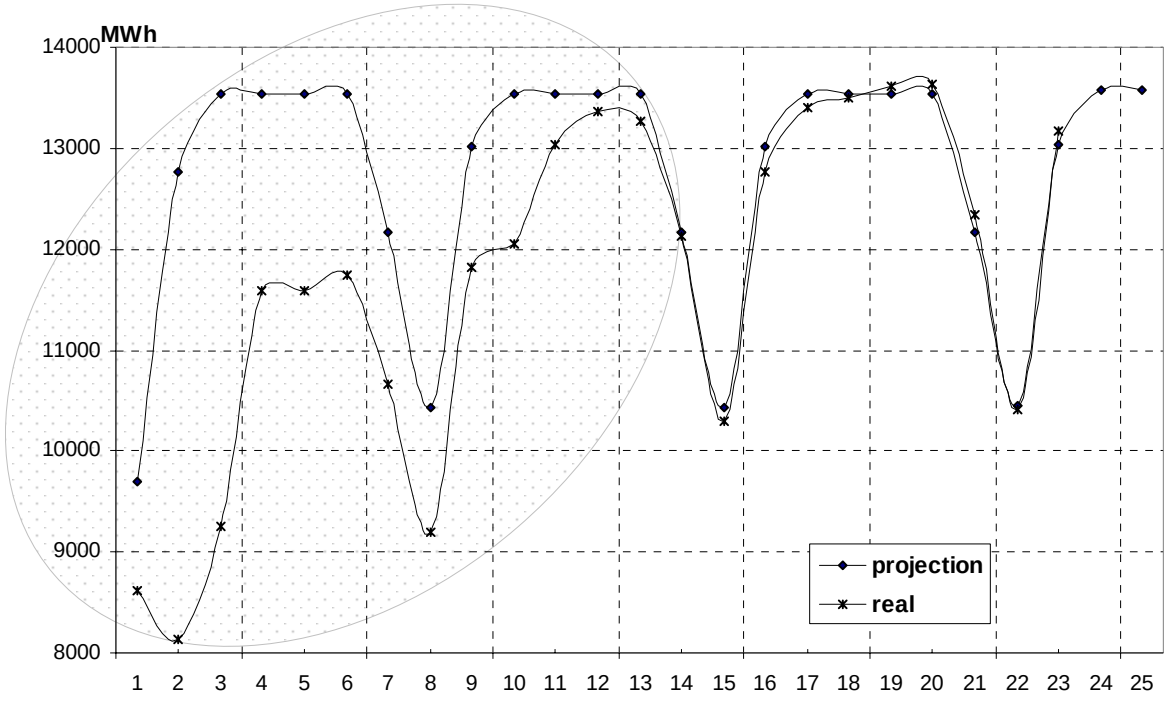
Finally, there are indirect costs related to transmission, involving only the binational Guatemala–El Salvador interconnection, which was out of service for approximately 20 days; the assessment compared average interconnection transactions in 1997 and priced power at 0.045 dollars/kWh.

The benefits of the hurricane were minimal, because when the rains came the country's main reservoir (Chixoy) was full and the extra water had to be released. Although at Jurún Marinalá extra water was gathered due to the increased level of lake Amatitlán —approximately 15 GWh in power terms—, it cannot be used due to the negative impact this would have on other sectors.

Graph 4
GUATEMALA: EFFECTS OF HURRICANE MITCH ON ELECTRIC POWER



Graph 5
GUATEMALA: EFFECTS OF HURRICANE MITCH ON ELECTRIC ENERGY



ii) Oil subsector. [17] Imports, refining, storage, distribution and marketing are private-sector activities. Damage was minor and related to the flooding of Esso's storage facility in the port of San José, which led to the temporary suspension of its operation (two to three days, for industrial security reasons). Information is not available to quantify this damage, but it is not substantial. There were reports of minor damage to exploration and drilling activities in El Petén and Alta Verapaz.

Efficient coordination at the Oil Directorate and rapid repairs on roads to the Atlantic and Pacific coasts prevented shortages of oil products. Careful management of aviation fuel stocks was equally important and made it possible to ensure continuity in rescue operations. The suspension of everyday activities decreed by the government on 2 and 3 November, also served to reduce demand for fuel and electricity.

c) Water and sewerage

Water and sewerage services are run by various national, departmental and municipal authorities. In urban areas they are operated by municipalities whereas in rural areas they are also managed by community organizations. In both cases support is provided by the Municipal Promotion Institute (INFOM), through the Drinking Water and Environmental Health Unit (UNEPAR). Assistance for the development and maintenance of drinking water services is also provided by FIS, the Public Health Ministry, other governmental and non-governmental organizations, and international cooperation agencies.

Problems in this sector include inadequate legislation governing the use of water, and relations among the many institutions and organizations that have a bearing on its use. Moreover, most towns are experiencing severe problems in drinking water and sewerage system management, reflected in some cases in the poor quality of the water supplied, deficient control, operation, and maintenance systems, excessive leakage, and inappropriate rates and collection systems. [18] The lack of trained personnel is also apparent, especially in the provinces.

Most damage to drinking water and sewerage systems is in the municipalities worst affected by the hurricane. One of the greatest challenges posed by the emergency was in reaching areas at the end of near-impassable roads. The short-term aims of the institutions involved are to re-establish damaged drinking water and sewerage systems, and to carry out health and education actions to prevent and reduce the risk of epidemics in affected areas; in the medium term, actions will focus on the total reconstruction and repair of damaged systems. By the end of the third week of November, 328 affected communities had been identified, 79 of which had already had their systems rehabilitated. The remaining 249 towns had been assessed and were in the reconstruction stage. Another 300 communities have yet to be assessed. Total damage amounts to 106.4 million quetzals (US$16.1 million), with around 91 million quetzals (US$13.8 million) needed for reconstruction (see Table 10).

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[17] Information provided by the Directorate of Oil at the Ministry of Energy and Mines.

[18] See INFOM, EMPAGUA, SRH, *Situación del Sector Agua Potable y Saneamiento en Guatemala,* a report by Douglas, F.A., Tobar Castro, M.A., and Aragón Soto, E., presented at the Regional Seminar: "Privatización de los Servicios Basados en Agua", Mérida, Venezuela, October 1996.

Table 10

GUATEMALA: DAMAGE TO DRINKING WATER SYSTEMS, WATER MAINS, SEWERS AND ENVIRONMENTAL HEALTH

	Damage			Reconstruction cost
	Total	Indirect	Direct	
Total (thousands of US$)	**16,128**	**5,632**	**10,497**	**13,811**
Total (thousands of quetzals)	106,446	37,169	69,278	91,154
INFOM/UNEPAR a/	62,346	24,939	37,408	57,054
FIS b/	34,100	10,230	23,870	34,100
EMPAGUA and others c/	10,000	2,000	8,000	

Source: ECLAC, based on figures from INFOM, FIS, EMPAGUA and own estimates.
a/ Throughout the country.
b/ Only in the departments of Santa Rosa, Escuintla, Jutiapa, El Progreso and Izabal.
c/ In the capital and some neighbouring municipalities.

Most damaged drinking water and sewerage systems are in the provinces. Indirect costs include an estimate of the cost of inputs provided to communities for water purification, as well as the cost of tanker transports and provisional water storage tanks.

3. Damage in productive sectors

This section includes estimates of damage to the agricultural, fisheries, industrial, and services sectors. Severe weather often causes serious disruptions, particularly in commodity-producing sectors. Crops tend to be the most affected due to excess water, and crop damage depends on various factors, which are described below.

Apart from losses of infrastructure and capital goods (tractors, combine harvesters, etc.), direct damage in the farming sector includes lost harvests and stored produce. The effect of the hurricane on future farming output is considered indirect damage, whereas in the industrial sector, inventories and goods in process affected by the hurricane are counted as direct damage.

Farming and fisheries play an important role in Guatemala's economy. They account for 22 per cent of total GDP, provide around 50 per cent of the country's foreign currency earnings, and make a major contribution to food supplies and employment. Hurricane Mitch caused severe damage in these areas. The intense rain, sometimes accompanied by wind, caused collapses, flooding, and strong currents. More than 98,000 hectares were affected throughout the country, mainly in the departments of Izabal, Guatemala, Zacapa, Escuintla and El Progreso.

The impact on the economy was significant, because apart from lost production, plantations, productive infrastructure and soil, the foreign sector and food supplies were also affected. The country's already deteriorated environment also suffered further damage, which is described in a separate section.

a) Agriculture

Agriculture suffered the greatest primary-sector losses, amounting to a total of 3,294 million quetzals, of which 3,244 million are in agriculture, particularly export crops (bananas and coffee), but also basic grains and agricultural assets.

i) Crops for domestic consumption. In 1998 Guatemala had 898,000 hectares turned over to crops for domestic consumption. Basic grains accounted for an estimated 830,000 hectares, with 49,000 devoted to fruit trees and vegetables and 19,000 to other crops. Of these, 14,000 hectares of maize sustained damages, mainly in Chiquimula (3,600 ha), Alta Verapaz (2,600 ha), Zacapa (2,100 ha), Jutiapa (2,000 ha), and Escuintla (2,000 ha).

Some 4,700 hectares of sesame were damaged, 2,800 in Escuintla and 1,200 in San Marcos; 3,500 ha of rice were also affected, with 2,100 in the Department of Izabal alone. Smaller areas of sorghum (1,700 ha), beans (2,200 ha) and soya (153 ha) also suffered damage (see Table 11).

Table 11

GUATEMALA: AREA OF MAIN CROPS AFFECTED BY HURRICANE MITCH

Crop	1998 Production area (hectares)	Area affected	
		Area (hectares)	Percentage of total
Total	**1,245,270**	**98,089**	**7.9**
Domestic consumption	897,764	34,562	3.8
Maize	587,930	14,269	2.4
Beans	122,780	2,218	1.8
Rice	12,000	3,461	28.8
Sorghum	39,620	1,703	4.3
Sesame	50,260	4,700	9.4
Soya	17,400	1,703	34.4
Tobacco	4,550	1,865	4.6
Vegetables	40,640	517	3.7
Fruit	14,144	3,632	54.2
Plantains	6,700		
Peanuts	1,540		
Peppers	200		
Export crops	347,506	63,527	18.3
Bananas	23,000	6,500	28.3
Coffee	270,000	55,778	20.7
Cardamom	49,650	883	1.8
Snow peas	3,290	280	8.7
Okra	780	43	5.5
Berries	786	37	4.7

Source: ECLAC, based on official figures and field inspections.

Sixty-six thousand tonnes of plantain, 29,000 tons of fruit, 25,000 tons of maize, 22,000 tons of tomatoes and 16,000 tons of vegetables were lost (see Table 12). In most cases, losses were caused

by rain or flood that damaged plantations; in others, plants were buried by landslides and silt carried by floodwaters.

Table 12

GUATEMALA: ESTIMATED PRODUCTION LOSSES IN THE AGRICULTURAL SECTOR CAUSED BY HURRICANE MITCH

(Tons)

Crop	Forecast 1998 production	Estimated losses
Bananas	1,446,700	409,000
Coffee	214,772	8,600
Tomatoes	219,800	20,000
Plantains	122,122	66,273
Tobacco	9,182	3,434
Maize	1,053,217	25,277
Fruit	783,079	29,000
Rice	41,090	11,834
Beans	111,100	2,000
Sesame	3l,617	2,972
Vegetables	487,500	17,550
Cardamom	192,300	3,462
Snow peas	15,000	1,300

Source: ECLAC, based on Ministry of Agriculture and Forestry (MAG-FOR) data.

Losses in crops for domestic consumption total 300 million quetzals (US$45.5 million), 210 million of which are direct costs and 90 million, indirect costs. The highest monetary losses were in tomatoes, maize, fruit and rice (see Table 13).

Apart from the monetary losses stemming from the hurricane, the precarious situation of small farmers must also be taken into consideration, since they have lost grains, fruit, and vegetables both for family subsistence and for income to cover basic needs. The poverty and extreme poverty in which many live have been exacerbated by the hurricane's effects. Therefore, it will be a priority during the emergency stage to provide them with the material and financial resources to recover their productive capacity and a means of subsistence until they reap their next harvest. Approximately 50,000 small farmers are in this situation. The needs of medium-sized farmers, who need new sources of financing to reactivate production, must also be taken into account, since they will experience difficulties in repaying loans contracted prior to Mitch.

ii) Industrial and export crops. Crops for international markets suffered the worst losses. The Motagua and Polochic rivers —both in the Atlantic basin of the country— overflowed, causing losses of vegetables, fruit, tobacco, and basic grains in the departments of El Progreso, Zacapa and Chiquimula due to soil slides and flooding. Later, in the Department of Izabal rice and banana plantations were also flooded, spoiling some 10,000 hectares.

Table 13

GUATEMALA: LOSSES IN AGRICULTURE AND FISHING
DUE TO HURRICANE MITCH

(Millions of quetzals)

	Damage			Impact on the foreign sector	
	Total	Direct	Indirect	Increase in imports	Reduction in exports
Total (millions of US$)	**499.4**	**187.6**	**311.8**	**136.7**	**307.0**
Total (millions of quetzals)	3,295.4	1,237.9	2,057.5	902.0	2,026.0
Agriculture	3,245.2	1,214.9	2,030.3		
Domestic consumption	300.4	209.5	90.9	150.0	
Maize	30.6	30.6			
Beans	13.7	13.7			
Rice	20.5	20.5			
Sorghum	2.4	2.4			
Sesame	13.2	13.2			
Soya	1.0	1.0			
Vegetables	23.1	23.1			
Fruit	35.4		35.4		
Plantains	48.1		48.1		
Tomatoes	60.5	60.5			
Peppers	7.4		7.4		
Others	44.5	44.5			
For export and agro-industry	2,143.8	285.4	1,858.4	500.0	2,000.0
Bananas	1,887.6	195.0	1,692.6		
Coffee	221.0	56.0	165.8		
Cardamom	16.5	16.5			
Melon	9.2	9.2			
Snow peas	4.7	4.7			
Others	4.0	4.0			
Assets	801	720	81.0	250	
Plantation losses	720	720			
Soil losses	81.0		81.0		
Livestock	26.0	16.0	10.0	2.0	6.0
Cattle	12.0	10.0	2.0		
Poultry	6.5	6.0	0.5		
Others	7.5		7.5		
Fisheries	24.2	7.0	17.2		20.0
Farmed shrimp	20.0	4.0	16.0		
Trolling	4.2	3.0	1.2		

Source: ECLAC, based on official figures and own estimates.

In the departments of Guatemala and Alta Verapaz 55,000 hectares of coffee were affected. The prolonged rainfall and high winds blew berries from bushes and caused landslides that destroyed plantations. In Alta Verapaz 730 hectares of cardamom were lost. Snow peas and other crops were also affected (Table 11).

The 10,000 hectares of banana plantations totally lost to flooding will need replanting and an annual 400,000 tons of fruit (850 million quetzals) will be lost. No bananas will be harvested for two years, because it will take a year to replant the 10,000 hectares; losses will total 1,900 million quetzals. Reports indicate 20,000 tons of fallen coffee berries were lost. The worst damage was caused by landslides, which destroyed some 1,000 hectares of plantations.

Reduction in agricultural exports is valued at 2,144 million quetzals; bananas account for 1,888 million, coffee 222 million, and other crops 34 million quetzals (Table 13).

Farming losses will have strong repercussions on the economy. Firstly, more than US$300 million in foreign currency earnings will be lost because of a drop in foreign sales from 1998 to 2000 (around 6 per cent of the country's total exports). Approximately 11,000 people employed by companies that suffered losses may lose their jobs in banana and coffee plantations. Farmers and businessmen may fall behind with loan repayments. Immediate solutions must be found to these problems to ensure the reactivation of the agricultural export sector.

Reactivation faces two serious problems. The first is financing: lost income will affect the ability of farmers and businessmen to repay loans invested in damaged or lost harvests, making them less creditworthy. However, additional financing is required to reactivate production, since employment and foreign currency earnings will be endangered if it is not made available; the situation must therefore be addressed as soon as possible through the domestic and foreign financial system.

The other problem is perhaps more important and concerns international markets, and the banana market in particular. As supplies from other producer regions substitute Guatemalan bananas this year and the following two years, there is a risk foreign sales will not recover, so trade negotiations must be held to ensure markets for Guatemalan exports. It would be advisable for European countries to adopt a flexible approach to restrictions on Central American bananas and for Guatemala to enter into negotiations with the United States to grant preferential treatment to the region's products, along the lines of regulations for Mexico under the North American Free Trade Agreement (NAFTA).

iii) Lost assets. Substantial agricultural assets were lost as a result of Mitch. Particularly hit were the plantations of continuous crops and the soil affected by landslides or sand and other deposits, which will either prevent farming over the short and medium terms or involve high recovery costs. The worst damages were sustained by banana, coffee, and fruit plantations. Lost agricultural assets are estimated at 800 million quetzals, or US$121 million (Table 13).

Flooded banana plantations will have to be replanted, because the shoots that reproduce annually after cutting at harvest-time were lost. The cost per hectare of a new plantation is approximately 65,000 quetzals, so the 10,000 hectares lost in the Department of Izabal will require outlays of 650 million quetzals. It will be two years for these plantations to produce marketable fruit, because replanting will take a whole year. Losses in coffee and fruit plantations total another 70 million.

The hurricane also washed away soil. More than 4,500 hectares of land were affected by landslides or flooding, and will require investments of some 80 million quetzals for rehabilitation.

iv) The livestock sector. Livestock sector losses were lower than in agriculture. The most affected department was Izabal, where 40,000 hectares of grazing and 10,000 head of cattle were lost (mostly calves and dual-purpose cows). Poultry farming was badly hit in the Department of Escuintla, where 361,000 poultry were lost. Losses were relatively low in other branches of the sector.

Total damage in the sector was 26 million quetzals, of which 14 million were in cattle (Table 13). This includes 2 million quetzals of indirect damage in lost dairy production due to lower yields. Damage in poultry is estimated at 6.5 million quetzals, and amounted to US$800,000 in hog farming. Lost pastureland is estimated at 4 million quetzals.

v) Fisheries. Most damage was to shrimp farming in ponds, mainly in the departments of Santa Rosa and Escuintla. Deep-sea and small-scale fishing were less affected. Overall, the sector suffered losses totalling more than 24 million quetzals (Table 13).

In shrimp farming, the main damage was to the walls (mostly made of concrete) of ponds, which will have to be repaired as soon as possible to be able to reactivate shrimp production and exports. Flooding also led to the loss of 500 tons of larvae and shrimp. Damage to this subsector amounts to 20 million quetzals.

Production was also lost in deep-sea fisheries and in small-scale fish and shrimp fishing; in the latter currents and tides dragged fishing equipment and tackle away and caused damage to unloading facilities. Losses are valued at 4.2 million quetzals, with 2.2 million pertaining to industrial fisheries and 2 million to small-scale activities.

The reactivation of fisheries requires two types of actions: one is to secure financing for companies that lost shrimp-farming and trolling assets, the other to replace the equipment and tackle lost by small-scale fishermen.

b) Industry, trade, and tourism

The damage caused by hurricane Mitch in industry, trade, and tourism was less severe than in agriculture. Manufacturing suffered damage totalling US$18.7 million, mainly in the garment and furniture industries. In tourism losses are estimated at US$15 million; although hotel facilities were not damaged, tourist flows are expected to decrease. Damage in mining amounts to US$300,000.

i) Manufacturing sector. Although industrial infrastructure was affected by heavy rains and flooding, the damage was relatively minor. However, output will be significantly reduced due to shortages in primary sector inputs extending beyond the period of temporary closures. In other words, the indirect effects were felt not only in the last two months of 1998, but will continue in 1999.

Direct damage consists mainly of broken-down machinery and equipment in the municipalities of Amatitlán, Mixco, Villa Nueva and Guatemala. Some companies that export to Honduras have not been able to make shipments and those that export perishables have suffered losses. There is no information on insurance amounts for such goods. One of the factors that affected trade flows was the suspension of activities on 2 and 3 November, which delayed clearance for exports.

The agroindustrial branch sustained losses in infrastructure, with damaged facilities and machinery; the main damage, however, was to production. Losses in the farming sector —described and quantified in the previous section— led to reduced processing of farming and fish products that will last several months.

Given the lack of quantitative information, an estimate was made of the combined volumes of goods lost and the difference between unit prices paid to producers and wholesalers. That difference was considered to be representative of the agroindustrial value added.

Indirect damage in agroindustry is calculated at 281.3 million quetzals (US$42.6 million, see Table 14). The processing of food commodities accounts for 71 per cent of this total, fish products 24 per cent, and meat packing 5 per cent. Of all indirect losses in agro-based industry (not counting fishing or cattle farming), 59 per cent was in processed goods for export.

In arts and crafts, producers in the highlands were unable to deliver their goods due to impassable roads and bridges, which delayed shipments. Sales also fell due to fewer tourists. Total damage in this area was 1.3 million quetzals.

In the garment industry, direct damage was small but indirect losses are considerable, especially due to lost working days and delays in deliveries of raw materials in ports and loading zones. Fifty-six export containers and 65 import containers carrying clothing and other raw materials were detained. Lost profits and the inability to supply raw materials are the main problems facing the sector. Total damage is calculated at 66 million quetzals (see Table 14).

Manufacturers of furniture and wood products had supply problems due to impassable access roads or the isolation of companies in the Zacapa and Alta Verapaz areas. Overall losses are estimated at 10 million quetzals. Other types of manufacturing suffered estimated losses of 46 million quetzals.

In mining salt production was lost and companies located in the Department of Santa Rosa (Pacific coast of Guatemala) suffered damage to infrastructure.

Table 14

GUATEMALA: DAMAGE IN THE MANUFACTURING, MINING AND TOURISM SECTORS

Branches	Damage			Cost of reconstruction	Increase in imports	Reduction in exports
	Total	Indirect	Direct			
Total (thousands of US$)	**79,614**	**73,814**	**5,800**	**6,200**	**5,180**	**4,500**
Total (thousands of quetzals)	525,450	487,170	38,280	40,920	34,188	29,700
Manufactures	404,670	388,170	16,500	21,120	34,188	29,700
Agro-based industry	281,250	281,250				
Crafts	1,320	1,320			528	
Garments	66,000	66,000			26,400	19,800
Furniture	9,900	6,600	3,300	1,320	660	
Other manufactures	46,200	33,000	13,200	19,800	6,600	9,900
Mining	1,980		1,980			
Tourism	118,800	99,000	19,800	19,800		

Source: ECLAC, based on official figures and own calculations.

ii) Tourism sector. The hurricane affected 20 per cent of the tourism industry, which is significant given that Guatemala is one of the main destinations in Central America and that tourism is the country's second highest source of foreign exchange. Direct damage is smaller, because 60 per cent of hotel facilities and services are in the country's central region (Guatemala City and Antigua Guatemala), where flooding was slight; indirect damages stem from fewer tourists, cancelled trips and reduction in reservations, lost foreign-currency earnings and lower handicraft sales.

In 1998 tourism activities were expected to bring approximately US$400 million in foreign exchange into the country. According to tourism authorities, indirect losses due to lower numbers of tourists will total US$15 million. The sites affected include the Quiriguá ceremonial centre in Morales and some churches in Antigua Guatemala. Tourism losses as a whole are estimated at almost 119 million quetzals.

4. Effects on the environment

a) Definitions and methods used in environmental assessment

Natural disasters can cause moderate or serious damage to the environment, or even the total deterioration of a natural heritage that provides society with environmental benefits. Quantifying the environmental impact of natural disasters on this heritage on the basis of relative indicators or in monetary terms is a relatively recent practice. This type of assessment has been applied, for example,

in analysing the impact of El Niño (1997-1998) on Costa Rica [19] and of hurricane Georges on the Dominican Republic. [20]

The theory is that natural habitats or ecosystems are generally in a state of ecological balance; natural phenomena involving high energy dissipation are normal, although they may only occur once in several years or decades and affect geographical areas at random; these processes are believed to shape biosphere physiography over time. Their main impact is therefore on an ecosystem's sensitivity, depending on its geophysical characteristics and its environmental conditions, and its vulnerability to neighbouring regions with human settlements, particularly if such settlements lack appropriate preventive land-use measures and planned, sustainable management of natural resources.

This diagnosis is based on the average value of environmental services provided by forests in terms of carbon fixation, water protection and production, biodiversity, ecosystems and scenic quality. These values are relative, since economic assessment of the effects of damage on the natural environment still requires further studies. Preliminary assessment of the damage was based on a rapid field study (touring the most affected areas by helicopter) and on studies of photographs and films, in addition to other information provided by technicians, specialists and Guatemalan government authorities, local NGOs (Defensores de la Naturaleza) and technicians from international missions participating in measures to address the emergency and optimise the country's recovery (UNDP, IDB, UNICEF, FAO).

The alterations caused by hurricane Mitch to Guatemalan territory are measured as direct impact in this study, since they specifically altered natural assets through losses or serious damage, in just a few hours (by the hurricane's wind impact) or several days (by the persistent rains). Impacts are classified as primary and secondary; the primary impact is caused by the storm's *in situ* energy dissipation, whereas the secondary impact refers to subsequent, cumulative dissipation, such as the major flooding that occurred in densely populated alluvial valleys and near the rivers that run through them.

Two types of hurricane impact were defined:

i) Immediate or primary direct impact (PDI) on the environment. Harmful or noxious impacts of a large-scale natural phenomenon, which occur during the event itself and have a direct effect on the state of natural assets as they were when the disaster began. Examples include strong winds that knock down, twist and defoliate plants, disturb fauna, and produce large waves and groundswell; landslides and large-scale erosion of topsoil caused by heavy, sustained rainfall on mountain slopes (erosion is particularly strong when trees have fallen); and immediate erosion of beaches or coastal damage stemming from intense waves or from groundswell.

ii) Secondary direct impact (SDI) on the environment. In addition to their local impact, the direct effects can also have an impact on the vicinity and areas some distance away from where a disaster initially broke out; these may be felt immediately, in a few hours or even days later, with explicit damage caused in areas rendered vulnerable by human activities. Examples include

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[19] ECLAC (1998), *El fenómeno El Niño en Costa Rica durante 1997-1998* (LC/MEX/L.363), 3 November.

[20] ECLAC (1998), *República Dominicana: Evaluación de los daños ocasionados por el huracán Georges, 1998* (LC/MEX/L.365), 1 December.

landslides, the formation of gullies and ravines left barren by waterlogging of the topsoil after losing its original vegetation, large sedimentary deposits in river beds and estuaries, sedimentary deposits on beaches and reefs, the formation of river islands that subsequently flood, drowning animal species, and floods and avalanches, among others. These effects may be intensified by other factors resulting from primary direct damage, such as rivers dragging vegetation uprooted by gusts or sustained winds, mud and accumulated rubble from cave-ins and landslides.

iii) Indirect impacts (II) on the environment. These stem from the action of weather phenomena involving major energy dissipation, and their effects depend on the type and extent of primary and secondary direct impacts, both of which indirectly affect the condition of natural assets when the disaster struck. These consequences can arise as soon as the direct impact takes place, or may appear and continue over a period of days, months or even years. One example is the disappearance of nutrients in an aquatic system, thus causing changes in the food chain; another is the disappearance of seed, fruits or flowers, the food source of birds and mammals, owing to the lack of a habitat, such as a forest. Although a tree can regenerate and sprout new leaves when it has lost its branches in hurricane winds, it will take longer to flower and produce fruit. Additionally, the lack of natural insect predators, such as bats, when they have been driven from an area, owing to the lack of a forest habitat, encourages the proliferation of insects that could be harmful to crops adjacent to the forest or to river banks. The lost habitat could also have been producing pollinating insects or insects generally beneficial to the agricultural environment of neighbouring man-made surroundings.

b) Impacts on the environment prior to 1998: occurrence of natural disasters and impacts caused by man

Guatemala has suffered the consequences of destructive natural phenomena throughout its history. The tropical storms and hurricanes that form between August and November cause high death tolls and enormous damage in the environment, forests and coasts, producing mountain landslides and flooding valleys. Most storms have entered the country from the east.

A combination of human activities and unplanned settlements (a direct cause), together with relatively high population growth, (an intensifying or magnifying factor), have made the environment increasingly vulnerable to natural phenomena, leading to major disasters.

Human activities that have a particularly strong impact on vulnerability are the disorderly expansion of the agricultural frontier based on felling and burning natural forests, and the expansion of pasturelands for extensive livestock-raising. The following practices also increase vulnerability to natural phenomena: agricultural production on mountain slopes (without soil conservation), in stream beds and river terraces (including primary activities), the opening of roads and the construction of highway, urban or other types of infrastructure, without taking into account environmental protection and land-use management measures (for agriculture and urban settlements).

Guatemala's forests cover an area of approximately 4,375,000 ha, 80 per cent of which is latifoliate forest, [21] and annual deforestation has been estimated at 82,000 ha. [22] Looking at the

[21] Office of the Coordinator of Guatemala's Forestry Action Programme (1991), *Plan de Acción Forestal para Guatemala.*

positive side, watershed management projects are under way, such as in the Chixoy (5,000 km^2) and Lake Amatitlán watersheds, and financial mechanisms have been devised to conserve water-producing forests with a minimum amount of felling, through direct payments to landowners (project financed by the IDB). From the institutional point of view, legal uncertainty regarding the right of use of natural resources (a major problem in some areas of Guatemala) should be considered one of the factors that discourages soil conservation practices and contributes to deforestation.

In the urban environment, the practice of dumping refuse into gullies in unplanned settlements lacking refuse collection services, coupled with inappropriate sand-extraction systems, have contributed to silting in riverbeds and drainage systems, either causing or aggravating flooding; such is the case in Lake Amatitlán.

In this context, future increases in population density will inexorably lead to extensive, indiscriminate territorial occupation, with all the infrastructure and human activities this entails, which will unquestionably increase vulnerability to natural disasters, unless alternative land use and resource-management approaches are taken. "One of the key factors in the recent catastrophe is deforestation and the expansion of the agricultural frontier, due largely to the interaction between poverty, demographic pressure and environment" (UNFPA). The situation must also therefore be addressed from the standpoint of population, land-use policies and regulations, nature conservation and environmental education, among others.

c) Direct impact on the environment

Official information was very limited when this report was written. The severity of the disaster in Guatemala and the prolonged emergency stage have hindered the identification and assessment of overall damage to the environment. An overflight of the Sierra de Minas Biosphere Reserve and information from the officials in charge show that the damage caused by fallen trees is insignificant.

No serious damage has been reported in protected areas. The only information received has been of flooding in buffer zones of the Sierra de Minas Reserve (in deforested agricultural frontier areas) and in the Complejo I southern reserve buffer zone in Petén.

i) Ocean impact.

1) Coastal geodynamics. Hydrometeorodynamic effects generate a primary direct impact through large waves and groundswell. No official data are available on the duration and size of the waves, or on the height of the groundswell. In Punta de Manabique several fishermen's families were evacuated prior to the arrival of Mitch and their dwellings were destroyed by the groundswell. Certain beaches where sea turtles lay their eggs were also eroded.

2) Coastal ecosystems. Deposits of debris, consisting mainly of branches, trunks, refuse and dead animals swept downstream by rivers, have accumulated in estuaries in the Pacific region (departments of Retalhuleu, Suchitepéquez and Escuintla). Coastal currents tend to carry fresh

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[22] Support Project for the Directorate and Coordination Office of the Forestry Action Programme for Guatemala. Newsletter No. 4, January-April 1997.

water loaded with sediment from inland floods further into the sea, burying some benthic marine ecosystems entirely. This type of problem was detected in brine shrimp breeding grounds. Some mangrove swamps were affected by silt deposits and erosion.

ii) Impact of rain. The consequences of hurricane Mitch had direct impacts (mostly secondary) on soil, forests, water resources and fauna. The effects of Mitch on the Lake Amatitlán watershed are being treated as a separate item owing to the importance of its human settlements.

1) Soil resources. Soil loss (washing away of the fertile layer) occurred mainly in the upper and middle parts of several watersheds as a result of concentrated erosion, landslides, and flooding of areas near river banks. The most affected areas were the Motagua River watershed and other basins on the Pacific side.

2) Water resources. Various types of effects on water resources were registered:

– Water pollution due to: a) washing away of agrochemicals used in agriculture; b) flooding of sewerage systems, septic tanks and latrines; c) decomposing animal corpses and refuse. Assessing the negative effects of these pollutants is no easy matter, since the enormous volumes of water have a great dissolving capacity.

– The increase in water turbidity, which reduces penetration of sunlight and the concentration of oxygen dissolved in water, and lower water conveyance capacity can have negative effects on aquatic ecosystems.

– The dragging of sediments led to changes in river channels (in the banana-growing area of the Motagua River, for instance) and in general to landscape changes.

3) Forestry resources and protected areas. Considerable damage was registered in forests situated on the banks of affected rivers. The little available information on protected areas does not reveal significant damage to primary forests. Cave-ins and landslides occurred mainly in agricultural areas, precisely because of the lack of permanent plant cover.

4) Fauna. Animal life has been affected by alterations and loss of habitat, although it is impossible to identify and assess these effects. One of the main causes of high mortality among land-based species (reptiles, mammals) is the formation of river islands that are subsequently swept away by the high waters.

5) Lake Amatitlán Watershed. [23] This is a sub-watershed of the María Linda River, covering 381 km^2. Most of it (62 per cent) is considered susceptible to serious erosion and around 40 per cent contains high-risk areas prone to floods and landslides. Although the majority of the land is suitable for forestry, perennial crops, grazing and natural reserves, 41 per cent of the watershed has been urbanised and only 8 per cent is forested. The population of municipalities within the basin is estimated at 1,200,000 and some 800 industries (textiles, metal-working, chemicals, food and others) operate in the area. No treatment plant for either industrial or domestic waste water exists. Only 30 per cent of the 250 tons of refuse produced daily is collected; the rest is disposed of in gullies

[23] Information supplied by the Amatitlán Lake and Watershed Sustainable Management Authority (AMSA).

and ravines. The lake is suffering from a process of hypereutrophication; native species of fish such as pepesca practically no longer exist and species such as tilapia and pompano have been introduced. The lead levels in fish caught in the lake are very high.

In this basin, the rains caused by hurricane Mitch resulted in loss of human lives, housing and crops, and damage to infrastructure. The silting of drainage systems and river beds caused by sediment and refuse aggravated the watershed's problem of loss of seepage caused by urbanisation and heightened the effects of the rain. An area of five km^2 was flooded. The lake received the sewage accumulated in septic tanks of flooded dwellings, in addition to refuse buried in a sanitary landfill which suffered a landslide. An indirect effect is an increase in the lake's eutrophication.

The Lake Authority has carried out works —mainly the construction of settling tanks—which have diminished the effects of the hurricane. Action is also being taken in the area of environmental education; a project financed by IDB (US$40 million), made up of different components: refuse and sewage management, watershed management, reforestation, environmental education and support for municipalities, is due to be launched next year.

Although most of the watershed's environmental problems have little to do with the hurricane, what occurred exemplifies the manner in which human activities (settlements in high-risk areas, unplanned urbanisation, deforestation, lack of garbage collection) can magnify the effects of natural disasters.

d) Indirect impact of Mitch on the environment

Since only two weeks have passed between the hurricane and this study, the effects that damage to plants, fallen fruit in forests and loss of foliage may have had on birds and mammals is still unknown; in fact, virtually nothing is known about the food sources (seeds, fruits, etc.) of various species. No information is available either on the status of small species (batrachians and fish) that are the food sources of mammals, reptiles and other creatures, owing to possible alterations in metlands.

This study also places emphasis on including the environmental value lost in rivers, since they are highly productive ecosystems that extend throughout the country's farmlands. Other effects on important and valuable aspects of these habitats could be occurring or will occur, and should be studied. Research conducted in Guanacaste National Park, Costa Rica, has shown that the environmental services provided by protected areas to singlecrop farming are highly beneficial.

With regard to biodiversity, exotic species such as bullfrog, tilapia and Venezuelan alligator which were introduced and were being exploited commercially escaped in areas close to the Monterrico and Hawai protected areas. It is impossible to gauge the effects, although the introduction of exotic species is one of the main causes of loss of biodiversity.

Another effect that should be borne in mind is the invasion of new lands by small farmers who lost their fields, especially near protected areas. This poses a real threat to the buffer zones of the Sierra de las Minas Biosphere Reserve.

e) Calculation of environmental damage

In addition to covering agriculture, health, housing and other sectors, an economic assessment of the damage caused by hurricane Mitch should also consider the effects on natural assets of the loss of benefits provided by natural areas. "Environmental services" are benefits derived from natural ecosystems, such as timber, the genetic bank, medicinal plants and biodiversity in general, carbon fixing, oxygen production, soil protection, water production, and scenic and recreational areas; it is becoming widely accepted that such services should be paid for, since they are necessary for sustainable development now and in the future.

This is a new market or export product that is being used to fund environmental conservation and sustainable development; for instance in Guatemala and Costa Rica important progress is being made in the area of carbon sequestration.

Four types of environmental services are considered in this assessment: i) reduction of greenhouse gas emissions; ii) protection of water for urban, rural or hydroelectric purposes; iii) protection of biodiversity as a valuable genetic resource for future development and global stability, sustainable scientific and pharmaceutical uses, and genetic research and improvement; and iv) protection of ecosystems, living organisms and natural scenic beauty for scientific, tourism and environmental education purposes. Some countries are issuing forestry conservation bonds as an important means of maintaining these services and ensuring ongoing production, thereby compensating the owners of environmental resources for the use of environmental services that benefit society. These bonds are for a minimum of 20 years and are a recent instrument since they were not previously available on the stock market.

One way of appraising the environmental damage caused by Mitch is to estimate the environmental benefits provided by an ecosystem in complete balance. Reference is made to the studies used by ECLAC to assess the environmental damage from the effects of El Niño, [24] and to recent assessments carried out in the Dominican Republic. [25]

Table 15 shows an estimate of the forested area destroyed by hurricane Mitch. Only river bank forests, which are the most affected, have been included. Forests in protected areas have not been taken into account, since preliminary reports do not indicate damage of any significance. Damage to other resources (soil, bodies of water) has not been assessed.

Table 16 shows the average values for each type. The values for Guatemala are considered similar to those of tropical latifoliate forests.

Table 17 shows damage to the natural heritage in annual terms and over a period of 20 years. Although total recovery time has not been established in many cases, approximate figures have been included; the estimated recovery period ranges from 15 to 20 years. The overall cost of damages throughout the period is around US$5.1 million. It should be stressed that this estimate is based on

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[24] Based on Carranza, C.F. et al. (1996), *Valoración de los servicios ambientales de los bosques de Costa Rica* (CCT/ODA/MINDA), San José, Costa Rica, Centro Cientifico Tropical; and Echeverría, J., et al. (1997), *Valoración económica de los beneficios del Área de Conservación Guanacaste* (CCT/PNUD), San José.

[25] ECLAC (1998), op. cit.

incomplete preliminary information; moreover, it does not take into account the value of lost soil resources and other unassessed damage (to water resources and fauna). Costs do not include an annual discount for differentiated carbon absorption.

Table 15

GUATEMALA: FOREST DESTROYED BY RAINS AND RIVER FLOODING AS A RESULT OF HURRICANE MITCH

Type of area (affected area a/)	Direct impact b/ and percentage of trees blown down, destroyed or swept away	Remarks
Riverside forests (63 km^2) c/	Severe (M), 70	Damage due to overflows, rock deposits, boulders, sand ant silt

a/ ECLAC, own estimate based on *Mapa de Cuencas y Vertientes del Plan de Acción Forestal de Guatemala*, 1990. The watersheds most severely affected by Mitch have been taken into account.

b/ As defined in this study. Minimum = Minor impact, Severe = Medium damage due to flooding; (M) = Damage with recovery over the medium term, (L) = Damage with recovery over the long term.

c/ Human interference of approximately 30 per cent has been taken into account.

Table 16

GUATEMALA: AVERAGE VALUES OF ENVIRONMENTAL FORESTRY SERVICES

(Dollars per hectare per year)

Environmental service a/	Primary forest b/	Secondary forest b/
Total	**58**	**41.76**
Carbon fixing	38	29.26
Water protection	5	2.50
Biodiversity protection	10	7.50
Ecosystem protection	5	2.50

Source: ECLAC, based on estimates.

a/ Based on: Echeverría *et al*. (1996), Carranza et al. (1995), op. cit.

b/ Values for the Republic of Costa Rica.

Table 17

GUATEMALA: ESTIMATES OF THE DAMAGE CAUSED BY HURRICANE MITCH TO ENVIRONMENTAL SERVICES, 1998

Type of area (percentage of average damage)	Affected area (km^2)	Equivalent total damage (km^2) a/	Cost (thousands of US$)					
			CO_2 capture	Water protection	Biodiversity	Ecosystem protection	Total per year	Total b/
Total	**63.0**	**44.1**	**167.6**	**22**	**44**	**22**	**255.6**	**5,112**
Riverside forests (70%), c/	63.0	44.1	167.6	22	44	22	255.6	5,112

a/ The area equal to total destruction based on actual area and percentage of trees fallen or swept away was calculated for each area.

b/ The overall cost for a 20-year recovery period is approximately US$5.1 million.

c/ The level of human interference in riverside forests was estimated at 30 per cent and does not include the lowest part of the lower basin and estuary of the main rivers. The system is initially estimated at 2,100 km, which corresponds to the most affected watersheds, and 30 m of riverside forest have been considered for the entire length.

River and river bank systems should also be assessed, since they were greatly affected throughout the country by high flows. Estimates indicate that 2,100 kilometres of river systems, 30 per cent of which have been altered by human interference (fragmentation, destruction, logging, etc.), were affected.

i) Carbon dioxide fixation. CO_2 absorption from the atmosphere through photosynthesis is a crucial link in the biogeochemical carbon and oxygen cycle. This process of accumulation as organic plant matter helps to prevent carbon dioxide levels from rising while simultaneously producing oxygen, for which highly industrialised countries are willing to pay to compensate for their own gas emissions. The loss of environmental services from the organic dysfunction of forests lost or

washed away (in the alluvial gullies of medium and high sub-basins) is taken into account in the calculations; such carbon will return to the atmosphere through rotting or burning, since it cannot be made use of except in certain cases.

A value of US$38 per hectare/year has been given to dense and logged forest; in other places, carbon fixation in brush areas and swamps has a low value (US$0.76, which hardly merits consideration), although they are obviously rich in biodiversity (insects, birds, etc.).

ii) Water protection. The qualitative and quantitative protection of forests has different repercussions on their water cycle, depending on physiography, land quality, amount of incoming and outgoing water, seasonal flows, erosion, sedimentation, nutrient flows, etc. The value of brush areas is negligible.

iii) Biodiversity protection. Biodiversity provides innumerable benefits for science, recreation, the pharmaceutical industry, pollinating species, insect and pest control, genetic heritage, etc. The time taken for the environment to recover from damage to biodiversity is still not known precisely.

iv) Protection of ecosystems and natural scenic beauty. This category covers numerous subjects: biocenosis protection, ecological processes, corridors, recreation, tourism, etc., and is closely associated with the previous section.

The last important factor in this calculation concerns the intrinsic value of an ecosystem, since it is what provides environmental services. Damaged forests are considered a lost service, at least in the amount that will no longer be earned until the ecosystem returns to full production.

f) Short-term projection

If human activities that make use of the environment are carried out without taking into account their possible adverse consequences on natural resources, they will almost certainly affect the stability or sustainability of natural resources by making them more susceptible to alteration and destruction when the environment suffers the impact of a natural disaster. In other words, human technological activities can easily worsen the effects of natural disasters. Moreover, if human settlements are not planned, do not take into consideration land-use management, prevailing biophysical factors and the risk involved in settling in high-risk areas, vulnerability increases in direct proportion to the lack of foresight.

For example, a basin that has been placed under strain through construction, road building, extensive farming, logging in natural forests, etc. will be unable to absorb exceptional, prolonged amounts of rainfall as well as it would under conditions of controlled and planned use. Water flows will be lower than their natural minimum during the dry season and rise excessively when it rains, even when there are no extraordinary weather patterns. If the dry season lasts longer than usual, groundwater storage will be insufficient; conversely, when there are large amounts of rainfall, the water flowing through the destabilised basin will be excessive. Either situation can be disastrous.

Another example is excessive population growth, a factor that heightens the impact of any disaster when a human settlement is located in an unstable area that can be devastated by the effects

of exceptional natural phenomena. Here the consequences of a natural impact are multiplied by man's alteration of environmental conditions, by the precarious living conditions of victims, such as poorly constructed housing built on slopes subject to landslides), and by causes stemming from a lack of foresight, management and social improvement.

Urban planning, land-use management, land conservation measures, environmental restoration, structural prevention measures for roads, bridges, reservoirs and other works, and any other technical measures designed to change or improve a natural setting within a framework of sound and respectful use of the environment and the laws of nature are certain to improve the quality of life through sustainable development. These aims require scientific research, databases on natural phenomena and early-detection measures whenever possible, as well as continuous education to create awareness of environmental management in society and provide an orderly response to natural disasters. These actions are in fact long-term preventive measures and will help to streamline efforts and improve coordination during the initial stages of an emergency, particularly if the country has good warning and civil-defence mechanisms.

Measures taken during the reconstruction stage following a natural disaster should be added to everyday conservation activities, so as to achieve an optimum approach to sustainable development.

Government and international agencies have stated the need for a change of attitude in dealing with natural disasters, focusing on disaster prevention, reduction of vulnerability and early warning. The International Decade for Natural Disaster Reduction (thus declared for the nineties by the United Nations General Assembly) has undertaken the task of incorporating multidisciplinary approaches in order to gain further understanding of the actions needed to deal with these phenomena and reduce negative effects through prevention.

5. Summary of damage

In keeping with the calculations presented in the preceding sections, hurricane Mitch is estimated to have caused damages totalling US$748 million (4,937 million quetzals), 40 per cent of which is direct damage. Partial or total damage to infrastructure should be rebuilt or repaired as soon as possible to prevent the country's economic-growth and social-development capacity from being hampered over the medium term. As previously stated, the reconstruction should be undertaken from the standpoint of improvement and disaster prevention and mitigation.

Direct (67 per cent) and indirect damages (84 per cent) alike were concentrated in the productive sectors. Most of the damage here was to the primary sector, particularly agriculture, which will have a strong impact on the country's balance of payments due to a larger amount of imports and lower exports of around US$444 million during the 1998-2000 period (forecasts indicate that exports will drop by US$307 million and imports, mainly of capital goods, will increase by US$137 million).

Losses in the infrastructure sector (US$116 million) basically refer to damaged roads and bridges. Although damage to the social sectors is relatively minor, the unmeasured effects on the welfare being of people who lost their homes, livelihood, etc. must be taken into account, i.e., in qualitative terms, the harm caused to the social sectors has a special significance which should be borne in mind upon embarking on rehabilitation and reconstruction activities.

Table 18 includes a column showing the estimated cost of reconstruction, which serves as a rough indication of the amount required to improve transport, health care, housing, education, production and environmental infrastructure. The appendix contains project profiles that include a time frame for the reconstruction efforts, which is important in that it has a bearing on the country's capacity to absorb and manage resources. Finally, the table includes an estimate of the imported component of reconstruction costs, which provide an approximate indication of foreign-exchange needs.

Table 18

GUATEMALA: SUMMARY OF DAMAGE AND COST OF RECONSTRUCTION

(Millions of US$)

	Total damage	Direct damage	Indirect damage	Cost of reconstruction	Imported component
Total	**748.0**	**287.8**	**460.2**	**415.5**	
Social sectors	48.1	33.0	15.1	52.2	
Housing	35.3	24.5	10.8	38.0	3.0
Health	4.9	1.1	3.8	1.9	1.0
Education	7.9	7.4	0.5	12.3	2.9
Infrastructure	115.8	56.3	59.5	82.2	
Roads, bridges, railways	89.7	40.1	49.6	60.4 b/	15.6
Water and sanitation	16.1	10.5	5.6	13.8	
Electricity	10.0	5.7	4.3	8.0	
Productive sectors	579.0	193.4	385.6	217.2	
Agriculture, fisheries, forestry	499.4	187.6	311.8	211.3	
Manufacturing a/	61.6	2.8	58.8	3.2	
Commerce, restaurants, hotels	18.0	3.0	15.0	3.0	
Environment	5.1	5.1		63.9	

Source: ECLAC, based on figures shown in tables 3 to 15.

a/ Includes mining.

b/ Does not include railways.

Figure 3

POSITIVE LINKAGE FOR INFORMATION, REACTION AND DEVELPMENT PROCESSES TO REDUCE VULNERABILITY AND PROMOTE SUSTAINABLE DEVELOPMENT