

**Document of  
The World Bank**

**REPUBLIC OF MOZAMBIQUE**

**A Preliminary Assessment of Damage  
from the Flood and Cyclone Emergency  
of February-March 2000**

**March 27, 2000**

**MOZAMBIQUE**

**A PRELIMINARY ASSESSMENT OF DAMAGE  
FROM THE FLOOD AND CYCLONE EMERGENCY  
OF FEBRUARY-MARCH 2000**

## TABLE OF CONTENTS

### I. INTRODUCTION \*

### II. THE CONTEXT \*

HISTORY OF THE FLOOD DISASTER \*

RESCUE AND RELIEF OPERATION \*

### III. AN ASSESSMENT OF THE DAMAGES \*

AGRICULTURE \*

HEALTH \*

EDUCATION \*

HOUSING AND PRIVATE PROPERTY \*

GOVERNMENT PROPERTY \*

WATER SUPPLY AND SANITATION \*

ENERGY \*

TELECOMMUNICATION \*

ROADS \*

RAILWAYS \*

THE PRIVATE SECTOR \*

ENVIRONMENT \*

DISASTER PREVENTION AND PREPAREDNESS \*

-

## REPUBLIC OF MOZAMBIQUE

### A PRELIMINARY ASSESSMENT OF DAMAGE FROM THE FLOOD AND CYCLONE EMERGENCY OF FEBRUARY-MARCH 2000

#### I. INTRODUCTION

This document is a World Bank contribution to the Core Group of Mozambique's external partners convened by the Government of Mozambique to assist in the response to the flood and cyclone emergency of February -March 2000. The document attempts to assess the cost of these damages to the Mozambican economy, both at the sectoral level and overall. **At this early stage, damage estimates are necessarily tentative, preliminary and subject to revision**, not least because rainfall and river levels remain in flux and the emergency period is not yet past. The findings presented in this document may be revised or supplemented prior to the International Donor Conference to be convened in Rome, Italy, on April 26-27, 2000, in light of newly available information. UNDP as the secretariat for this Conference, has agreed to take responsibility for any such revisions. It will be the aim of the Conference to mobilize external resources required for Mozambique's sustainable recovery and vulnerability reduction.

From March 12 to 24, 2000, a World Bank team traveled to Mozambique to assess the flood and cyclone damage sustained in the country following heavy rains in February and March. Together with members of other agencies in the Core Group, and in close consultation with the Government and the wider development partnership in Mozambique, the team attempted to assess the impact of the damage, in each sector and on the economy as a whole, and to identify priorities for rehabilitation. This document sets out the team's findings

In preparing this assessment, the team attempted to distinguish between direct or same-standard replacement costs (i.e. the costs for restoring assets to the standard that existed before) and optimal-standard reconstruction costs (i.e. the costs for rebuilding to a standard that optimally responds to local conditions, including the risk of natural disaster). There was consensus on the team that, given Mozambique's high degree of exposure to hydro-meteorological hazards, same-standard replacement might not be the best response to this recent disaster. To inform the discussion of these different options, the team attempted, for each sector, to determine the direct costs, indirect costs, and reconstruction costs to date of the recent flood and cyclone disaster. The cost of emergency relief activities was also estimated. In Table 1, and in this document generally:

- *Direct costs* refer to physical damage to capital assets and inventories, valued at same-standard replacement costs.

- *Indirect costs* refer to flow effects such as output losses and foregone earnings.
- *Relief costs* refer to (i) the provision of life-supporting services (e.g. food aid, health care, safe water and sanitation) to populations whose access to these services has been lost as a result of the disaster and (ii) assistance to these populations to enable them to resume sustainable livelihoods
- *Reconstruction costs* refer to costs for rebuilding damaged infrastructure to standards optimally designed to reduce vulnerability and risk of loss through future disaster, taking into account Mozambique's resources, policy framework, and level of development.

**Preliminary damage assessments total \$273 million in direct costs and \$428 million in optimal-standard reconstruction cost** (see Table 1 on next page) **These totals are likely to be revised significantly as detailed on-site damage assessments are completed by qualified experts (including engineers) in the coming weeks and months.** Where data have appeared to be quite uncertain or based on untested assumptions (e.g. direct losses to housing and private property, direct losses to traders, and indirect losses due to damaged roads), bases for the estimate have been discussed in the text, with more conservative bases generally been preferred.

	<b>Costs</b>			
	<b>Direc</b>	<b>Indirect</b>	<b>Relief</b>	<b>Reconstruction</b>
<b>Food aid</b>	–	–	35.5	–
<b>Health</b>	15.7	*	5.2	25.8
<b>Education</b>	18.7	*	0.5	37.3
<b>Housing and private property</b>	29.1	*	6.0	43.6
<b>Government property</b>	5.2	–	–	10.2
<b>Sub-total: Social Sectors</b>	68.7	*	47.2	116.9
<b>Water and sanitation</b>				
<b>Water and sanitation</b>	13.4	*	6.6	13.4
<b>Energy and telecommunication</b>				
<b>Energy and telecommunication</b>	13.6	10.7	–	15.5
<b>Roads</b>				
<b>Roads</b>	47.0	30.0	11.0	87.2

<b>Railways</b>	7.3	10.7	–	49.2
<b>Sub-total: Infrastructure</b>	81.3	51.4	17.6	165.3
<b>Agriculture**</b>	57.9	63.0	–	57.9
<b>Livestock</b>	7.9	0.8	–	7.9
<b>Fisheries</b>	8.5	6.1	–	8.5
<b>Industry*</b>	25.7	68.0	–	30.8
<b>Trade</b>	15.7	15.0	–	15.7
<b>Tourism</b>	2.0	10.5	–	2.5
<b>Sub-total: Productive Sectors</b>	117.7	163.4	–	154.2
<b>Sub-total: Environment</b>	2.0	–	–	2.8
<b>Sub-total: Disaster Prevention</b>	3.4	–	–	19.4
<b>Grand Total</b>	273.1	214.8	64.8	427.7
<i>Source: The World Bank. Notes: * Less than \$500,000. ** Lost sugar cane production is included in agriculture; lost refined sugar production is included in industry. See text for definition of column headings.</i>				

This summary table requires comment: First, the **totals in each column combine public sector and private sector losses.**

Second, **costs to the public sector are estimated to total about \$135 million in direct costs**, and include costs in health (\$15.7 million), education (\$18.7 million), government buildings and their contents (\$5.2 million), water and sanitation (\$12.0 million), energy (\$13.1 million), roads (\$47.0 million), railways (\$7.3 million), and agriculture infrastructure (\$16.4 million). Indirect costs to the Government in these sectors total \$13 to \$14 million. They are marginal in most sectors (less than \$500,000), but reach significant amounts in the power sector (\$2.4 million (with the remainder a loss to private-owned HCB)) and the railway sector (\$10.7 million).

Third, **costs to the private sector are estimated to total about \$130 million in direct costs**, including costs to housing and private property (\$29.1 million), agriculture (\$41.5 million), livestock (\$7.9 million), fisheries (\$8.5 million), industry (\$25.7 million), trade (\$15.7 million) and tourism (\$2.0 million). Indirect losses in these sectors also fall to the private sector and are estimated to be quite high, at about \$190 million. The indirect costs of damage to the roads network is estimated to be about \$30 million and these fall to the private sector as well.

Fourth, **relief costs as calculated in Table 1 understate total costs for the relief effort** as they are limited to costs associated with providing basic services and attempt strictly to exclude rehabilitation or reconstruction costs. The estimated total, \$64.8 million, is therefore significantly less than the \$160.5 million which the Government indicated to be the gross requirement for the emergency response in its most recent International Appeal, prepared in collaboration with the UN and issued on March 22, 2000. Items such as road repair; building repair; and the provision of goods and services that are provided to restore livelihoods are included as direct costs of the disaster, and not as relief costs, though some of these items were included in the Appeal. At the same time, except for food aid, Table 1 does not attempt to capture extraordinary relief costs (e.g. for family reunification and emergency (air-borne) rescue operations) that would significantly add to the relief costs total.

Fifth, **estimates of reconstruction costs are highly preliminary**, as specialists have only just begun to identify and cost out effective risk-reducing strategies for sectoral activities in the affected areas. Moreover, the decision whether to rebuild to improved standards can only be determined by assessing the exposure of the relevant asset to catastrophic losses and the economic impacts of these losses. This involves informed speculation on the probability of severe flooding on the affected flood plains or exposure to other hazards in the future. Based on death and damage tolls from floods in 1970 and 1977, it is clear that flooding in these areas periodically reaches magnitudes that are sufficient to cause extensive damage and loss of life. Every effort must be made to reduce the human costs of these events, and to incorporate loss exposure levels into standard model projections to obtain a realistic view of an asset's probable returns and insurance needs.

## II. THE CONTEXT

### HISTORY OF THE FLOOD DISASTER

From February 4 to 7, 2000, due to the effects of cyclone Connie, Maputo city received 455 mm of rainfall, or nearly half the average annual total. Similar exceptionally heavy rains across southern Mozambique exacerbated normal seasonal flooding, inundating low-lying areas. From February 20 to 22, heavy rainfall associated with cyclone Eline boosted rainfall totals in neighboring South Africa, Zimbabwe and Swaziland, filling reservoirs on river basins draining through southern Mozambique and triggering more extensive flooding, particularly along the Limpopo, Incomati and Umbeluzi rivers. It was the first time in recorded memory that all three river systems flooded at the same time in Mozambique. Although flooding has receded from peak levels recorded in early March, continuing rainfall together with releases from dams upstream have kept river levels high, perpetuating flood risks and slowing the drainage of river basins back to normal seasonal conditions. In early March, heavy rainfall affecting the Save, Buzi and Pungoe river basins threatened to cause additional flooding in these areas further to the north. As of March 25, river levels and rainfall patterns have not completely returned to their normal states, with the consequence that ecological systems continue to be in perilous condition and renewed flooding remains a distinct possibility.

The provinces currently most affected are Maputo, Gaza, and northern Inhambane. Also affected are Sofala and Manica provinces, but to a lesser extent. The total population in the five affected provinces is about five million. According to the Instituto Nacional de Gestao de Calamidades (INGC), as of March 23, 640 people have lost their lives due to the flooding and about two million people are experiencing severe economic difficulties, including 491,000 people who are either displaced or trapped in flood-isolated areas. As the waters recede, high levels of standing and contaminated water have exposed many of these people to heightened risk of diarrheal disease, cholera and malaria. Break points in the transportation system, resulting from destroyed roads, bridges and railways, separated people in the affected areas from food, water, and essential services. Many families have lost crops, livestock, and possessions and sustained total destruction of their dwellings. More permanent structures such as schools, clinics, and municipal buildings have also sustained damage or been emptied of their contents. In addition, electrical and telecommunications grids have been ripped asunder, and water systems and sanitation systems have been rendered inoperable through siltation.

The flooding devastated the affected areas (about 12 percent of the cultivated land in the five provinces) and caused considerable loss of life and property. A substantial effort is needed to address, rapidly, the relief and rehabilitation needs particularly of communities normally situated on the Incomati and Limpopo flood plains. The Government and its development partners also need to remain vigilant for the remainder of the rainy season, as the situation for people on the flood plains—people who refused to leave as well as people returning prematurely—is precarious. At the same time, these efforts should not undermine development activities elsewhere in the country, or involve significant deviations from existing policy and reforms. In particular, the current emergency should not be allowed to undo the progress of the past few years, which has seen a marked shift away from the supply-driven approach to service delivery dominant in Mozambique during previous (war and drought) emergencies to a demand-driven approach involving effective community participation in making decisions and managing systems. The latter approach, which has been demonstrated to contribute greatly to system sustainability and is supported by an increasing number of donors with long experience in Mozambique, should not be displaced by a return to the ‘emergency’ mentality and the fragmented, inappropriate and unsustainable systems that it produced.

## **RESCUE AND RELIEF OPERATIONS**

When flooding first occurred in Maputo province in early February, the situation, though worrisome, appeared to be manageable. Only later, when dam releases and heavy rainfall in the Limpopo catchment area caused that river to send a wall of water through Chokwe and lower Xai Xai in the middle of the night, did the situation become an emergency. News from Chokwe and Xai Xai was slow to reach the broader international community, but as media images of the flooding were broadcast, a substantial response was initiated by the United Nations, major international donors, local and international NGOs, and—significantly—Mozambique’s immediate neighbors. Relief and reconstruction activities are being coordinated by the Government of Mozambique with support from the United Nations and international donors. A Government appeal, prepared with UN support and released on March 22, itemizes remaining relief requirements by sector, as well as donor pledges against those requirements to date. The present document, by contrast, attempts to articulate Mozambique’s reconstruction requirements.

A number of factors will determine the adequacy of the relief effort and its linkages to reconstruction activities. These include donor subscription levels and follow-through on these pledges; the quality and appropriateness of health, water, educational and other services provided; and the adequacy of short-term relief-to-recovery activities

(such as seeds-and-tools and livestock-restocking programs) to restore productive assets and assist displaced persons in reestablishing their livelihoods. Transitional assistance will be particularly important for the 200,00 or more flood victims who have lost virtually everything during the emergency and would otherwise be left destitute once the relief effort ends. In addition, the entire displaced population is likely to require assistance at least until the next harvest and will remain exceptionally vulnerable to climate-related anomalies occurring during the subsequent agricultural season. The International Donors Conference scheduled for April 26-27 will provide an opportunity to revise damage and loss estimates, update relief and reconstruction requirements, review strategies for the transition period, and discuss approaches to long-term disaster prevention for Mozambique.

### III. A PRELIMINARY ASSESSMENT OF THE DAMAGE

#### AGRICULTURE

Flood and cyclone damage affected substantial areas of agricultural production in southern and central Mozambique, resulting in crop and livestock losses and damage to agricultural infrastructure and equipment. Preliminary estimates suggest that losses will reach almost \$58 million in the agriculture sector and \$8 million in the livestock sector, or almost \$66 million in total (see Table 2). Of this, 47 percent results from smallholder losses, mostly in annual crop and livestock losses; 27 percent from commercial farms, mostly in plantation crops (sugar, bananas) and productive infrastructure and equipment; and 26 percent from the public sector, mostly in productive infrastructure, including irrigation schemes. Livestock losses have been estimated at 20,000 cattle; 4,000 goats, sheep and pigs; and 180,000 chickens, but it must be noted that these numbers are at the low end of a range (with the high end approximately doubling these numbers). The cattle losses may delay by several years recovery of the pre-war herd and, as cattle continue to play an essential social and economic role in the Incomati-Limpopo region, they will also deeply affect regional development. Smaller species have virtually disappeared in the flooded areas, removing another source of revenue and nutrition from the small farmer.

	<b>Public</b>	<b>Smallholder</b>	<b>Commercial</b>	<b>Total</b>
<b>Annual crops</b>		20.95	2.73	23.68
<b>Plantation crops</b>			3.29	3.29
<b>Sub-total: Cultivation</b>		20.95	6.02	26.97
<b>Productive infrastructure</b>	16.40	2.17	0.07	18.64
<b>Admin. infrastructure</b>	0.02			0.02
<b>Equipment</b>	0.01		11.38	11.39

<b>Tools</b>		0.89		0.89
<b>Sub-total: Capital assets</b>	16.43	3.06	11.45	30.94
<b>Sub-total: Livestock</b>		7.90		7.90
<b>Total</b>	16.43	31.91	17.47	65.81

Source: MADR and Agricultural Provincial Directorates (DPADRs).

Flooded planted areas, which mostly supported maize and rice, totaled about 140,000 hectares, or 12 percent of cultivated land in the affected region, including 90 percent of the country's irrigated land. The largest impact was in Gaza (accounting for 43 percent of the flooded cultivated land), followed by Maputo (31 percent) and Sofala (18 percent). Assuming constant yields across hectares, up to 21 percent of expected agricultural production in the affected region, or 7 percent of expected national production, was lost (see Table 3). In a normal year, the region produces 57 percent of Mozambique's sugar, 32 percent of its cashews (chiefly a highland crop), and just one percent of its cotton. Although the region's rice and maize output may be sharply reduced, the overall impact on national exports will be relatively small, provided that exports under the United States sugar quota remain at the current level. Moreover, to the extent that a post-flood yield on flooded land is realized in the 1999/2000 season, crop losses will be revised downwards. The most heavily affected crop was sugar cane. The Maragra sugar plantation (just about to enter production for the first time) was inundated and totally lost, and the Xinavane and Buzi plantations reported 10 percent losses, implying that almost 50 percent of Mozambique's projected can and sugar production are lost.

**Table 3: Preliminary Estimates of Major Agricultural Flows Losses (US\$ millions)**

	Agricultural Production Flows			Loss (%) Relative to	
	98/99		Flood Loss	98/99	Region
	National	Region			
<b>Agriculture</b>	1,242.3	399.7	82.0	7	21
<b>Cereals and Grain Crops</b>	413.7	153.3	23.0	6	15
<b>Root Crops</b>	299.9	263.3	10.1	3	38
<b>Industrial Crops</b>	119.0	68.7	25.7	22	37
<b>Cashew</b>	41.9	13.5	0	0	0

<b>Seed Cotto</b>	19.8	5.4	0	0	0
<b>Sugar Cane</b>	17.2	15.2	6.4	37	42
<b>"Melaço"</b>	1.1	1.1	0.1	12	13
<b>Livestock</b>	4.5	2.6	0.3	7	12
<b>Cattle</b>	4.0	2.2	0.2	*	8
<b>Goats, Sheep and Pigs</b>	0.5	0.4	0.1	22	35
<b>Total</b>	1,211.8	368.7	63.0	7	20
<i>Note: Data for sugar production is 99/00 expected production.</i>					

Substantially increased food imports are unlikely to be needed as a result of the flood and cyclone damage, though imports have occurred and will continue as part of the international effort to sustain persons directly affected by the disaster until the next harvest. The pre-flood national food balance indicated a maize surplus of 90,000 tons, and estimated rice import requirements to be 148,000 tons. Post-flood maize and rice production losses are estimated to be less than 10 percent of national needs. Food shortages in the affected areas could, in principle, be supplied through central and northern food market surpluses.

As many areas are still flooded, the inventory of infrastructure damage and losses is still very incomplete. There is likely to be substantial damage to irrigation channels in the Chokwe Irrigation Scheme as well as to land drainage schemes, particularly in the Xai Xai region. Light damage will have occurred to inundated buildings, including provincial and district administrative offices; seed, meat, and tomato processing plants in Chokwe; rice milling plants in Chokwe and Xai-Xai; and the agricultural input store in Chokwe. Damage may also have occurred to the Sabie Irrigation Scheme, but this has not been assessed. Small holders in many instances have lost most or all of their productive assets, including dwellings and grain stores. Most of these facilities were made of local construction materials which could be easily obtained in the past but will now require high transportation costs. Overall, equipment damages account for about 12 percent of total capital losses and consist chiefly in medium-grade damage that can be recuperated through complete cleaning, lubrication, and substitution of sensitive components.

To improve data quality, MADR is planning to complete, by mid April, both a regular annual crop assessment (with FAO) and an assessment of the flood's impact on agricultural non-crop production. In parallel, the National Directorates of Livestock and Forestry will assess flood impacts in their respective sub-sectors. Livestock public authorities will soon organize an emergency livestock survey linked with the provision of animal health measures to surviving animals. The cost of the initiative is \$450,000, including \$300,000 in veterinarian pharmaceuticals.

**Government Strategy:** An ad-hoc Comité Operativo de Emergência (COE) within the Ministry of Agriculture and Rural Development (MADR) is defining the basic principles which should guide the emergency relief and rehabilitation effort. The short term objective is to recover agricultural production through the timely supply of basic agricultural inputs. To this end, COE has defined the contents of a basic AgPack to include seeds (10 kg of

maize, 3 kg of beans and 10 gm each of tomato, onion and cabbage), tools (two hoes, one cutter, and one sickle) and a medical-livestock kit. Each Ag-Pack is valued at \$19.00. Distribution to affected farmers, which may add 20 percent to the cost of the Ag-Pack, is expected to be achieved by late April, in time to capture the second agricultural season, by agencies that have a pre-flood presence in the area as well as recognizable experience in agricultural input procurement. At the same time, efforts must be made to identify and tailor assistance to different households needs. For example, about one in five households in the affected areas is headed by a female, and so has a different labor profile. While the average household farms between two and three hectares, some farm considerably less but highly fertile land and other considerably more but marginal land. In addition, while about 15 percent of Gaza households with low-lying fields also have fields in highlands, and consequently may have safeguarded some resources during the recent emergency, 47 percent only have fields in the lowlands and may have lost virtually all of their crops and possessions

A long-term strategy involves encouraging people who live on the flood plains to pursue less risky livelihoods than cattle ranching and crop farming in an area that cycles between flood and drought. The affected area is organized into relatively strong communities which have been in contact with more developed regions and have imported new technologies and institutions from them, so some behavioral mobility is possible. It will be important, in this context, to review earlier attempts to relocate these populations after the 1977 flood. Decisions on land use in the area will also need to be based on a review of prospects for irrigated land in the Limpopo-Incomati region and for the fertile peat soils that border the flood plain. Lack of a comprehensive development strategy for the region has resulted in inefficient exploitation of the Chokwe irrigation schemes, some 6,200 ha of peat soils (which requires adequate drainage to reach its potential), and about 10,000 ha of land in the lower Limpopo. For full exploitation of agricultural potential in the Xai Xai region, the channels of the drainage schemes will need to be dredged-- largely at public expense, as the cost will be prohibitive to the recently affected farmers -- and efficient models of production and marketing will need to be identified and adopted.

## **HEALTH**

The immediate health impact of the floods is an increased morbidity and mortality of the affected population and damage to health sector infrastructure, hampering its capacity to deliver services when and where they are most needed. The death toll of the floods stands at 640 as of March 23, 2000. Increased morbidity mainly results from skin problems, malaria and diarrheal disease. Many victims suffer from ulcers and conjunctivitis. Cholera cases have been reported in Maputo province and are expected in the other flood-affected provinces, since cholera is endemic in Mozambique. Malaria cases are expected to increase in the coming weeks as the enormous increase in standing water gives opportunity for parasite-bearing mosquitoes to breed.

Ministry of Health (MOH) damage assessments, conducted through its provincial offices while flood waters were still very high, indicated total damages of about \$11 million to infrastructure (see Table 4). These estimates probably overstate flood damage to each building, as they were made by the MOH without the benefit of on-site visits by qualified engineers. On the one hand, it appears that many concrete buildings withstood flood exposure remarkably well; on the other hand, the number of damaged buildings is probably somewhat understated, as many smaller facilities, staff housing, and district health directorate offices may have been overlooked. These errors may have offset one another. Required repairs to water and sanitation facilities associated with health facilities are estimated by MOH to total about \$700,000 and losses to drugs, medical equipment, furniture, and other supplies has been estimated at about \$4 million—a number that some actors in the health sector deem to be too

low. Even so, for purposes of this document, the overall MOH damage estimate of \$15.7 million is tentatively accepted. Reconstruction costs are estimated to total \$25.8 million, assuming a cost of \$150,000 for each of 47 health clinics and health posts, a cost of \$2 million for each of 6 hospitals, and a cost of \$6 million for lost equipment and supplies.

**Table 4: Reconstruction Losses to Health Infrastructure**

	<b>Affected facilitie</b>	<b>Damages (US\$ 000)</b>
<b>Maputo City</b>	1 general hospital	495
<b>Maputo Province</b>	14 health centers	1,390
<b>Gaza</b>	1 rural hospital	2,831
	8 health centers	
<b>Inhambane</b>	2 rural hospitals	4,158
	8 health clinics	
<b>Beira</b>	1 central hospital	1,738
<b>Sofala</b>	1 rural hospital	
	12 clinics/posts	
<b>Manica</b>	5 clinics/posts	365
<b>Total</b>	53 facilities	10,977
<p><i>Source:</i> Ministry of Health. <i>Note:</i> A standard health center costs around \$150,000, including fencing, two staff houses, water and sanitation.</p>		

The indirect costs to the Ministry resulting from the floods are likely small, as health care revenues are limited even under ordinary circumstances, but the costs of the relief operations have been estimated by the United Nations to be about \$5.2 million, principally for assessments, drugs, medical supplies, and therapeutic nutrition.

**Government Strategy:** MOH in cooperation with many national and international NGOs and UN agencies has launched a substantial relief effort, providing emergency and routine care in the areas of health, nutrition, water and sanitation. As a consequence, the negative impact of the disaster on the health status of the affected population may be reasonably well-contained for a disaster of this magnitude, though the enormous international presence required to contain it (a presence including some 140 international NGOs) clearly indicates that the costs of service delivery are unsustainable.

Since Mozambique has only recently emerged from civil war, MOH has significant experience with coordinating emergency relief provided by international donors and NGOs. As the international relief effort got underway, the Ministry registered incoming foreign NGOs and guided them towards the most needy locations. It also set up regular meetings with implementing agencies and with the donors to ensure coordination in planning and executing the relief effort. Nonetheless, there has been some confusion, and as of March 23, many NGOs still had not registered and the Ministry was still not informed of all donations of medical supplies and pharmaceuticals.

## EDUCATION

The disaster affected about 500 primary schools (8 percent of all schools in the country), 1,300 classrooms, 208,000 children and 3,100 teachers in five provinces and 35 districts as well as in Maputo city. Seven secondary schools, two technical colleges and the Universidade Eduardo Mondlane (UEM) suffered partial damage. Total direct costs of the disaster to the education system are estimated at \$18.7 million (see Table 5). In calculating direct costs, it has been assumed that replacing a school built of traditional materials (clay, straw and wood) will cost \$3,000 per classroom, including school furniture, and rehabilitating a school built of cement will cost \$10,000 per classroom, or 50 percent of the cost for new building (a number that appears to be high but has nonetheless been retained in the calculations summarized in Table 5). It has also been assumed that schools built of traditional materials will need to be completely rebuilt.

**Table 5: Direct Costs to Educational Facilities**

<b>Category</b>	<b>Remarks</b>	<b>Cost Estimates</b>
<b>Primary schools</b>	500 schools, 1,300 classrooms	8,800,00
<b>Secondary schools</b>	7 schools	1,950,00
<b>Technical schools</b>	2 schools	1,500,00
<b>UEM</b>	Student hostels, faculty buildings	1,200,00
<b>Sub-total</b>		
<b>Primary school books</b>	200,000 x \$7 per kit	1,400,00
<b>Secondary school books</b>	3,000 x \$12 per kit	36,000
<b>Learning kits</b>	Paper, pencils, exercise books, maps	3,600,00
<b>District and Prov. Offices</b>		260,00
<b>Total damages</b>		18,740,000

Source: Ministry of Education and World Bank estimates.

Schooling was officially suspended in the affected areas on March 3. Within the Ministry of Education, an emergency task team is coordinating the relief and reconstruction plans with its partners to ensure that affected children complete the current school year and graduate in time to join the ordinary promotion next September. To ensure this, temporary classes will be held in tents using donor-provided school materials until recovery is completed. Rehabilitation of school infrastructure is expected to take 12 to 18 months, at a total cost of about \$2 million. Together with replacement of lost school materials and textbooks, monitoring and technical assistance, the total reconstruction cost for the education sector is estimated to be \$37.3 million (see Tables 6 and 7).

*Primary School Facilities:* About 23% of all the primary schools in the affected provinces were damaged or destroyed. Gaza and Maputo provinces were hit the hardest, with more than a third of all the schools damaged. The government intends to rehabilitate schools that have suffered minor structural damage, but about 45 percent of affected schools (mostly built of traditional materials) will need to be rebuilt and in some cases resited. The Ministry of Education intends to rebuild these schools to the improved standard set out in the Government's current education program, which mandates the use of more durable materials (cement, brick, or wood) able to sustain heavy rains and storms. In effect, traditional classrooms with a constructed value of about \$3,000 per classroom will ultimately be replaced with structures valued at about \$20,000. This cost per classroom includes an office, three teacher houses, a well, latrines, and school furniture. Learning materials, education kits (pencils, rulers, etc.) and textbooks will be distributed as soon as temporary facilities or relocation to existing schools have been arranged.

**Table 6: Reconstruction Costs for the Primary School System**

Province	Classrooms			Reconstruction Costs		
	Total	Cement	Other*	Repair	Rebuild	Total
<b>Maputo province</b>	297	170	127	1.6	2.5	4.2
<b>Sofala</b>	267	189	78	1.9	1.5	3.4
<b>Manica</b>	104	52	52	0.5	1.0	1.5
<b>Gaza</b>	448	162	286	1.6	5.7	7.3
<b>Maputo city</b>	144	124	20	1.2	0.4	1.6
<b>Inhambane</b>	40	24	16	0.2	0.3	0.5
<b>Total</b>	1,300	721	579	7.2	11.6	18.8

Source: Ministry of Education and World Bank estimate. \*Traditional schools of clay, straw and wood.

*Secondary School Facilities:* Seven secondary schools were affected. Rehabilitation costs are estimated by the Ministry to total \$2 million, or almost \$300,000 per school. In Maputo city, the schools have been only marginally damaged, but a number of the secondary schools in Gaza, with school blocks built of clay and wood, will require extensive reconstruction. No serious interruption in the secondary school system is anticipated at this time.

*Universidade Eduardo Mondlane :* UEM suffered damage totaling about \$1.2 million, principally to student and workers' hostels, four faculty buildings, and a student cafeteria. Repairs are expected to be completed within five to seven months and teaching will not be affected.

**Table 7: Reconstruction Costs for Educational Facilities**

<b>Category</b>	<b>Remarks</b>	<b>Cost Estimates</b>
<b>Primary schools</b>	499 schools, 1,300 classrooms	18,800,000
<b>Secondary schools</b>	7 schools	1,900,00
<b>Technical schools</b>	2 schools	1,500,00
<b>UEM</b>	Student hostels, faculty buildings	1,200,00
<b>Sub-total</b>		23,400,000
<b>Primary school books</b>	200,000 x \$7 per kit	1,400,00
<b>Secondary school books</b>	3,000 x \$1 per kit	36,000
<b>Learning kits</b>	Paper, pencils, exercise books, maps	3,600,00
<b>Blackboards</b>		100,00
<b>Administrative Offices</b>		260,00
<b>Sub-total</b>		5,396,00
<b>Supervision</b>		2,000,00
<b>Technical Assistance</b>		500,00

<b>Total</b>		31,296,000
<b>Contingencies*</b>		6,000,00
<b>Overall Total</b>		37,296,000
<i>Source:</i> Ministry of Education, UEM and World Bank. <i>Note:</i> *Contingencies are broken down as follows: Construction (transport, etc.): \$3.5 million; delivery of textbooks, learning kits and tents: \$1.0 million; technical assistance (for procurement fees/logistics): \$1.5 million.		

**Government Strategy:** The Government's primary objective is to ensure that education is returned to normal conditions as soon as possible and that affected children complete the current school year and graduate in time to join the ordinary promotion next September.

The Ministry's strategy and response is three-fold: (i) to assess the affected areas and prepare detailed plans for relief and reconstruction as well as coordinate incoming external support (ii) to provide shelter, food, clothing, medical supplies, and tents for temporary schools, as well as learning materials and textbooks for returning children and their families; and (iii) to provide pedagogical and psychological support to teacher and pupils to address the psychological impact of the flood disaster.

The Ministry has already contracted a local company to carry out detailed assessments in the districts where flood waters have receded. UNESCO intends to provide an architect, and the Ministry will use existing resources in its school construction unit to carry out further surveys. The key disaster mitigation strategy proposed by the Ministry to date is to relocate destroyed schools to areas of lower flood risk and build them to higher standards. Guidelines and plans for site assessment, procurement and construction already exist, but will need to be updated after surveys have been completed. Once the flood waters have receded, and on the basis of the surveys, the Ministry will be able to prepare revised cost estimates. Revised procurement and activity plans should be prepared by May 2000, and all reconstruction work should be concluded by September 2001. The Ministry, and UEM, will use existing institutional arrangements for rehabilitation, but reinforce the units to accelerate reconstruction. Because the Ministry hopes to rehabilitate or rebuild the 500 flood-affected schools (about 5 percent of the annual program) and also continue with its pre-flood annual program of constructing 2,500 classrooms, it recognizes a need to add capacity and so it intends to hire more staff and package procurement, as needed.

## **HOUSING AND PRIVATE PROPERTY**

Flooding forced at least 250,000 people, or approximately 50,000 families, to abandon their homes and their possessions. The vast majority of these people are extremely poor, and lived in rural areas or in the informal settlements around the towns. Their homes were typically constructed of local materials, and were typically destroyed or washed away completely, along with most of their possessions. For the very poor, losses were small in monetary terms, but as they were virtually total losses, they will be experienced as more devastating than larger but partial monetary losses among the better-off. The imputed value of losses among the very poor is difficult to estimate, as the pre-flood value of housing and possessions varied enormously, but it is estimated to approach \$18.1 million. Losses among the middle and higher income groups have been estimated to reach \$11.0 million.

This gives a total loss in housing and private property of about \$29.1 million. As both estimates are highly speculative, their bases are discussed in some detail below. It must be noted too that the number of internally displaced persons (IDPs) remains uncertain, and that loss estimates change dramatically using different IDP numbers. In this document, it has been assumed that there are 250,000 IDPs (a number supplied by MAE in mid-March), though the March 22 Appeal states there are 491,000. Using this higher number, the total loss in housing and private property would reach about \$60 million.

**Urban Areas:** About 4,400 families, or some 22,000 people, lost their homes in the urban areas. This includes 800 families in Maputo, 700 in Matola, 1,200 in Chokwe and 1,725 in Xai Xai. Populations who lost their homes in urban Maputo and Matola were largely situated in *bairros* around the periphery of the towns

To calculate direct costs of the disaster to these families, it was assumed that the average household suffered a value loss of \$2,500 after depreciation (including about \$600 in structural damage, clean-up, and paint; \$500 in furniture; \$300 in electronics; \$300 in clothing; \$250 in vehicles; \$200 in major appliances; and the remainder in miscellaneous items (crockery, carpet, drapery, stored food items, etc.). Opportunities for salvage were estimated to be fairly high. The reconstruction cost was assumed to be one- and one-half times the value loss, or about \$3,750 per family.

**Rural Areas:** About 45,200 families, or 227,000 people, fled rural homes during the floods. Most of these families will have lost substantially all of their assets, including their homes, possessions, and livestock. A very small number of rural families (1,000 to 2,000, or two to five percent of the total) owned two homes, one in the flood plain and one on higher ground, to help protect their assets from normal levels of flooding in the river valley. According to the Ministry of Public Housing (MOPH), about 2,800 rural families were displaced in Maputo province (in Moamba, Manhiça, and Magude); 29,200 in Gaza (in Chokwe (18,993), Guijá (6,738), Chibuto (3,124) and Xai-Xai (427)); 11,900 in Sofala (in Machanga (9,952), Búzi (1,499), and Chibabava (417)); and 1,300 in Inhambane (in Govuro)

To calculate the direct costs of the disaster to these poor families, it was assumed that the average household suffered a value loss of \$400. This is approximately one-third to one-half the annual income of a five-member household living in poverty (i.e. on \$0.45 to \$0.65 per day). The value loss assumes that the average dwelling built of traditional materials has a cost (in purchased inputs, imputed labor, and social costs associated with the event of construction) of approximately \$250. The remaining \$150 consists mainly in estimated values for agricultural tools, clothing, blankets, cooking equipment, furniture, and radios. As property in livestock is not included, the \$400 represents only a fraction of the total loss suffered by most rural households. Reconstruction costs were again estimated, rather arbitrarily, to be one- and one-half times the value loss, or \$600.

**Government Strategy:** Both MOPH and MICOA are developing plans to encourage displaced persons to adopt risk-reducing livelihoods and resettle on higher ground. Under consideration are providing land and moving essential services (clinics, schools, water and sanitation) to higher ground. As no person will be forced to relocate unwillingly, the success of such efforts is hard to project. The fertile alluvial deposits on the flood plain are likely to entice many displaced families to choose to return to their previous locations, though the experience of the recent floods may induce risk-reducing behavior within the parameters of that general choice. To aid in the recovery effort, the Government is also considering providing basic building materials (blocks and roofing sheets), possibly to be purchased through subsidized credit, both to improve housing standards and to jump-start the local construction industry. Families to be resettled would first be provided with temporary shelter, in the form of a tent, on their new allotment. MOPH estimates the costs of providing public services (e.g. serviced plots

for urban resettlement on higher ground, as well as basic building ‘kits’ in urban and rural areas, to amount to about \$13 million.

## GOVERNMENT PROPERTY

Flooding caused damage to public buildings and equipment, particularly in Chokwe and Xai Xai, severely limiting the ability of local government to perform its functions. Losses encompass the value of damaged physical assets, reduced local government revenues associated with services, and reduced economic activities dependent on government services. As of March 18, estimates of damage and losses to public property were still highly tentative. Structural engineers and Government officials will need to survey lower Xai Xai, central Chokwe, and flood-affected areas of Maputo, Matola and various district capitals to provide more reliable estimates.

The most extensive damage appears to have occurred in Gaza Province, in urban Xai Xai and Chokwe, where sizeable concentrations of improved structures were completely inundated. In Xai Xai, the Governor’s offices (ground floor), the Provincial Assembly building, MAE’s provincial offices, district administration buildings, and staff housing buildings—all located in the town’s center on the flood plain—were fully submerged. In Chokwe, as well as in Guijá, Massangena, Macarretane, Lione, Chilembene, and Chanhane, Government-owned structures, including staff housing, were also submerged and their contents damaged or lost. Damage also occurred in Inhambane to Government buildings along the Save river or in the path of Cyclone Eline, particularly in Govuro, Mabote and Save, with high winds in some cases removing roofs. Sofala province was affected by flooding along the Búzi river and high winds following the cyclone, but major damage was limited to Machanga. Damage in Maputo province resulted from the first days of flooding in early February, and was concentrated in the low-lying areas along the Incomati river, and along the short Infulene river valley between Maputo city and Matola. Although damage to permanent structures appears in many cases not to have been serious, loss of furniture, computers and office equipment will temporarily halt most local Government activity. The loss of Government records in heavily-affected communities may be substantial, possibly resulting in property and other disputes as well as lower Government revenues from taxes and other levies.

UEM Engineers have offered to undertake, for any municipality that requests it, a rapid assessment of damages, including physical damages and losses in municipal revenue resulting from reduced economic activity. This assessment would be the basis for a UEM-led consultative process for defining rehabilitation priorities and developing an action plan. UEM is now completing the first of these assessments in the city of Maputo, and will soon undertake a second in Matola.

**Table 8: Reconstruction Costs of Public Buildings**

Category	(US\$ m)
Public buildings	6.0

<b>Office equipment</b>	2.0
<b>Communications equipment</b>	0.5
<b>Vehicle</b>	0.5
<b>Other equipment</b>	1.2
<b>Total</b>	10.2
<i>Source: MAE.</i>	

MAE has estimated that the reconstruction and refurbishment of public buildings will cost about \$10 million in total (see Table 8). Of this, \$6 million is estimated to be required for the reconstruction of public buildings in new locations. A World Bank estimate of direct damages, made on the basis of limited site visits and consideration of salvage opportunities, totals about \$1 million, assuming that rehabilitation will be favored over relocation. Losses in municipal revenues are difficult to estimate, chiefly because an accurate accounting of annual revenues is not available for Xai Xai and Chokwe. Recent data on municipal revenues (see Table 9) suggest that these two communities, which together have a population almost twice as large as Pemba, collect about \$280,000 in own-source revenues per year and so will lose about \$23,000 to \$24,000 of revenue per month until collection is reestablished. This should occur fairly soon after the flood waters receded, keeping actual losses relatively low. The costs of recreating lost records has not been estimated, but could be substantial in terms of Government capacity

<b>Table 9: Municipal Revenues (1999)</b>			
<b>Municipality</b>	<b>Total (Mt billions)</b>	<b>Own source</b>	
		<b>(Mt billions)</b>	<b>(US\$ 000)</b>
<b>Nampula</b>	17.7	5.9	472
<b>Pemba</b>	4.7	1.9	152
<b>Quelimane</b>	10.5	5.1	408
<i>Source: MDP, World Bank.</i>			

**Government Strategy:** As local governments in the affected areas have had to cope with urgent emergency needs in the absence of their usual infrastructure, little sustained thought has been devoted to the rehabilitation of Government property. MAE at present expects simply to repair damaged buildings and replace lost equipment. In the provinces, and at MOPH, there has been some discussion of relocating key public facilities to higher ground, particularly in Xai Xai, where higher ground is proximate. Relocation is unlikely to be cost-effective for an

structure which escaped extensive damage, and should in any case be evaluated alongside other possibilities (e.g. improving drainage and flood protection embankments around Xai Xai).

## **WATER SUPPLY AND SANITATION**

**Water Supply:** Total direct damages to water supply systems in the affected areas amount to approximately \$7 million, with rural systems accounting for about \$3 million of this total

*Maputo Province:* The International Federation of the Red Cross (IFRC) assessed water supply systems in Maputo province in late February and early March. It found that water supply in rural areas, critical before the floods, was degraded further during the floods, particularly in the districts of Marracuene, Magude, Boane, Namaacha and Matutuíne. With respect to rural point sources, the report estimates the need for 62 new boreholes, 21 rehabilitated boreholes, and 33 new hand-dug wells. With respect to small piped systems, damage involves burnt-out pumps, pump motors, electrical control panels, and other electrical equipment as well as some damage to sections of distribution networks.

*Maputo City:* Emergency repair and reconstruction works to the water supply system which serves Maputo and Matola has already been carried out by the operator, at an estimated cost of \$1.5 million.

*Chokwe:* South African consulting engineers, Africon, assessed Chokwe's water supply and sanitation systems between March 12 and 16, under a USAID contract. Flood waters moved slowly through Chokwe, causing little if any damage to structures or pipework. Problems involved electrical equipment burn-outs and silt deposits into open structures such as valve chambers. The consultants found that Oxfam and MSF had been repairing pumps and motors, that the water supply system was again operational at levels approaching pre-flood levels, and that approximately \$50,000 was needed to restore services and make minor improvements in the distribution network. They also recommend spending \$1,270,000 to increase production.

*Xai Xai:* Provided that flood waters continue to recede, Africon will soon be able to complete a planned USAID-supported assessment of water supply and sanitation systems in Xai Xai. As no site visits have been undertaken to date, estimates of damage remain highly speculative.

*Gaza, Inhambane, Sofala and Manica:* Little detailed information is currently available on the state of point source or small piped systems in these provinces. Preliminary assessments, undertaken by DNA staff and consultants, are due to be completed by March 27. Detailed assessments by consulting engineers will follow, by March 31, to prepare technical specifications and bidding documents for the required works.

**Sanitation:** Direct damages to sanitation systems in the affected areas are estimated to total about \$6.4 million.

*Maputo and Matola:* A report will be produced by March 27 on flood damage to Maputo's sanitation and drainage infrastructure. Rehabilitation estimates reach \$2.5 million. A report for Matola will probably only be available by March 31.

*Chokwe:* Africon also examined Chokwe's sanitation systems (sewerage, septic tanks, latrines, and drainage) which were limited in their coverage even before the floods. The piped sanitation system, which conveys both

wastewater and stormwater, is full of silt and unusable. Flooding also filled septic tanks and pit latrines with water, causing them to overflow and contaminate the town. Recommended short term interventions (cleaning pipes and septic tanks and providing 100 new latrines) would cost about \$50,000. There is a significant short-term problem of providing new pit latrines to the flooded areas as the water table remains extremely high. Traditional latrines cannot be dug and alternative solutions need to be found (such as raised latrines or chemical toilets) until the water table drops

*Xai Xai:* Africon will soon complete an assessment of the sanitation systems in Xai Xai, assuming the flooding has subsided sufficiently to permit the work to be done. Results are expected to be reported by the end of March.

*Rural and peri-urban sanitation* There is little detailed information currently available in the five provinces on the effects of the floods on existing sanitation (in most small towns, this consists mainly in latrines, septic tanks and drainage systems; in rural villages, it consists in latrines or nothing). Sanitation systems that existed in the affected areas prior to the floods were probably typical of those in small towns and rural areas throughout Mozambique: limited in coverage and not always adequately designed, operated or maintained.

**Table 10: Direct Losses to Water Supply and Sanitation Systems**

<b>Activity</b>	<b>Cost (US\$)</b>
<b>Maputo</b>	
Investigation of sewerage, drainage, sanitation damage	150,00
Additional water system interventions	1,500,00
Boreholes for resettled peri-urban communities	140,00
Sewerage and drainage interventions	2,500,00
Club Naval embankment / Av. F. Engels drainage	933,00
<b>Matola</b>	1,350,00
<b>Beira</b>	200,00
<b>Xai Xai</b>	505,00
<b>Chokwe</b>	185,00
<b>Small piped systems (5 provinces)</b>	1,173,00
<b>Rural systems (boreholes, wells – 5 provinces)</b>	3,052,00

<b>Rural and peri-urban sanitation (latrines – 5 provinces)</b>	1,079,00
<b>Implementation support to DNA</b>	660,00
<b>Total</b>	13,427,000
<i>Source: DNA and the World Bank.</i>	

**Government Strategy:** DNA have created an Emergency Commission consisting of a Central Commission, chaired by the National Director, and four groups which have specific functions and are led by DNA staff with support from donor partners. These include an information and monitoring group (supported by UNDP); an investigation, planning and programming group (Netherlands); a resource and activities coordination group (SDC and CIDA); and an immediate actions group (UNICEF). DNA intends to strengthen the Emergency Commission's capacity to manage, coordinate, and implement its everyday response with appropriate contracted technical assistance. It also intends for rehabilitation and reconstruction activities to be undertaken by the relevant DNA department.

Relief costs for the water supply and sanitation sector have been estimated at \$7.3 million. This number is based on the UN's estimates of water supply and sanitation relief requirements for the sector from March through August 2000, and on known NGO and bilateral relief activities in the sector to date.

## ENERGY

Reported energy sector losses total \$13.6 million in damage to physical infrastructure, mostly on the EDM system in Gaza and Maputo provinces. Reported damages in the gas and petroleum sectors are negligible, though oil companies have not yet completed their assessment of the impact on the fuel depot and filling stations in the area. Until damages are repaired, power sector revenues will decline by about \$300,000 a month, and cash expenses will increase by about \$900,000 per month, as bulk electrical power is imported from South Africa to cover the domestic shortfall. Indirect effects on the economy are more difficult to estimate, because public services and industrial output in most locations have been affected not only by failures in power supply but also by other factors (e.g. closed roads or flooding to the industrial site). Some of these other factors may take longer to address than power supply.

<b>Table 11: Direct Losses to the Energy Sector</b>	
<b>EDM</b>	<b>US\$ 000s</b>
Immediate actions	1,900

	110 kV transmission line near Moamba	700
	66 kV sub-transmission line in Maputo	800
	Maputo province rural network	3,650
	Gaza province rural network	3,700
	Beira network	270
	Inhambane province rural network	140
	Manica province rural network	230
	Other infrastructure	1,000
<b>Total EDM</b>		12,390
<b>Non-EDM isolated systems</b>		720
<b>Hidroelectrica Cahora Bassa (HCB)</b>		500
<b>Total</b>		13,610
<i>Source: EDM, MIREME.</i>		

**Electricity:** *Electricidade de Mocambique (EDM):* EDM has suffered over \$12 million in damage to its networks, with \$11.5 million occurring in Gaza and Maputo provinces. This includes

- Damage to rural networks in the provinces of Gaza (\$3.7 million), Maputo (\$3.65 million), Manica (\$230,000), and Inhambane (\$140,000);
- Erosion along a key 66 kV sub-transmission line within Maputo city (\$800,000)
- Eight downed towers on the 110 kV transmission line in the Moamba area (\$700,000), leaving Maputo wholly dependent on one 275 kV link for all of its electrical power needs;
- Damage to the Beira network in Sofala province (\$270,000), due to Cyclone Eline; and
- Damage to EDM district offices and miscellaneous equipment (\$1 million)

As of 16 March, EDM had identified a need to replace about 500 km of distribution wires, including 230 km of 33 kV line and 192 km of 0.4 kV line; 67 transformers; and an assortment of other equipment and installation. Two back-up diesel generator stations and associated substations require repair. The estimated cost of repair and replacement is \$12.39 million, assuming full replacement of many distribution facilities. There may be cost-reducing opportunities (not yet identified) to salvage some assets and effect repairs. Further reductions may come from bulk procurement processes.

EDM additionally faces lower revenue and higher costs amounting to about \$1.2 million per month. The bulk of this total is due to the higher cost of power purchased from Eskom in South Africa (at \$1.32 million per month) to make up for the loss of power from the Cahora Bassa hydroelectric facility (normally available to Mozambique at \$417,600 per month)– for a net impact of \$902,400 per month as long as the DC transmission line from Cahora Bassa is down.

*Hidroelectrica Cahora Bassa (HCB):* The 533 kV line from the Cahora Bassa hydroelectric power plant to South Africa suffered about \$500,000 of damage. It will take about six weeks in total to repair this damage, with restoration of service expected in late April. HCB is absorbing the full cost of repair and has made no request to GOM or donors for support. Foregone earnings from energy exports to South Africa are estimated, very roughly to total about \$5 million over the repair period (late February to late April).

**Table 12: Indirect Losses to the Energy Sector (per month)**

EDM		US\$ 000s
	Maputo province sales	157
	Gaza province sale	120
	Costs of additional power purchases	902
<b>Total EDM cash losses</b>		1,179
<b>Estimated HCB export loss*</b>		2,500
<b>Total Indirect Losses</b>		4,858
<small>Source: EDM, MIREME, and MPF. * While DC line to RSA is out of service.</small>		

*Isolated Systems:* Four small isolated systems (not operated by EDM) suffered about \$620,000 damage, according to Government estimates, and the development of one isolated system (in Nova Mambone) may have incurred an extra \$100,000 in costs.

**Natural Gas:** There was no damage to field operations and equipment at the Pande natural gas field (the source of the small amount of gas produced in Mozambique). The PVC pipeline from the field to the towns of Inhassoro and Vilankulo were also unaffected. Nonetheless, plans to extend gas distribution to Nova Mambone to power a small generating station and distribution system may be delayed (and costs increased) due to flooding of the Save River in that area. Other oil and gas exploration activities experienced little or no impact from the floods and cyclone.

**Petroleum Products:** The key liquid fuels in the affected areas are diesel, kerosene, and LPG. Consumption of these products was limited pre-flood – most residents of the area use little or no commercial fuels – and concentrated in towns and along the EN1 coastal highway. No major damage was reported to the Petromoc fuel depot in Xai Xai; Petromoc was able to remove supplies from this depot two days before the flood inundated the city. Petromoc and BP Amoco dominate the market in this area, and have not yet made any request for Government or donor assistance to effect repairs, though Petromoc (80 percent owned by the Government) is expected to request Government aid in rehabilitating its depot and ten filling stations in the area. Fuel deliveries will be constrained until tanker trucks can navigate the roads again.

**Charcoal:** Maputo city households dependent on purchased charcoal for cooking have also experienced higher energy prices due to the cut-off of charcoal supplies from the Limpopo river valley. While supplies have resumed and prices have fallen, these households collectively will have paid out about \$1 million more than normal (for this time of year) over the course of the last month. It is expected that, as a result of the loss of agricultural output, rural populations will turn very rapidly to charcoal production during the next six months to make up for lost income (as happened immediately after the cease-fire). This could boost charcoal supplies and depress prices at the point of production, though lower charcoal prices may not be fully passed on by middlemen to urban consumers.

**Government Strategy:** Most energy sector losses occurred within the EDM network. EDM's strategy is to divide the work into two tranches:

- Immediate actions (\$1.9 million), focusing on priority customers (hospitals, schools, water supply facilities, communication facilities, and industries), customers that can be re-connected with minimal effort, and repairs that can be made provisionally.
- Permanent repairs, replacing affected assets or restoring them to their previous state.

EDM's weak finances impeded its ability to respond. Some immediate repair work was delayed while EDM sought funds (ultimately provided by Danida). Even so, many provisional repairs have already been made (for example, some service has been restored in Chokwe) and work is underway on other priority items— especially the 110 kV and 66 kV sub-transmission lines. Restoration of the 533 kV DC link with South Africa is also a priority repair, and HCB has already started on this work.

**Table 13: Electricity Distribution System Damage**

Area	33/22 kV (km)	11/6.6 kV (km)	0.4 kV (km)	Transformers
Xai Xai	20	25	61	15
Chibuto	47		4	4
Chokwe	15		60	11
3 de Fev. area	50			7

<b>Moamba, Sabie</b>	30		5	6
<b>Changalane</b>	35			
<b>Mahotas</b>	31	20	60	11
<b>Inhambane</b>	2		2	4
<b>Beira, Manica</b>	10	3	13	9
<b>Total</b>	240	48	205	67
<i>Source: EDM.</i>				

While the current plan envisions rebuilding assets as they were and where they were, EDM (with donor assistance) will also consider upgrading and/or relocating assets where this can be done efficiently. It will take some months, and input from consultants, to formulate a plan to incorporate risk reduction into permanent repair plans. Reconstruction cost estimates at this point are very preliminary, ranging from zero to \$2 million in expenditures in addition to same-standard replacement costs. The Government has indicated that disaster management and prevention is a priority, and that a tariff increase will be considered in conjunction with increased EDM efforts to reduce system losses and increase collections. The impact on recovery costs is unknown, but will be assessed in light of the overall Government strategy and donor assistance rather than as a part of the short-term emergency response. About 60 percent of repairs will be completed in 2000 and 40 percent in 2001.

## TELECOMMUNICATIONS

Given the extremely low teledensity in Mozambique (less than 0.5 percent), the floods and cyclones did not result in major losses of telecommunications infrastructure. Some district radio transmitters were lost. In addition, flooding of the local exchange in Xai Xai, which supports about 2,500 lines, interrupted all fixed line service associated with that exchange. Outside of Xai Xai, there is virtually no fixed-line service in Gaza province.

Further information on the indirect consequences and secondary effects of the flood emergency on the telecommunications sector is anecdotal at this stage, because TDM is not yet prepared to discuss these matters with the international community. As TDM is a profitable company—indeed, among state-owned enterprises it is easily the largest contributor to the state budget—it will probably be able to self-finance repairs to its system. It is also likely that TDM has benefited financially from the increased use of its highly profitable long distance services since the onset of the emergency, more than offsetting capital and revenues losses resulting from damage to the Xai Xai exchange.

## ROADS

Road damage occurred in all five affected provinces. On trunk roads, 46 rehabilitation projects have already been identified (13 in Sofala, 11 in Maputo province, ten in Manica, six in Gaza, and six in Inhambane). The damage amount for trunk roads is estimated to total \$22.7 million, but reconstruction will cost more, as ANE has decided to reconstruct roads to design profiles that permit higher vehicle traffic. To the extent that design profiles also incorporate changes aiming to reduce flood loss exposure, reconstruction costs could rise to as much as \$39.8 million. Damages to tertiary roads are estimated to be about \$9.1 million, with reconstruction costing about \$1 million. It is not clear at this early stage in the assessment process whether all affected unclassified feeder roads have been captured in this estimate.

The flood relief program in the sector consists of four components, which complement each other and overlap in preparation and implementation. In summary, the program involves:

*Traffic Restoration on National Roads:* This component aims to permit secure passage of vehicles on road sections which have suffered interruptions or major damages. It is estimated to cost about \$1.3 million, to be financed from the Road Fund, and is currently under implementation.

*Rehabilitation of Smaller Sections of National Roads:* Under this component, which is being financed by the World Bank from the Roads and Coastal Shipping 2 credit, selection of contractors takes place under simplified procurement procedures permitting rapid commencement of works. Contracts for the following four road sections have already been awarded

- Rio Movele on EN 251 (1 lot)
- Rio Movele on EN 3 (1 lot)
- EN 254 – Rua do Jardim (2 lots)
- EN 1 – Marracuene/Manhica (2 lots)

Other contracts are under preparation, with interruptions due to continuing heavy rains, in parts of Gaza, Inhambane and Sofala provinces.

*Rehabilitation of Larger Road Sections:* For this component, consultant design studies aiming to define sub-projects for competitive bidding have already been launched. The main sub-projects currently under preparation include:

- EN 1 – Baixa de Incoluane. Deviations have been constructed on this 10 km stretch of road to restore circulation. Consultant studies are underway for a project estimated to cost between \$3 million and \$5 million. Options for alternative routing of the road are being reviewed with a view to providing improved flood resistance in the future.
- EN 1 – Baixa de Chicumbane. This 20 km section of road is still partially under water. As a consequence, emergency repairs have not yet started, excepting for the construction of a temporary bridge. Engineering consultants have been selected to design a project estimated to cost between \$8 million and \$12 million. Options for alternative routing of the road are also being reviewed for this sub-project.
- EN 1 – Provincia de Inhambane: Before the floods started, engineering studies for this already deteriorated road section had been prepared and a contractor selected. Pre-flood cost estimates totaled \$ million, but the cost is likely to have increased substantially as a result of the flood. It is planned to retain the pre-selected contractor and renegotiate the contract on the basis of modified designs and quantities. The financing package may also require modification.

- EN 1 – Provincia de Sofala: This stretch of road is located between the Save river and Muxungo. competitive tender was in the final stages of preparation for financing when the road was flooded. At present, it is intended to proceed with the bidding process, but modify the designs and quantities as needed, provided the financing package can be adjusted.
- Others: Studies are currently under preparation for rehabilitation projects in Manica province (District of Mussurize) and in Sofala province (EN 1 – Machanga)

*Rehabilitation of Tertiary Roads:* Tertiary roads have also suffered widespread damage and will cost about \$1 million to reconstruct to improved standards, including adequate drainage. This is a very important component of the overall response in the road sector as it is essential to reconnecting rural communities to the domestic economy. In the past, these works were carried out exclusively with intensive labor, but in order to accelerate implementation in this emergency context, some equipment will now be used as well.

*Rehabilitation of Municipal Roads:* ANE has made very preliminary estimates of damages to the roads in Maputo, Matola, Xai Xai and Chokwe. These total about \$15.2 million.

**Table 14: Damages to the Road Network (US\$ million)**

	<b>Direct costs</b>	<b>Reconstruction*</b>
<b>Primary and secondary roads</b>	22.7	39.8
<b>Tertiary roads</b>	9.1	16.0
<b>Maputo streets</b>	6.5	13.4
<b>Matola streets</b>	5.1	10.5
<b>Xai Xai streets</b>	2.1	4.3
<b>Chokwe streets</b>	1.5	3.2
<b>Total</b>	47.0	87.2

Source: ANE and World Bank estimates. \* The weighted average of reconstruction costs is 1.6 times direct costs, assuming a 50 percent reduction in loss exposure for drainage and major structures.

To assess damages and calculate cost estimates, on-site assessments have been, and continue to be, made by engineering consultants and Government officials. Direct costs have been estimated on the basis of costs actually incurred for recently completed work of similar standard. Reconstruction costs were calculated to a weighted average of 1.59 times direct costs (with a range from 1.34 to 2.25, depending on the section of road estimated) these costs assume that design profiles will need to be altered both to bear higher levels of traffic for a growing economy and to provide greater resistance to flood damage. In particular, it was assumed that flood loss exposure for the improved designs would be reduced by 50 percent, with profiles for minor drainage adjusted to accommodate a 1-in-20 year flood and profiles for major structures (e.g. bridges) adjusted to accommodate a 1-

in-40 year flood. Finally, indirect costs were calculated using available data on vehicle circulation and the economic value of road passage (in time, vehicle operation, and operational benefit costs) per vehicle and per kilometer.

**Government Strategy:** The Government will postpone less urgent work planned for 2000 to undertake immediate repairs to trunk roads as well as high-priority tertiary roads (e.g. those providing access to large populations, accommodation centers, and critical services). In the emergency repair phase (expected to last one to two months), ANE will complete minimal work required to ensure the secure passage of vehicles. On trunk roads, this will include grading, rebuilding road-bearing dykes, and constructing temporary bridges over newl (re)opened river channels on the Limpopo flood plain. Less important secondary and tertiary roads be repaired in two to four months. For the remainder of 2000 and 2001, rehabilitation will aim to return damaged roads to appropriate design profiles, with reinstalled drainage. Although it is unlikely that wholesale resiting of trunk roads on the flood plains will be economically efficient, as any road across the flood plain involves risk o similar order of magnitude, reconstruction to an improved standard on original sitings is likely to be desirable.

## RAILWAYS

Within CFM, water damage was limited to CFM-S. Damage was very severe along the Limpopo line linking Maputo with Zimbabwe. It runs directly through the flood areas of the Limpopo, and as of March 23 parts of th line were still not accessible. There has been substantial destruction of bridges, culverts and railbeds, though in many places, rails and sleepers are not only intact, but remain connected, albeit sometimes suspended in the air. The main damage was caused on sections of the railbed, which were washed away, rather than on bridges an other concrete structures; but one major bridge at Aldeia da Barragem was partially destroyed. The impact on th Goba and Ressano Garcia lines was small and localized. Points requiring repair were easily reached and traffic was restored quickly. Additional works are required to bring these lines back to the pre-flood standard. The Maputo port suffered slight damage to a few short rail line sections. In Beira port (an area otherwise little affected), flooding caused considerable destruction in the fishing harbor.

CFM has carried out a preliminary assessment of necessary repair works. Immediate works to restore limited rail service will cost about \$7.3 million. Work on the Goba and Ressano Garcia lines (\$400,000) was starte immediately and is continuing. Work on the Limpopo line (\$6.9 million) has not yet started as the line remains inaccessible. This work will also require external financing, as CFM does not have the necessary resources, and it is expected to take four to six months. Current estimates for full reconstruction of the line (totalling \$27 million are very preliminary as they are based on average figures for reconstruction elsewhere and not supported by sit visits or engineering studies. The estimate includes provision for measures to prevent similar damage from future flooding.

**Table 15: Direct Losses to Railways**

	Repair	Reconstruction
<b>Goba</b>	0.1	1.8

<b>Ressano Garcia</b>	0.3	3.8
<b>Limpopo</b>	6.9	43.6
<b>Total Damag</b>	<b>7.3</b>	<b>49.2</b>
<i>Source: CFM and World Bank estimates.</i>		

As a result of flood damage, CFM has foregone revenues on various rail lines and in Maputo port, to the extent that affected train traffic would have carried transit goods for Swaziland and Zimbabwe or Mozambican exports and imports. For the Limpopo line, these losses may reach \$3 million (virtually all foreign exchange earnings) assuming that emergency repairs take three months to prepare and a further three months to implement. On the Goba and Ressano Garcia line, losses are estimated to total about \$1 million with only one month of traffic interruption overall. In addition, Maputo port will suffer revenues losses estimated to total about \$6.7 million (see Table 16). The Limpopo estimates in particular must be viewed with caution, as they depend on untried assumptions regarding the speed of emergency repairs and the ability of the concessionaire (scheduled to assume management responsibilities around mid-2000) to complete rehabilitation work and increase traffic volumes.

<b>Table 16: Indirect Losses to CFM (US\$ m)</b>	
	<b>2000</b>
<b>Goba Line</b>	0.3
<b>Ressano Garcia Line</b>	0.7
<b>Limpopo Line</b>	3.0
<b>Maputo Port</b>	6.7
<b>Total</b>	10.7
<i>Source: CFM and World Bank estimates.</i>	

The financial effects on CFM have an indirect impact on the Government's budget. If CFM had to finance emergency repairs, rehabilitation and income loss out of its own resources, they would not be available for later transfer to the Government or for covering CFM's obligation under the retrenchment program (which would thus become an additional obligation for the Government). This implies either foregone budget revenue or additional budget expenditure. The Government will also lose revenues raised from taxes and levies on domestic exports and imports to the extent that closure of the rail lines reduces traffic.

**Government Strategy:** The Government has already started work on restoring traffic to the Goba and Rissan Garcia lines. It also aims to complete emergency repairs to the Limpopo line to permit the resumption of limited

and low-speed train traffic between the port of Maputo and Zimbabwe as soon as possible. This minimal level of service will be restored in four to six months. Full rehabilitation of the line will occur later, with works dependent on site visits, risk assessments, engineering and designs, as well as resolution of outstanding issues regarding the planned concession of the line to a private operator. Government negotiations with the concessionaire, which were near completion when the floods occurred, are not expected to be substantially affected if the emergency repairs can be carried out within the planned time frame.

## THE PRIVATE SECTOR

Since 1995, almost \$3.6 billion in projects has been approved by the Investment Promotion Center. Of this, about 15 percent (or \$540 million) is in the affected areas (Gaza, Inhambane, Manica, and Sofala). Flood damage to commercial interests in the private sector in these provinces come in several forms:

- Loss and damage to the physical assets and inventory associated with the enterprise;
- Loss of production or sales due to damaged public infrastructure (including in particular power outages and transportation failures); and
- Loss of employment due to loss of production or sales

These have also affected Mozambique's balance of payments, as export volumes have decreased and import needs increased (both to substitute for reduced domestic production and to provide inputs to the reconstruction effort). The precise extent of damages will not be known for several months, when detailed surveys (to be undertaken by the Government with support from UNIDO and USAID) near completion. The following estimates are at best indicative.

The private sector, as the engine of growth, requires special support from Government and donors so that it can attempt to revitalize itself in an effort to return to economic levels prior to the floods. People have lost not only their homes but also their livelihoods and, until productive activities can be resumed, these people will be dependent on external assistance. Increased rates of unemployment have been a secondary effect. Even small enterprises may affect the lives of hundreds. For example, the fish processing plant in Xai Xai indirectly supports several hundred fishermen and the inundated banana plantation affects several thousand banana peddlers who have lost the source of their product. These secondary effects are very difficult to quantify, but they cannot be ignored. Without some form of intervention, (e.g. in the form of direct matching grants or subsidized credit), small and medium enterprises may be unable to recoup the losses to agricultural crops, animals and equipment. This in turn may increase social pressure in Maputo city, as more and more people immigrate from the rural areas seeking work, increasing demands on the city's infrastructure, and possibly resorting to crime to support themselves.

**Tourism:** Lost revenues in tourism are expected to be substantial, adversely affecting Mozambique's foreign exchange position. Although Maputo and the affected areas have received large numbers of foreign visitors as a result of the disaster, partially offsetting lost tourism revenues, tourist destinations in the country as a whole are likely to have significantly reduced bookings for the usually busy Easter season. This is true for several reasons. First, tourist facilities in lower Xai Xai (hotels, pensions, and restaurants) are not serviceable. Second, road transportation around the flood-affected areas is often difficult or impossible, discouraging visitors. Third, and most importantly, international tourists may be reluctant to holiday in a country which has just undergone a

globally televised disaster that (*inter alia*) may result in higher levels of contagious disease. Total losses to the tourist industry are estimated at approximately \$2 million in damaged infrastructure and \$10.5 million in lost revenues (principally due to cancellations). Spin-off effects, in revenue losses to businesses that service the tourist industry, will also be considerable.

**Fisheries:** In Inhambane and Beira, the fishing industry was adversely affected by Cyclone Eline. According to the Ministry of Fisheries, preliminary estimates indicate that businesses in the industry have reported almost \$1 million in lost production and physical losses (boats, warehouses, and processing plant) as a result of the disaster. For example, PESCAMAR and Companhia das Pescas da Zambezia, the two largest fishing companies, reported combined losses totaling about \$5 million in assets and \$2.5 million in lost production. In addition PESTAI lost about \$3 million in assets and \$2.1 million in revenue. The remaining companies lost about US\$1 million. Most materials for rebuilding assets will need to be imported. They will also result in reduced revenues for the shrimp industry, which is Mozambique's largest foreign exchange earner, and have a large secondary impact on employment. For example, a small company on the Sabe River suffered no loss to its fishing fleet, but did lose a warehouse including a freezer containing about four tons of fish, with a total value of about \$100,000. Informal commercial relationships with about 300 fishermen who obtained nets and equipment from the company and sold their catch to the company will be adversely affected.

**Banking:** The banking sector has also been impacted, both in loss of equipment and in potential for increased portfolio losses. For example, Credicoop has lost its branch at Sabie and anticipates portfolio losses due to farmers unable to repay loans, and Standard Totta, which has offices in Xai Xai, has had to transfer its operations to a temporary location, work manually, improve security, and reduce their cash amounts. BIM is facing similar problems, as their installations in Xai Xai and Chokwe were submerged under water. BoM is currently working with the banks to determine the extent of loss to equipment and portfolio. It is estimated that credit at risk by the SME's total about \$15 million. This sector, prior to the disaster, already experienced difficulty accessing credit and this event will hamper it even further.

**Construction:** The construction industry has suffered immediate losses, which will be largely offset by medium- and long-term gains. On the one hand, ongoing construction in flood- and storm-affected areas has suffered some losses. For example, flood-contaminated sand deposits have impeded the ability of the designated cement provider to provide construction firms working on N4 installations with concrete; as a result, firms have been idle. On the other hand, the extensive work required to restore damaged infrastructure to previous or improved design profiles over the next 12 to 18 months will result in an extended construction boom, increasing employment within the industry.

**Trade and Industry:** Mozambique's industrial sector is concentrated in Matola and Maputo. Disaster-related losses are estimated to exceed \$10 million, with Coca-Cola reporting losses of almost \$2 million and Cervejas 2M reporting \$500,000 (due principally to transportation bottlenecks). Losses in Xai Xai and Chokwe will be smaller in monetary terms, though large as a proportion of the regional economy. Traders in the Matola, Xai Xai and Chokwe areas also suffered large relative losses, chiefly as a result of destruction to inventory. Assuming that about 350 traders lost an average of \$30,000 in inventory—either to flood damages or to the theft which followed—total losses exceed \$10 million. USAID is supporting a more detailed survey and assessment, to be completed by the NGO Technoserv. Companies such as ULC, the leasing company, have experienced high revenue losses due to the inability of their transport vehicles to move freely around the country.

**Agroprocessing Industries:** Agriculture has been adversely affected, particularly in Chokwe, and Chibuto, with spill-over effects on agro-industry

Sugar. Excepting the Marrromeu company in Sofala, all operational sugar companies in Mozambique have experienced losses as a result of the floods. The newest sugar plantations, at Maragra (a \$45 million investment) on the mouth of the Incomati river, were affected the most. Just about to enter production (projected at 30,000 tons in 2000 and 60,000 tons in 2001), the crop was completely destroyed by the flooding. Equipment and installations (dikes and roads) were also damaged. It is believed that the plant has lost the sugar cane crop for both 2000 and 2001 and possibly longer. Assuming that all 90,000 tons of projected production would have been realized, this represents a loss of \$18.0 million (using the world price of about \$200 per ton) and \$36.9 million (using the guaranteed domestic price of \$410 per ton). For purposes of this document, the lower \$18 million is used as the estimated indirect cost to Maragra. An indirect effect is the loss of approximately 2,000 jobs which would otherwise have been filled in the processing plant. Combining Malagra's losses with losses at Xinavane in the south and Buzi in the center (which are estimated to have lost approximately 10 percent of their production), sugar cane production is expected to fall from 82,000 tons projected for 2000 to about 49,000 tons.

Cotton and Cashews. As the agricultural season for these crops had not yet started, and neither crop is grown in large quantities in the flood-affected areas, losses are expected to be negligible.

Other industries that have been severely affected include a regional banana plantation. About 300 hectares were flooded, just as the company was about to re-enter the international market. This will be a major setback. The poultry industry also suffered losses. Thousands of chickens, as well as infrastructure and equipment for breeding and feeding, were lost, sharply reducing the poultry take-off totals in the region. The entire loss is estimated at about \$1 million. Other industries including fully submerged rice-processing and tomato-processing plants in Chokwe, have lost large quantities of equipment. Finally, LOMACO, a cotton producer, lost some physical assets estimated to value about \$1 million.

According to GAPI, there are approximately 98 small- and medium-sized enterprises located in Maputo and Gaza, of which 56 are in agriculture, 26 are agro-processors, and 16 are in construction and other small scale industries. The majority of these companies have suffered losses, and have minimal or no insurance. These losses have been valued at \$10 million in total, or approximately \$100,000 per enterprise.

**Government strategy:** In this emergency period, the Government and the international community have focused on minimizing the results of the disaster and ensuring that sufficient food, water, essential drugs, and shelter are available to persons displaced by the floods. Only in the last few weeks, as this process has been brought under control, has the Government started to consider what the private sector needs to realize its economic recovery. This is a complex matter, not least because there is more than one private sector that has been affected by the floods. First and foremost, there are thousands of subsistence farmers who will require life-supporting services at least until the next harvest. Second, there are various traders, ranging from electronics dealers in downtown Xai Xai to small shopkeepers operating in isolated villages, who have lost significant quantities of inventory; many without having insurance. Finally, there are the large businesses, including multinationals such as Coca-Cola, which have lost considerable assets in monetary terms, but which also have insurance coverage that will enable

them to recover from the disaster with minimal financial losses. The process of determining what the rural farmer and small goods trader require to resume economic activity, and how this requirement can best be satisfied, is just beginning, with the Government meeting with the private sector and the international community, including donors and NGOs, to develop a strategy. Discussion of these issues is still highly preliminary, and it has included the possibility of establishing some kind of fund providing small-scale businesses with matching grants or subsidized credit.

## **ENVIRONMENT**

As rainfall continues and rivers still run at high levels, it has been impossible to carry out a detailed environmental assessment of the disaster. It is possible that damage occurring in some areas (e.g. in gullying and other forms of land erosion) has been offset by gains realized in others (e.g. in fertile alluvial deposits on the flood plains), but precise estimates of these tradeoffs are difficult in this early post-flood period. Moreover, overall estimates of environmental consequences may conceal large local discrepancies. For example, upstream communities may have suffered soil losses which downstream communities subsequently gained. These issues will require further study, in the context of international work on land and water resource management in southern Africa

In this document, the \$2 million direct cost to the environment includes only the (very roughly estimated) cost of locating and removing landmines that have migrated as a result of the flooding. These migrated and unmapped landmines may now endanger life and impede reconstruction of infrastructure (including roads, bridges and railways).

## **DISASTER PREVENTION AND PREPAREDNESS**

**Hazard Risks:** Mozambique has a high degree of exposure to hydro-meteorological hazards. From 1965 to 1998, twelve major floods, nine major droughts, and four major disasters from typhoon landfalls have occurred. Many of these events were associated with outbreaks of cholera and diarrheal diseases. Floods in 1971 and 1977 were comparable to the floods this year, resulting in 300 to 500 deaths and affecting half a million people each. Droughts have been even more devastating, by several orders of magnitude. Drought and famine in 1980, 1983, 1985 and 1992, exacerbated by ongoing warfare and political-economic instability, resulted in 100,000 deaths and affected over 17 million people.

This combination of hazard exposure and historical vulnerability has created a situation in which, from 1965 to 1998, the annual average death toll due to droughts, floods, typhoons and epidemics was 3,300 people, with an annual average of nearly one million people affected. Two sets of risk factors contribute to these high historical averages. One relates to Mozambique's ability to anticipate and effectively manage environmental relationships affecting life, property and economic activity. The other is a function of Mozambique's physical geography.

Mozambique's geographical location and physical characteristics combine to generate nearly annual hydro-meteorological hazard events of sufficient magnitude to threaten human health and well-being. First, as Mozambique is located between approximately 12 and 28 degrees south latitude, it experiences high coefficients

of inter-annual rainfall variation, caused in part by ocean temperature effects on atmospheric circulation patterns that generate rainfall. The association between drought disasters in southern Africa and El Niño/Southern Oscillation (ENSO) events is statistically significant, such that drought disasters in the region tend to occur during ENSO warm events and not during other years. Second, because Mozambique is located on the east side of the southern African sub-region, it is in the path of cyclones and typhoons generated annually in the Indian Ocean. Third, three major international river basins—the Limpopo, Save and Zambezi—as well as numerous smaller ones, drain eastward across Mozambique from South Africa, Zimbabwe, Zambia and Malawi into the Mozambique channel. Rainfall events and land and water management practices within the catchment areas of these river basins, which extend over Mozambique’s western neighbors, increase the country’s exposure to flooding. Fourth, tropical temperatures in Mozambique fuel cholera and malaria epidemics when health services are disrupted or (dis)favorable environmental conditions are created during hazard events. Finally, Mozambique’s climatic variability may be exacerbated in the future as a consequence of global warming caused by increase concentrations of carbon dioxide and other gases that trap heat in the atmosphere. Climate-change predictions related to these increases include, in order of decreasing certainty, average global temperature increases, a rise in sea levels, and an enhanced hydrologic cycle. Although the specific character of future regional climates cannot be reliably predicted, an enhanced hydrologic cycle would be experienced in Mozambique as an increase in the frequency of climatic extremes.

**Vulnerability Reduction** : Damage and losses sustained during the current floods expose the vulnerability of people, services, and infrastructure to flood events of similar or greater magnitude. Meteorological and hydrological observing systems essential for monitoring and forecasting hydro-meteorological hazards experienced were lost during the floods and will need to be replaced. In addition, existing flood protection embankments now require emergency repairs (see Table 17 for cost estimates).

**Table 17: Costs of Disaster Prevention and Preparedness**

	<b>Direc</b>	<b>Reconst.</b>
<b>Meteorological systems:</b>		
Instrumentation	0.12	0.12
Station infrastructure	0.10	0.20
Immediate enhancements		0.73
Medium-term enhancements		2.89
<b>Hydro-meteorological stations rehabilitation</b>	0.10	0.60
<b>Sub-total: Hazard monitoring and forecasting</b>	0.42	4.54

<b>Flood protectio</b>		
Existing embankments – emergency measures	2.00	10.00
Priority rehabilitation of affected dams and equipment	1.00	1.00
Structural integrity of dams – investigation		0.10
Feasibility study of Mapai Dam on Limpopo for flood control		0.50
Desk study for siting possible flood control dam on Save River		0.10
New flood protection measures (incl. dredging) – investigation		0.55
<b>Sub-total: Flood protectio</b>	3.00	12.25
<b>Enhanced disaster reduction capacity</b>		
Regional cooperation		0.60
Evacuation plans – preparation and dissemination		0.50
National-level sectoral plan preparation/coordination		1.00
Strengthened national-local coordination for high risk areas		0.50
<b>Sub-total: Enhanced disaster reduction capacity</b>		2.60
<b>Total</b>	3.42	19.39
<i>Source: World Bank estimates.</i>		

In light of Mozambique's geography and disaster history, future floods, typhoons and droughts are inevitable. Reconstruction provides an opportunity to evaluate hazard exposure, reassess or develop standards, and incorporate appropriate measures for reducing or transferring risks of future loss and damage. Reconstruction costs in Table 17 include replacement of lost infrastructure as well as enhancements to improve hazard monitoring, forecasting and early warning, flood protection and civil preparedness

**Government Strategy:** Mozambique's strategy for long-term disaster reduction is articulated in its national emergency management policy and draft national action plan. Prevention and preparedness are stressed and specific elements include involvement of civil society, sectorally integrated approaches, development of sector and hazard-specific disaster management plans, community-based approaches and civic education, promotion o

risk reduction incentives, institutional capacity building, and creation of financial reserves and materials in consideration of especially high-risk areas.

INGC was created by statute within the Ministry of Foreign Affairs and Cooperation. Thus, sound policy and statutory bases already exist for future institutional development in disaster prevention and preparedness, and there appears to be considerable international interest in providing support. In addition to items included under Table 17 for hazard monitoring, forecasting and early warning, additional items related to institutional strengthening are included, with the intention of supporting measures identified in the national disaster management policy and statutes and the draft national disaster management action plan. Additional consultation with the Government of Mozambique and international donors is needed to identify next steps and implementation requirements. The Bank is prepared to assist with these efforts as needed.