

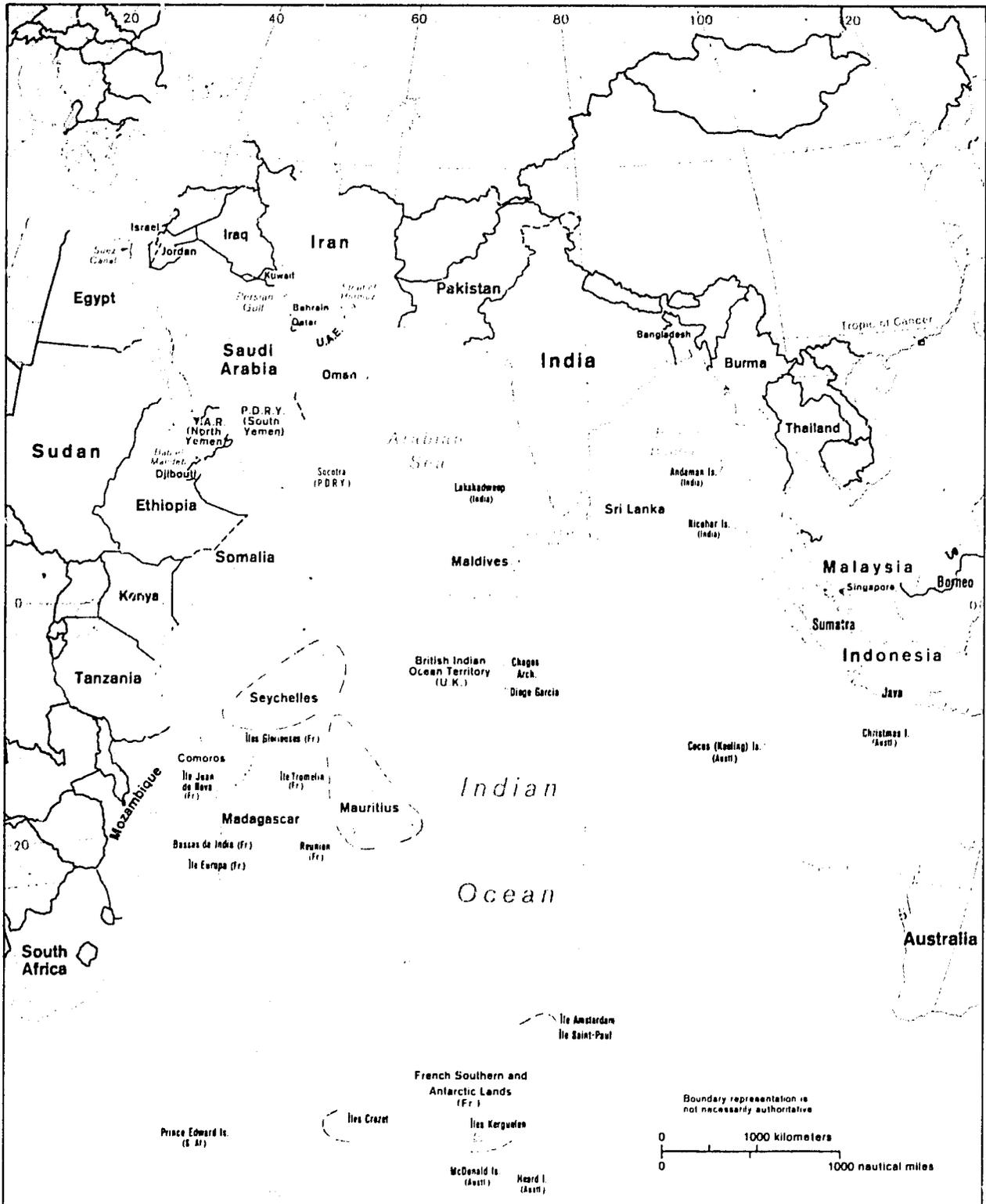
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# **Island Countries of the Indian Ocean**

## **A Regional Profile**

**Office of Foreign Disaster Assistance  
Agency for International Development  
Washington, D.C. 20523**

# Indian Ocean Area



ISLANDS OF THE INDIAN OCEAN: A REGIONAL PROFILE

prepared for

The Office of U.S. Foreign Disaster Assistance  
Agency for International Development  
Department of State  
Washington, D.C. 20523

by

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Evaluation Technologies, Inc.  
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The regional profile of the Indian Ocean is part of a series designed to provide baseline country data in support of the planning and relief operations of the Office of U.S. Foreign Disaster Assistance (OFDA). Content, scope, and sources have evolved over the course of the last several years; the relatively narrow focus is intentional. To avoid redundancy, some topics one might expect to find in a "country profile" are not covered here.

We hope that the information provided will also be useful to others in the disaster assistance and development communities. Every effort is made to obtain current, reliable data; unfortunately it is not possible to issue updates as fast as changes would warrant. A cautionary note, therefore, to the reader: statistics are indicators at best, and if names and numbers matter, the bibliography will point to a current source.

We invite your comments and corrections. Address these and other queries to OFDA, A.I.D., as given above.

November 1984

OFDA COUNTRY PROFILES: NOVEMBER 1984

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INDIAN OCEAN

Island Countries of the  
Indian Ocean  
The Comoros  
Madagascar  
Maldives  
Mauritius  
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Seychelles

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### Islands of the Indian Ocean

The islands off the coast of East Africa in the Indian Ocean consist of nations which are a unique blend of African, Arab, and Asian peoples and history. Some have been shaped by more than a thousand years of history while others were uninhabited until the era of European colonialism and expansionism. During this period, many of these islands were very important trading posts and refueling stops. However, after the Suez Canal was completed in 1869, eliminating the necessity of going around the Cape of Good Hope to get to the Far East, most of the islands reverted to being on the periphery of world affairs.

The Indian Ocean is smaller than the Atlantic and considerably smaller than the Pacific, but it still encompasses 14% of the world's surface and has a total area of close to 73.4 million sq. km. Though its exact boundaries are arguable, it stretches from East Africa to Tasmania and from Southern Asia to Antarctica. Its greatest depth is 7,730 m, off the island of Java.

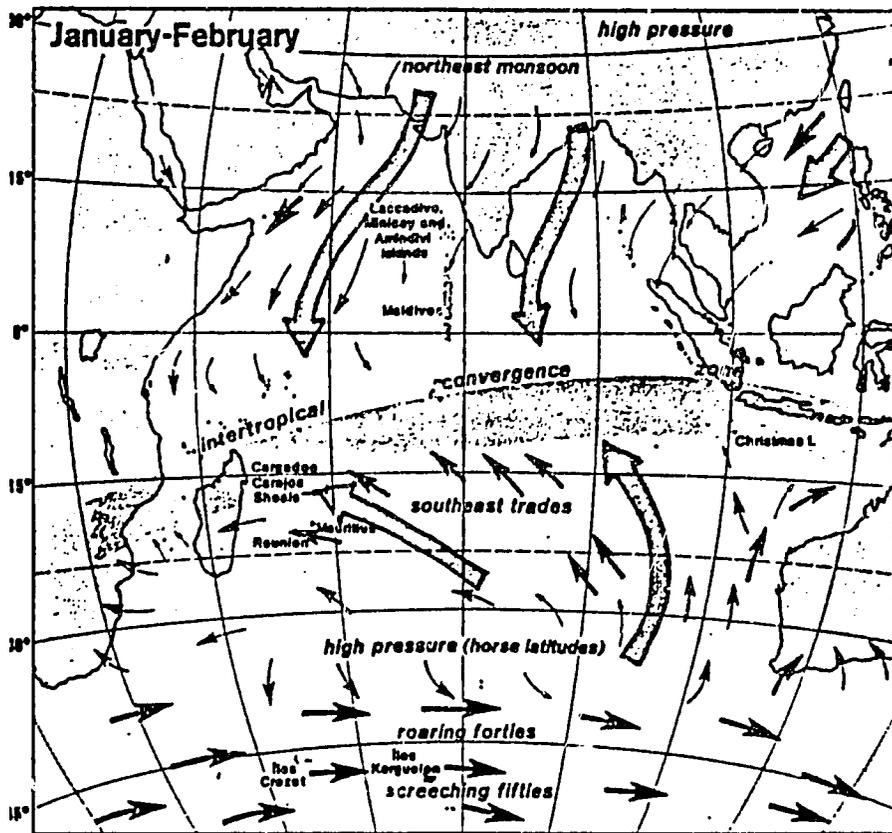
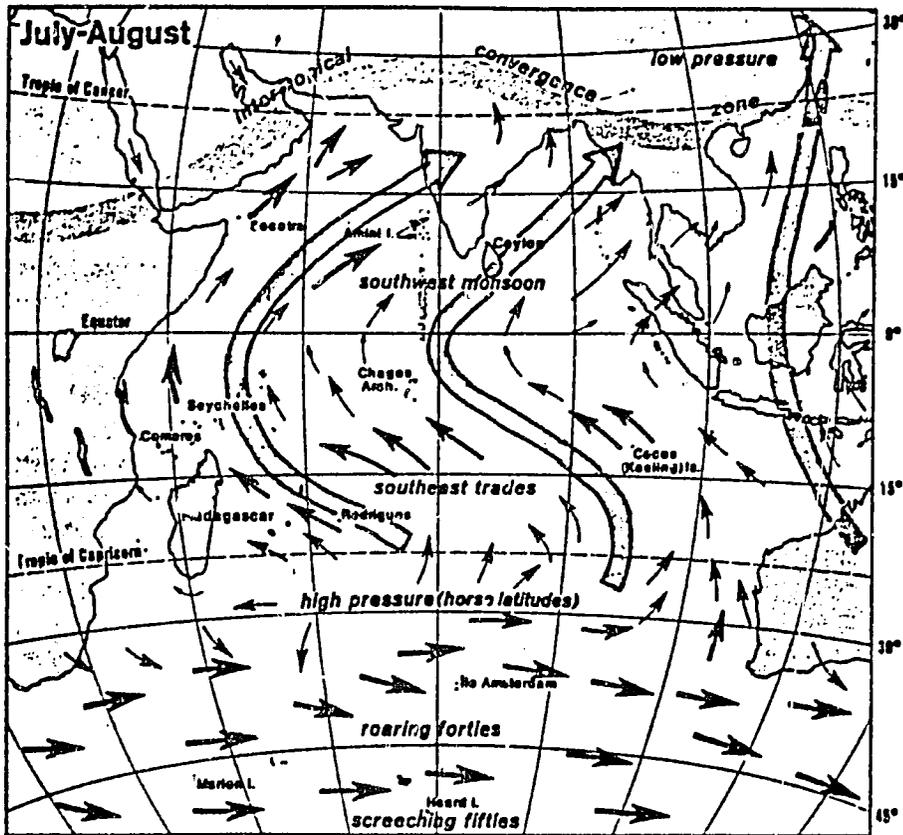
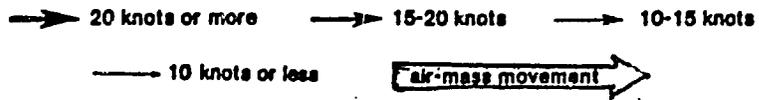
### Land Forms

Millions of years ago in the Mesozoic age, according to the theory of continental drift, there was a vast landmass in the southern hemisphere which has been named Gondwanaland. Africa, South America, India, and Australia were all part of this continent. When Gondwanaland broke apart, Madagascar, which has strong geological links with East Africa, and part of the Seychelles became separated from the larger landmasses. Much of eastern and central Madagascar is formed from a granitic shield, which is thought to be over three billion years old. The northern islands of the Seychelles are also granitic.

Many of the other islands in the Indian Ocean were formed differently. Mauritius, Rodrigues, and Reunion, which make up the Mascarene Islands, were formed by undersea volcanic eruptions. The Maldives and the Chagos Archipelago originated from the accumulation of coral in shallow tropical water.

There is a chain of submerged ranges, called the Mid-Indian Ocean Ridge, which marks the juncture of three of the continental plates. At this point, the ocean floor is spreading around 10 cm per year. Molten rock frequently emerges along fissure lines and weak, shallow earthquakes are common along the Ridge. The most active area is along the Java Ridge where the Indian plate slides underneath the Eurasian plate.

# Seasonal windflow:



Source: C.I.A. Indian Ocean Atlas

### Climate

The climate in the countries of the Indian Ocean depends greatly on latitude and associated winds. The Indian Ocean reaches its northernmost point in the Arabian Sea on the shores of Pakistan and Iran just north of the Tropic of Cancer at about 25°N. The ocean then stretches south past the Antarctic Circle to the frigid continent of Antarctica. There is very little land south of the 30°S parallel, in great contrast to the northern hemisphere. Therefore, there is nothing to break the impact of the westerly winds in that region and they are often referred to as the "roaring forties" and "screeching fifties". The few islands in the southern Indian Ocean, such as Heard Island, Ile Amsterdam, Iles Kerguelen, and Prince Edward Islands, have very cold and inhospitable climates, and few if any inhabitants.

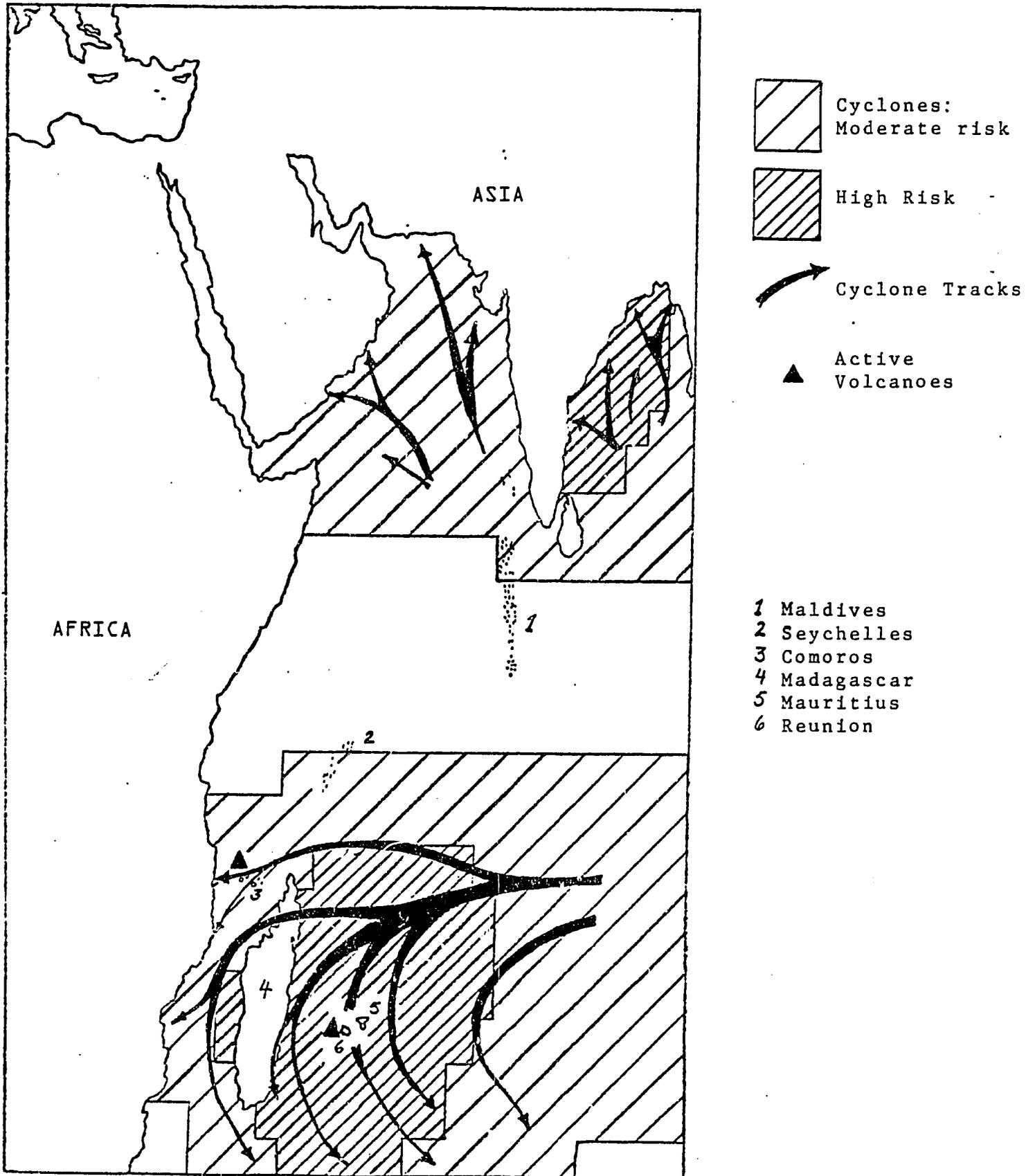
The area centered about 35° (in January) and 30°S (in July), known as the horse latitudes, is characterized by warm dry air and high pressure, resulting in mild, fair weather and light variable winds year-round. However, there is no land in these latitudes to take advantage of this pleasant weather.

The next climatic zone is the doldrum belt, or the intertropical convergence zone (ICZ), a somewhat ill-defined area of calm winds, ascending air, and low pressure. This zone shifts latitudinally with the sun and is most distinct from December through February or March when it is centered about 10°S in the eastern part of the ocean and between 15°S and 20°S in the west (see map). January is often a month of heavy rain due to the convergence in the doldrums of the northeast monsoon air current and the southeast trade winds, which bring moist and unstable air. It is near the ICZ that weather disturbances grow into tropical storms which threaten Madagascar, the Mascarene Islands, and the southeast coast of Africa.

When the ICZ shifts to the north from May to September, the southeast trade winds become dominant between 30°S and the equator. These are steady winds at about 10 to 15 knots and they bring mild weather with partly cloudy skies. The trades bring about 75 mm of rainfall to Reunion in July and 70 mm to Rodrigues.

North of the equator, the major climatic influence is the monsoon system. The Arabian Sea and the Bay of Bengal are strongly affected by this system. The northeast monsoon originates in Asia and it is very dry from November to March while it passes over India and Pakistan and the Arabian Sea. However, it picks up moisture across the Bay of Bengal and brings substantial precipitation to northeastern Sri Lanka in November and December. The southwest monsoon, on the other hand, starts in the Indian Ocean at the equator and travels over water for great distances beginning in May or June. It brings more than 360 mm of rain to the windward slopes of Sri Lanka in June. Daytime temperatures at low elevations in the monsoon region are usually in the low 30s (°C) while nighttime temperatures range from 24°C to 27°C. The southwest monsoon usually lasts through September.

# NATURAL HAZARDS IN THE INDIAN OCEAN



Source: UNCTAD. The Incidence of Natural Disasters in Island Developing Countries 1983.

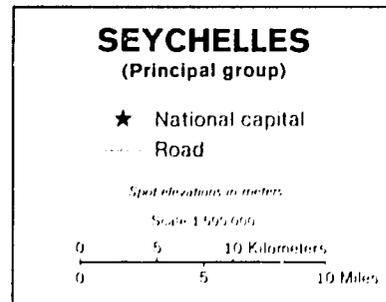
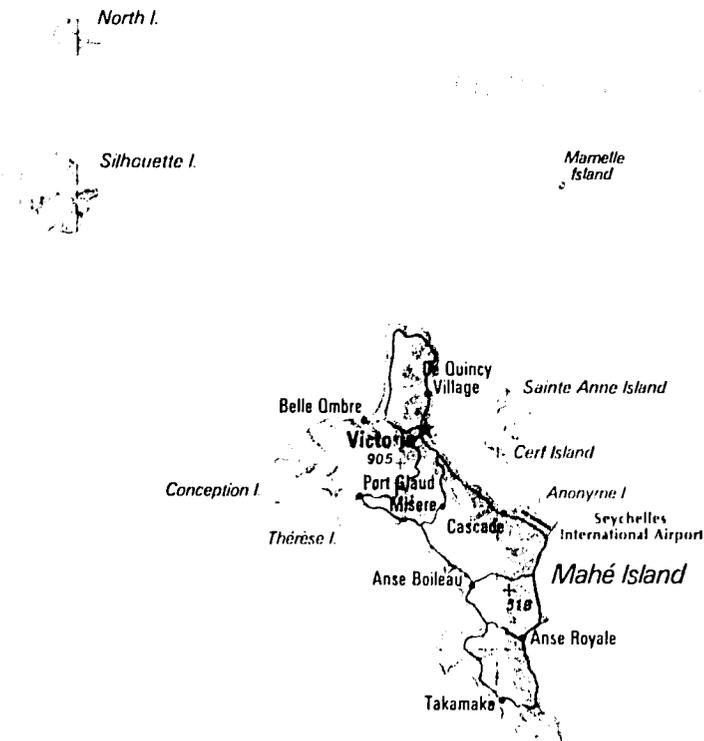
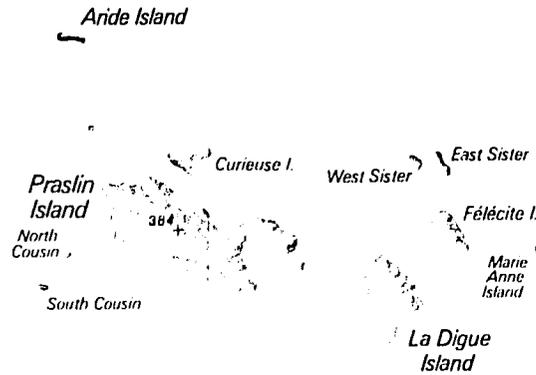
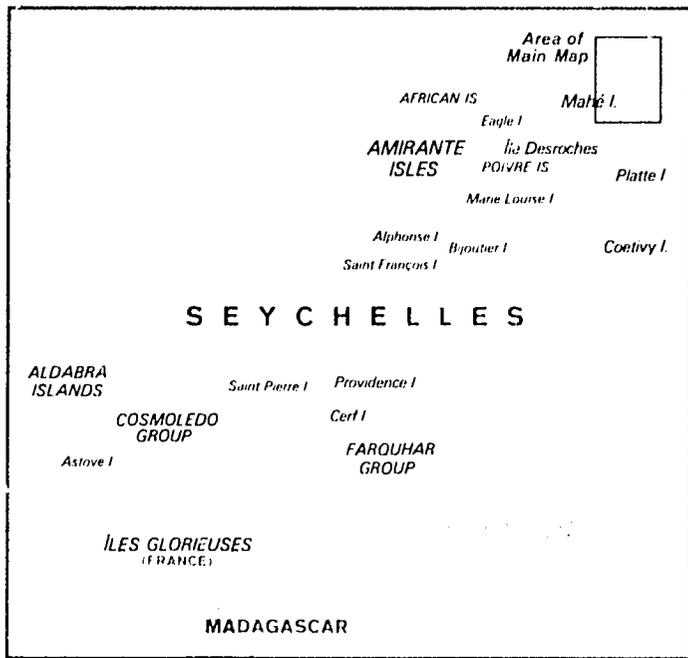
### Cyclones

There are two principal areas where tropical cyclones originate. The first is in the Bay of Bengal where cyclones tend to start before and after the southwest monsoon as the ICZ migrates through the area. Typically, about five tropical storms (wind speeds of 34 to 63 knots) originate in the Bay of Bengal per year, one or two of which mature into cyclones (wind speeds greater than 63 knots). These storms are particularly dangerous when they touch land on the densely populated north coast of the Bay. Flooding from the torrential rains causes the most damage.

The second area which gives rise to cyclones is the central Indian Ocean east of Madagascar. These storms generally move toward the southwest and then later change course to the south and southeast. About eleven tropical storms a year form in this area, with about four developing into cyclones. The map on page 4 shows that Mauritius, Reunion, and the east coast of Madagascar are in a high risk cyclone area while the Comoro Islands and the west coast of Madagascar are in a moderate risk area. Most of the islands of the Seychelles and Maldives are rarely threatened by the tropical storms.

### Nations of the Indian Ocean

This regional profile concentrates on the three most disaster prone island nations: Madagascar, the Comoro Islands, and Mauritius. In this overview, three other countries will be given a less thorough discussion: the Seychelles, the Maldives, and Reunion. Many of the remaining islands, such as the Chagos Archipelago and those in the inhospitable southern Indian Ocean, are largely uninhabited.



SeychellesGeographic Codes

AID Standard                    662  
AID Region                    AID/AFR/SWA  
State Region                    AF/E

Host Mission in the U.S.

c/o Permanent Mission of Seychelles to the  
  United Nations  
820 Second Avenue, Suite 203  
New York, NY 10017  
(212) 687-9766

U.S. Mission in Seychelles

Box 148  
Victoria  
Tel: 23921 or 23922  
APO NY 09030

Time Zones

GMT+4; EST+9

Currency

The Seychelles rupee (SR) is currently pegged to the International Monetary Fund's special drawing right (SDR). In 1981, the government revalued the currency to SDR 1 = SR 7.23. In October 1984, US \$1 equaled SR 7.05.

Travel and Visa Requirements

A valid passport is required. No visa is necessary.

Geography

The Seychelles archipelago consists of about 115 islands scattered in the western Indian Ocean. With a total land area of 444 sq. km, it is one of the world's smallest nations. About forty of the islands are granitic, peaks of the Mascarene Plateau. These islands generally have sharply rising rocky hills and mountains with narrow coastal plains. Almost the entire population (99%) lives on these islands, the principal one of which is Mahe. The Seychelles' capital and only city, Victoria, is located on Mahe, where there is also an excellent port. The Seychelles is about 920 km northeast of Madagascar, 1,700 km north of Mauritius, 1,600 km east of Mombasa, and 2,800 km southwest of Bombay.

The seventy other islands are coralline and very flat, rising only about a meter above sea level. Most are uninhabited. Ile aux Vaches, Ile Denis, the Amirantes Group, Ile Plate, and Coetivy Island have extensive coconut plantations, while some of the other coralline islands are important breeding grounds for turtles and birds.

The climate of the Seychelles is tropical with little seasonal variation. Temperatures on Mahe are almost always between 27° and 32°C. The mean annual rainfall on Mahe is 230 cm at sea level, though some of the southernmost coral islands only receive an average of 50 cm per year. The high humidity of the archipelago is moderated by prevailing winds.

### Ethnic Groups

The people of the Seychelles are relatively homogeneous, being a mix of European and African descent. The Asian population, consisting of Indians and Chinese, is relatively small compared to most Indian Ocean islands, and only the Indians have resisted inter-marriage. Traditionally, the upper class were white plantation owners, and light skin still carries status. However, virtually all Seychellois are too mixed to be classified.

### Language

The mother tongue of more than 90% of the population is Creole, which comes from dialects of southwestern France spoken by the original settlers of the Seychelles. It has a mostly French vocabulary with a few Malagasy, Bantu, English, and Hindi words, and a mixture of French and Bantu syntaxes. In 1982, Creole was designated as the first language of the nation, with English second and French third.

### Religion

More than 90% of the population is Roman Catholic. About 8% is Protestant (mostly Anglican) with the remaining 2% Hindu, Moslem, or Buddhist.

### Historical Background

The first recorded landings in the Seychelles were made by the British in 1609; however, more than a century later, in 1756, the French claimed the islands. Settlement in the Seychelles began on Mahe in 1778 with French expatriates from Mauritius, Reunion, and India who brought along their African slaves. Until 1838, when slavery was abolished, the majority of the population were slaves who worked on plantations producing cotton, coconut oil, spices, coffee, and sugarcane. After 1838, these labor-intensive crops gave way to cash crops such as coconut oil, copra, cinnamon, and vanilla.

The British first threatened French control in 1794 and possession alternated between the two until 1810 when French forces surrendered to the British. For many years, the Seychelles was an obscure colonial outpost administered as a dependency of Mauritius, but in 1903, it was made a British Crown Colony. The British began to permit Seychellois involvement in their own political affairs in 1948 when limited suffrage was granted.

### Recent Politics

In the early 1960s two parties were formed: the Seychelles Democratic Party (SDP), led by James Manchum, and the Seychelles People's United Party (SPUP), led by France Albert Rene. The SDP supported a capitalist system and continued association with Great Britain while the SPUP had a socialist orientation and wanted complete independence from Britain and the establishment of a non-aligned foreign policy. In the 1970s, independence became the dominant issue, with both parties supporting it. Britain granted the Seychelles internal self-government in 1975 and complete independence on July 29, 1976.

At the time of independence, Mancham was president and Rene was vice president as a result of a 1974 election in which the SDP had won under allegations of fraud. Less than a year after independence, in mid-1977, supporters of the SPUP overthrew the government in "the coup of sixty rifles" and installed Rene as president.

A new constitution went into effect in mid-1979 which established a one-party state. This party was designated the Seychelles People's Progressive Front (usually just called the Front) and it controls all political activity. The president of the country is nominated by the National Congress of the Front and stands for election unopposed. The president serves a five-year term and can serve for a maximum of three terms. There is also a 25-member popularly elected People's Assembly which considers bills submitted to it by the Front.

Though the rhetoric of the regime is sometimes radical, its policies have been pragmatic, and in its efforts to improve living standards it has continued to welcome tourists and has not restricted the flow of capital in and out of the country.

In foreign policy, the Seychelles government has shown a particular interest in the movement to turn the Indian Ocean into a Zone of Peace and to remove all foreign powers and bases in the area. It is strongly opposed to the U.S. base at Diego Garcia on the British Indian Ocean Territory. However, in 1981 it did renew for ten years an agreement regarding the U.S. satellite tracking station in the Seychelles (albeit at a much higher cost).

There have been three coup attempts since 1977, the most recent one in November 1981. Exiled leaders were implicated and the extent of possible opposition to the government at home is unknown.

### Population

Based on the 1977 official census, the estimated population in 1983 was approximately 68,000. Close to 40% of the population is under the age of 15 and the yearly population growth rate is 2.1%. Population density is 153/sq. km. The government is concerned about the high growth rate and promotes family planning despite the disapproval of the Roman Catholic Church.

About 85% of the population lives on Mahe and another 15% live on two nearby islands, Praslin and La Digue. About 23,000 people live in the capital city of Victoria.

### Economy

Basic economic indicators of the Seychelles are:

GDP (1980):	\$95 million
GNP per capita (1981):	\$1,800
Exports:	\$92 million
Imports:	\$122 million

Tourism is the mainstay of the Seychelles economy and the tourist industry and government account for the largest proportions of both employment and the GDP. Construction is next, followed by agriculture, and finally by a very small manufacturing sector. The Seychelles depends also on foreign capital to maintain economic development.

The principal export is copra (which is considered to be of high quality). Frozen fish, cinnamon, coconuts, guano, and re-exports (of tourist-related duty-free items and petroleum products) are also important.

The Seychelles is not self-sufficient in food production and the attainment of self-sufficiency is not likely. Rice is a staple of the diet; however, it cannot be grown on the islands nor can other cereals. Arable land is in short supply -- there are only about 900 hectares available on Mahe and a few hundred on other islands. The soil is generally not very fertile and does not hold water well.

### Health

The health status of the population of the Seychelles approaches that of a developed country. The islands are blessed with a favorable climate and an absence of tropical diseases (such as malaria and yellow fever). In addition, the quality of the health care is very good and is available free to those unable to pay. Life expectancy is 67 years and infant mortality is 17/1,000.

### Diet

The staple food is rice, which is usually eaten with lentils or vegetables and often fish. About 90% of the protein in the diet comes from fish. Fruits are plentiful.

### Transportation

An international airport was built on Mahe in 1971, ending the isolation of the Seychelles. The Seychelles International Airport has a permanent-surface runway between 2,500 and 3,700 m and there are direct flights to London via Nairobi. Air transport is provided by Air Mahe and Air Seychelles. In addition to the airport on Mahe, there is a usable airport on each of the islands of Bird, Praslin, and Astove.

Victoria has an excellent harbor with port facilities for international shipping. The port is protected by a chain of islands and coral reefs and is safe in all winds. Depending on the weather and the size of the ships, six ocean-going ships can be accommodated in the outer harbor simultaneously. Rentable warehousing is available. The port authority is: Director of Port and Marine Services, P.O. Box 47, Mahe, Seychelles. Tel: 22800, 22311, 22409, 22400, and 21231, Telex: 2329 TRATUR 57.

The Seychelles has a road network with a total of 215 km, 145 km of which is paved. The country also operates an inter-island ferry service which makes frequent trips to Praslin and La Digue. There are no railroads or inland waterways.

### Communications

The major radio station is the government-owned Radio Seychelles, which operates two medium-wave transmitters and broadcasts 60 hours per week in Creole, English, and French. The other radio station is operated by the Far East Broadcasting Association, a Protestant missionary group. FEBA Seychelles uses a 30 kw short-wave transmitter to broadcast in 12 languages on nine frequencies. In 1976, there were 17,000 radio receivers.

Mahe and a few other islands are connected by a national telephone service, and telecommunications facilities are highly developed. There is no television.

### Disaster Vulnerability

The Seychelles is fortunate in that almost none of the islands is in a cyclone risk area. Mahe was hit by a cyclone once in recorded history, in 1862. There is no seismic or volcanic activity in the Seychelles. And, as mentioned previously, the nation is not afflicted with debilitating tropical diseases nor is there a problem with malnutrition.

The most serious problem in the Seychelles is erosion. The early settlers felled almost all of the trees for shipbuilding, houses, and cinnamon kilns, leaving the thin soil unprotected. In some areas, highly flammable bracken has taken over where trees have been felled, and damaging fires have resulted.

The other problem which the Seychelles faces is possible water shortages. Because catchment provides most of the water, yearly variations in rainfall or a brief period of drought can cause significant shortages. Since 1969, small dams have been built on Mahe, but drought can still be a problem there, and even more on La Digne.

ReunionGeographic Codes

AID Standard                    604  
AID Region            AID/AFR/SWA  
State Region                    AF/E

Host Mission in the U.S.

Reunion is under the jurisdiction of the French Embassy at 2535 Belmont Rd. NW, Washington, D.C. 20008

U.S. Mission in Reunion

None

Time Zones

GMT+4; EST+9

Currency

Reunion uses French currency. In October 1984, US \$1.00 equaled 8.8 Francs.

Travel and Visa Requirements

Passport required. A visa is not required for a stay up to 3 months. Yellow fever certificate required of visitors one year of age and over arriving from infected areas. Smallpox certificate is also required of travellers from infected areas.

Geography

The French Department of Reunion is the westernmost of the Mascarene Islands, approximately 800 km east of Madagascar and 230 km west of Mauritius. The oval shaped island is 72 km long and 53 km wide and has a total land area of 2,512 km. The capital is Saint Denis.

Like the other Mascarene Islands, Reunion is of volcanic origin, with a mountainous interior surrounded by a narrow coastal plain. The highest peak is Le Piton des Neiges (Snowy Peak), about 3,000 meters high. In the southeast lies an active volcano, Piton de La Fournaise (Furnace Peak, 2,500 meters), which erupts on an average of once every two years. Several short, fast moving rivers flow from the central mountain ranges to the coast.

The climate is tropical, but the eastern, windward side receives heavy rainfall brought by the southeast trade winds, while the western, leeward side is much drier and crops must be irrigated. November through March are normally the hottest and wettest months of the year.

### Ethnic Groups

Reunion's population is an intermixture of European, African, and Asian peoples. The original French settlers imported farm laborers from East Africa, India, and Indochina and gradual miscegenation resulted in a primarily Creole population.

### Languages

French is the official and most prestigious language and is used in government and schools. However, Creole is spoken and understood by the entire population, regardless of ethnic origin.

### Religion

Approximately 94% of the population (including most Indians and Chinese) are Roman Catholic. Less than 1% of the population is Muslim, and non-Christian Chinese are generally Taoist or Buddhist. Folk beliefs in magic and spirits persist among much of the population.

### Historical Background

Reunion is believed to have been discovered by the Portuguese navigator, Pedro de Mascarenhas, around 1528. The island was first settled by the French, who came from Fort Dauphin on Madagascar. Originally called Ile de Bourbon, the island served as a stopover point for trading ships on their way to India. The island was renamed Reunion during the French Revolution. The French began to establish coffee, spice, and sugar plantations on the island, which necessitated the importation of slaves from East Africa. Between 1810 and 1814, the island was occupied by the British, who called it by its original name, Bourbon. In 1814, the island was returned to the French, who changed the name back to Reunion. During the last half of the 19th century, immigrants came from India, Africa, Indochina, and China, most to work as indentured laborers in the burgeoning sugarcane plantations. The colony was made an overseas department of France in 1947.

### Recent Politics

Reunion is governed by an appointed prefect and an elected general council of thirty-six members. As an overseas department of France, Reunion elects three deputies to the French National Assembly and two to the Senate. In 1974, amidst increasing debate over Reunion's departmental status, France created an indirectly elected Regional Council to coordinate the island's fiscal policies. Reunion serves as headquarters for the French Indian Ocean fleet and houses approximately 4,000 troops and

26 warships. The Prefect of Reunion also administers four tiny islets, each containing weather stations, airstrips, and wildlife sanctuaries. Of these tiny islets, Iles Glorieuses, Ile Juan de Nova, and Ile Europa in the Mozambique Channel are also claimed by Madagascar, and Ile Tromelin, due north of Reunion, is claimed by Mauritius. Despite a 1978 OAU resolution calling for the island's independence and a small left-wing separatist movement on Reunion, the population has repeatedly voted to stay within the French fold and seeks more French investment and welfare benefits.

### Population

According to the 1982 census, the population of Reunion is 515,814, with 109,072 inhabitants living in St. Denis. The average annual growth rate is only 1.5%, thanks largely to net emmigration and effective family planning programs. Due to high unemployment on the island, an average of 5,000 young people leave Reunion each year to find employment in France.

### Economy

Basic economic indicators of Reunion area:

GNP (1981):	\$2.5 billion
GNP per capita (1981):	\$3,830
Exports:	\$128 million
Imports:	\$871 million

Sugarcane grows on two-thirds of the arable land on the island (37,620 ha) and accounts for 83% of the exports. Attempts at agricultural diversification have been resisted by the large sugar plantation owners. Other exports include molasses, rum, vanilla, tea, tobacco, and perfume essences. However, agricultural exports account for only 12% of the GDP. Reunion's primary trading partner is France. Cultivation of fruits and vegetables, animal husbandry, and small-scale fishing also takes place on the island, but Reunion still must import most of its food.

Reunion's distance from world markets, its lack of natural resources, underdeveloped industry and tourism potential, and unskilled population have made it dependent on massive French subsidies. Unemployment in recent years has hovered between 25 and 30% and the inflation rate is also very high. Over 60% of the total labor force is employed in the civil service or "tertiary" sector. Despite the construction of several new hotels, Reunion does not attract as many tourists as Mauritius or the Seychelles. The high price of air fares is generally blamed for the lack of tourism. Reunion's almost total dependence on France is usually given as the major reason why the majority of Reunionnais still wish to remain part of the Republic.

### Health

Although malaria and yellow fever have been largely brought under control, parasitic diseases and malnutrition among young people remain serious health problems. Reunion has a poor health care system and many islanders still believe in magic remedies. In 1980, there were 43 hospitals and clinics on the island.

### Diet

Much of the island's supply of meat, rice, and other foods must be imported and few people can afford high protein foods. The dietary staple is rice, accompanied by curried lentils or vegetables. It is estimated that most of the population receives less than two-thirds of daily minimum calorie needs.

### Transportation

Reunion has a 2,745-km road network, which continues to be expanded into the neglected hill country. A national coastal highway encircles the island, linking most of the major towns, and another route crosses the island from north-east to south-west linking Saint Benoit and Saint Pierre. A 128-km railway between Saint Benoit and Saint Pierre is no longer in operation.

Reunion's principal port is at Pointe des Galets (20°55'S, 55°18'E), but it can only accommodate ships up to 170 meters, with draughts of 7.5 meters and tonnage of 12,000 tons. In an effort to increase trade, the Government has decided to open a second port at Possession, a few kilometers east of Pointe des Galets along the northwest coast.

Gillot Airport, near St. Denis, has a permanent-surface runway (2,440-3,659 m) and regularly handles international flights. There is another small airstrip at La Possession. Air France, Air Madagascar, and Air Mauritius fly into Gillot Airport. Reunion Air Service, a subsidiary of Air France, has a fleet of seven single-engine airplanes and has scheduled service to Mayotte and Comoros.

### Communications

The telecommunications system is described as adequate for the island's needs. In 1983, there were a total of 60,300 telephones on the island. France Region 3 (Place Sarda Garriga, 97405 Saint Denis) operates two AM and nine FM stations and two TV stations, which broadcast in French. There were an estimated 100,000 radio receivers and 77,000 TV sets in use in 1983. Reunion is served by the Indian Ocean satellite station and maintains radiocommunications with the Comoro Islands, France, Madagascar, and Mauritius.

Disaster Vulnerability

Reunion is afflicted with recurrent volcanic eruptions and tropical cyclones. The mountain range to the southeast of the central plateau is an area of active volcanoes. Piton de la Fournaise (2,500 meters) erupts on an average of once every two years. In periods of strong activity, outflows may cross the coastal highway and pour into the sea. Large eruptions took place in 1927, 1931, 1943, 1961, and 1975. The last significant eruption was in April 1977, near the town of Sainte-Rose. That eruption affected approximately 1,000 people, destroyed many houses and thousands of hectares of forests and crops.

Reunion also lies in the high risk tropical cyclone belt of the southwest Indian Ocean. These tropical cyclones, which vary in intensity from weak disturbances to storms of hurricane force, normally occur during the months of January through March. In January 1980, Cyclone Hyacinth crossed over the island and then doubled back over it again, destroying crops, road and communication networks, killing at least 20 people, and leaving 7,000 people homeless. Reunion's national disaster plan is based on Plan ORSEC (ORGanisation de SECours en cas de catastrophes), a disaster plan used by all French departments and territories.

MaldivesGeneral InformationGeographic Code

AID 320

Host Mission in U.S.

Maldives has no diplomatic representation in the U.S.

U.S. Mission in Maldives

The U.S. Ambassador to Sri Lanka is also accredited to Maldives.

Colombo (E), 44 Galle Rd., Colombo 3  
P.O. Box 106 Tel: 21520, 21532  
Telex 0803 21305 AMEMB CE

The U.S. Consular Agency in Male is located at  
Mahduedurage, Violet Magu  
Henveru, Male  
Tel: 2581 Telex: 66028

Time Zones

GMT+5; EST+10

Currency

The Maldivian rufiyaa (Rf) is the monetary unit. U.S. \$1.00 = Rf 7.00 (Jan. 1984).

Travel and Visa Requirements

Visas not required of U.S. citizens for stays up to 30 days. Cholera vaccination certificate required of travelers arriving from a country any part of which is infected; yellow fever certificate required of travelers arriving from infected areas.

Geography

The Maldivian archipelago, situated between 7°0'N and 0°45'S latitude and 72°31'E and 73°48'E longitude, comprises 19 atolls or clusters of small islands numbering about 1,200. The long narrow chain (750 km north to south and 120 km east to west) covers an area of about 106,000 sq. km.

Total land area, however, is estimated to be only 298 sq. km. The plateau underlying the Maldivian atolls is continuous with that beneath British Chagos archipelago to the south and India's Minicoy and Lakshadweep Islands to the north. Sri Lanka is 670 km to the east.

The northern and central atolls, from Haa Alifu to Laamu, are separated by deep but easily navigated channels. The southern atolls are separated from the main group of islands by two wide channels - One and a Half Degree Channel (between Laamu and Kaafu) and Equatorial Channel (between Gaafu and Seenu) - which are hazardous to navigate because of strong currents and unmarked reefs.

The island of Gamu in the Laamu atoll is the longest at 7.2 km; most islands are less than 2 km in length. Being coral based, the islands are low-lying with the highest point seldom more than 2 m above sea level. The water table, high in all the islands, is generally highest along the shoreline and in the center. Several islands have fresh water lakes and ponds. The enclosure reefs of each atoll have breaks through which small boats can pass.

The Maldives' equatorial climate is influenced by the system of monsoon winds. Moisture-laden southwest monsoon winds flow from the equatorial region of the Indian Ocean over the archipelago from the end of April until mid-August, although the season is irregular. Heavy squalls, thunder, and strong winds are common. High winds may cause rough seas, cutting off connections between islands and between Maldives and India and Sri Lanka. Steady, drier breezes come with the northeast monsoon from December to March. Effects of the southwest monsoon are felt more strongly in the northern atolls than in the south; however, rainfall is greater in the south (381 cm annually compared with 254 cm in the north). The mean daily temperature in Male averages 30°C, with little variation throughout the year. Humidity, which is always high, is rarely below 80% during the southwest monsoon.

#### Ethnic and Sociocultural Groups

According to legend, Aryan settlers (Sinhalese) from Ceylon or India joined an aboriginal Dravidian people on the islands around the beginning of the Christian era or perhaps earlier. Later Arab contacts introduced the third major ethnic strain. Maldivian ethnic consciousness is strong, the population being unified by a common religion and language. The society tends to be closely knit, rigidly structured, and disciplined. Power is concentrated in a small national elite in Male. About 1,000 mainly nonpermanent immigrants reside in Male.

### Languages

The Maldivian language, Dhivehi, spoken throughout the archipelago, is derived from Elu (old Sinhalese) and contains elements of both Arabic and Hindustani. Thaana script, written from right to left, is the common form of writing. The Government permits use of Roman script for official correspondence and documents. English is the second language of about 3% of the population and the second most widely spoken. Other languages spoken by small minorities are Arabic, Urdu, and Sinhala.

### Religion

Islam is the state religion; virtually all Maldivians are of the Shafi school of the Sunni Muslim faith. It is common belief that the Muslim faith supplanted Buddhism in 1153 when the sultan was converted by a visiting holy man.

### Historical Background and Government

A centuries old sultanate, temporarily replaced by a republic from 1953 to 1954, ruled until 1968 when it was abolished by national referendum and the country became the Republic of Maldives. Although there was little interference in local affairs and no British presence, Maldives was a British protectorate from 1887 until full independence was achieved on July 15, 1965. In 1976, the United Kingdom abruptly terminated a 1956 agreement, under which Gan island in Seenu atoll had been leased for a 30-year period as an RAF staging post, and withdrew all its forces.

The 1968 Constitution provides for a President and a Ministers' Majilis or Cabinet appointed by him, as well as a unicameral Citizens' Majilis (House of Representatives) of 48 members. The President, nominated by the legislature for a 5-year term, must be confirmed by national referendum. Islamic law, under which the President has final authority of interpretation, provides the legal framework for most civil and criminal cases. There are no political parties. Ibrahim Nasir, the country's first president, was succeeded in November 1978 by Maumoon Abdul Gayoom, who pledged greater openness in government and a decentralization of the decision-making process. President Gayoom was re-elected to a second term in September 1983.

There are no constitutional provisions for local governments. The country is divided into 19 administrative districts corresponding to atoll groups. Each atoll has a presidentially appointed chief (verin), advised by an elected committee, and each inhabited island is administered by a mosque-appointed chief (khatib), a number of assistant headmen, and one or more functionaries (mudim). Atoll and island chiefs have responsibility for maintaining public safety, collecting statistics, implementing government policies, and conducting local education. District radio communication keeps atoll chiefs in touch with the regional offices of the Ministry of Provincial Affairs.

### Population

The first official census in 1977 recorded a national population of 142,800. This number had grown to an estimated 160,200 by the end of 1982, showing a national growth rate of 2.3% for the period. With a population of about 35,000 in an area of roughly 1.5 sq. km, the island of Male (seat of government) is the most densely populated island by far (19,000 per sq. km); countrywide, the population density is 538 per sq. km. About 45% of the total population is under the age of 15, and 2.3% is over 65.

### Economy

#### Basic Indicators

GDP (1982):	\$59.8 million
GDP per capita (1982):	\$350 (est.)
Exports Goods and NFS (1981):	\$23.4 million (excluding re-exports)
Imports Goods and NFS (1981):	\$38.8

Maldives' open economy has a narrow resource base traditionally dependent on fishing. While the fisheries sector remains the economic mainstay, employing 44% of the labor force and accounting for 13.6% of GDP in 1982, tourism has expanded rapidly since development began in the early 1970s to become the most important foreign exchange earner. The contribution of tourism to GDP increased from 9% in 1978 to 15% in 1982. Shipping is a third important source of revenue and foreign exchange. Maldives Shipping Ltd. (MSL), the government-owned shipping line, was established to provide transport for Maldivian trade, but its expanded operations now include the Far East, the east coast of Africa, and the Middle East. Agriculture plays a minor role in the economy, accounting for about 10% of GDP and employment and consisting mainly of subsistence

gardening around homesteads. The contribution of manufacturing to GDP is also small at about 10%, though the sector generates considerable employment. Some 22% of the working force -- three-quarters of them women -- work primarily in cottage industries. There are also two new garment factories on Ga. and another being opened on Thulusdhoo, as well as a tuna canning factory and a mica fabrication plant in Male.

Maldives experienced strong economic growth during 1978-82 with real GDP growing at an average rate of 12% per year and per capita GDP at nearly 10%. Development has been accompanied, however, by an increasing economic and social imbalance between Male and the outer atolls. The government's goal is to combine future economic growth with a more equitable distribution of benefits.

Fresh fish is the main export item, followed by processed fish and other marine products and by garments and other manufactured goods. Merchandise imports include food and other consumer items, petroleum products, and intermediate and capital goods. The growth of imports in the latter category has been especially dramatic since 1977 in response to expansion in the fishing, construction, and tourist industries. A surplus on the services account in recent years (profit transfers from MSL, tourist expenditures, official grants, etc.) has offset the traditionally large deficit on the trade account to result in a small surplus in the overall balance of payments.

### Health

#### Health Indicators, 1971-81 (World Bank)

Crude birth rate (per '000)	44.4
Crude death rate (per '000)	12.4
Infant mortality rate (per '000 live births)	88
Child death rate (age 1-4 years per '000)	21.2
Number of practicing physicians	9
Population per practicing physician	17,333
Number of practicing nurses	57
Population per practicing nurse	2,737
Number of auxiliary health workers	825
Number of hospital beds	98
Population per hospital bed	1,592
Number of atoll health centers	23

Waterborne and tropical communicable diseases are highly prevalent in Maldives. Inadequate access to a safe water supply and sewerage facilities has resulted in frequent epidemics of diarrhea in children and periodic outbreaks of cholera and typhoid. The health hazard is especially great on the densely populated island of Male where basic urban infrastructure is virtually non-existent. Government programs are addressing the country's serious health problems; however, much remains to be accomplished. A malaria eradication program has brought that disease under control. Efforts are being made to combat other endemic diseases such as leprosy, tuberculosis, and filariasis.

Because of difficulties in inter-island transport and shortages of resources and personnel, medical services have been concentrated in Male. In an effort to decentralize primary health services, the government has established 23 atoll health centers staffed by community health workers. Each health center has a health launch at its disposal to be used for emergency treatment and transportation. Family health workers dispense medicine and first aid and carry out disease prevention programs on the more populated islands.

### Diet

Rice, most of which is imported, is the staple grain, served accompanied by highly spiced sauces of meat, fish, or vegetables. Pork is not eaten and consumption of beef is low. Consumption levels of fish, the main source of protein, is said to be among the world's highest. Home grown fruits, vegetables, and coconuts supplement the diet. Malnutrition does not appear to be a serious problem; however, WHO and UNICEF surveys have shown that nutritional anemia and other dietary deficiencies are common.

### Transportation

Because of its archipelagic nature and the small size of the islands, Maldives does not have an extensive road network. The road system on most islands consists of a broad coral-sand main street, intersected at right angles by a shorter road leading from the wharf or landing beach. On all islands, people travel mainly by foot or on bicycles. There were 1,404 motor vehicles (58% motor cycles) in Maldives in 1982.

Most inter-island traffic is by sea, although Air Maldives operates twice weekly air service between Male and Gan. Sailing boats (dhonies) are generally used in intra-atoll traffic while mechanized boats handle most inter-atoll traffic, particularly to and from Male, which is the direction of most travel. There is little traffic between atolls. Trips from Male to the southern atolls may take as long as a week because of hazardous conditions. The present inadequate inter-atoll transport system is seen as a serious constraint to the spreading of economic and social services. A project supported by the Asian Development Bank (ADB) and consisting of the construction of two specially designed cargo-passenger vessels was expected to introduce the first regular transport service between Male and the outer atolls in the spring of 1984.

The port at Male handles limited oceangoing traffic. There are no deep water berths, the harbor being only 0.5 to 3 meters deep. Because of heavy port congestion, even small foreign trade vessels are not permitted within the inner harbor. Imports are off-loaded by lighters which are pulled by tugs to the commercial section, then off-loaded by mobile cranes. The operation is time consuming, with average turnaround time a week to ten days.

There is no direct shore access to most other islands except by very small craft. A project proposed by ADB would begin development of a new commercial harbor within the Male port area by reclaiming additional land and relocating storage sheds. Reclamation will be done with materials obtained from deepening the harbor basin to a proposed depth of 6 m for vessels up to 2,200 dwt. The existing deteriorated wharf will be reconstructed and two new barges procured to reduce turnaround time. A sub-project provides for the deepening of access channels through coral reefs and within lagoons for a number of priority islands. In addition to the ADB project, a small harbor facility is being constructed on Thulusdhoo to relieve congestion in Male harbor.

The national shipping line, Maldives Shipping Ltd., provides the only effective sea link with the outside world, carrying most international trade with the exception of fresh fish exports and high value imports shipped by air freight. The fleet consists of 41 vessels with an average size of 8,000 dwt.

The airport on Hulule island, about one mile from Male, has been improved and expanded to international standards. With the runway now suitable for wide-bodied jets, charter flights from Europe have begun operation. Maldives International Airlines, with one Boeing 737, operates four flights a week between Male and Colombo and Trivandrum in southern India. Maldives is also serviced by Indian Airlines, Air Lanka, Alitalia, Condor, Lufthansa, Balair, Singapore International Airlines, and Aeroflot. There is another airstrip on Gan island in the southernmost Seenu atoll, site of the Royal Air Force base which closed in 1976. Although the runway can handle any weight of modern aircraft, facilities there are not used for international traffic.

### Communications

Male and the nearby resort islands have a public telephone service with automatic exchange and a capacity of 1,500 lines, expandable to 7,500 lines. Inter-atoll communications between Male and atoll capitals is through a network of HF transceivers which do not work efficiently due to frequent power problems. Inter-island communications, within atolls and with boats, is by short range walkie-talkie.

The ADB-financed Interisland Transport Project (See Transportation) is providing a "backbone" system of 19 VHF sets to be installed in the atoll capitals along with one SSB set in Male. Each interisland vessel will be equipped with both VHF and SSB to allow ship to shore connections (VHF) as well as continuous monitoring on the international frequency allocated for emergency distress calls (SSB).

A satellite earth station, installed in 1977, provides more than adequate external communications. At present, six channels are leased from INTELSAT IV, covering telegraphy and telephony. Cable and Wireless has sole operating rights.

With the expansion of the Hulule airport and the establishment of charter flights from Europe, some upgrading of national meteorological services was deemed necessary. A program prepared by the WMO and the Maldives Department of Meteorology to be implemented by the end of 1986 calls for setting up a meteorological telecommunications center to receive data and processed pictorial products from the Regional Meteorological Center (New Delhi) and the area forecast center (Colombo). The program will also establish three aeronautical stations with SSB receivers, one agrometeorological station (to support the government's agricultural extension programs), and one component for equipment operation and data

analysis. A proposed ADB-financed project would provide equipment for an APT/WEFAX (Automatic Picture Transmission/Weather Facsimile) station needed for the reception of high resolution satellite information for continuous weather observation. This would improve cyclone tracking capability as well as the preparation of forecasts and warning.

#### Disaster Vulnerability

Except for occasionally severe weather during the southwest monsoon, Maldives is relatively immune to natural disasters. The islands are located in a zone where tropical cyclones are rare, and only the northernmost islands are likely to experience any side effects (rain, wind, and strong seas) from such storms affecting Lakshadweep.

Natural disasters affecting particular islands or atolls were recorded in the eighteenth and nineteenth centuries. These included earthquakes (1729/30 and 1815), fires (1721, 1759, 1773, and 1887), famine (1818/19), storm (1819), and tornado (1820). Epidemic appears to be the most common disaster type, however, and the only one recorded in this century. It is also the only type having national significance. Other disasters have tended to affect only one island or atoll. The absence of a safe water supply, poor drainage, and poor sanitation pose a serious health hazard throughout the islands but especially on the densely populated island of Male. An influenza epidemic ("Maldivian fever") caused 300 deaths in Male in 1922. Several epidemics of waterborne diseases have occurred in recent years: gastroenteritis (1965), typhoid (1966), diarrhea (1968), cholera (1978), and diarrhea (June 1982). The 1978 cholera epidemic was the most serious of recent disasters. Beginning in the southern atolls, the disease, at first thought to be severe gastroenteritis, spread throughout the country, reaching epidemic proportions before being confirmed as cholera in early April. Over 11,000 persons were affected and 219 died before the disease was brought under control.

Regional Disaster Prevention and Preparedness

Tropical cyclones are the most pervasive and destructive natural hazard affecting the islands of the Indian Ocean. On 12 November 1970, probably the most devastating tropical cyclone that has ever occurred struck the coast of East Pakistan (now Bangladesh), killing over 300,000 people and causing incalculable damage to property. Following this disaster, the United Nations General Assembly adopted a resolution instructing the World Meteorological Organization (WMO) to establish national and regionally coordinated systems to ensure that the loss of life and damage caused by tropical cyclones are reduced to a minimum. Under the regional component of the WMO Tropical Cyclone Programme, groups of countries in distinct tropical cyclone areas have joined together to improve their storm warning systems, with a view to reducing fatalities and mitigating material losses caused by tropical cyclones. In the southwest Indian Ocean, this cooperative effort is effected through the Regional Association I (RA I) Tropical Cyclone Committee for the Southwest Indian Ocean, comprised of members from Malawi, Mozambique, the United Republic of Tanzania, Comoros, Madagascar, Mauritius, the Seychelles, and France, representing Reunion.

The RA I Tropical Cyclone Committee has developed an operational plan defining the forecasting and warning responsibilities of all members and establishing procedures for the exchange of information and the provision of observational data. According to this plan, responsibility for analyzing and forecasting the formation and movement of tropical storms in the region lies with the national meteorological services of each member country. Cyclones are tracked by weather radar, reconnaissance aircraft, and meteorological satellites. This information is shared with all members by means of facsimile transmission, special meteorological bulletins, and cyclone advisories. The Operational Plan is regularly reviewed and improved upon by the RA I Tropical Cyclone Committee to reflect the latest advances in cyclone early warning systems.

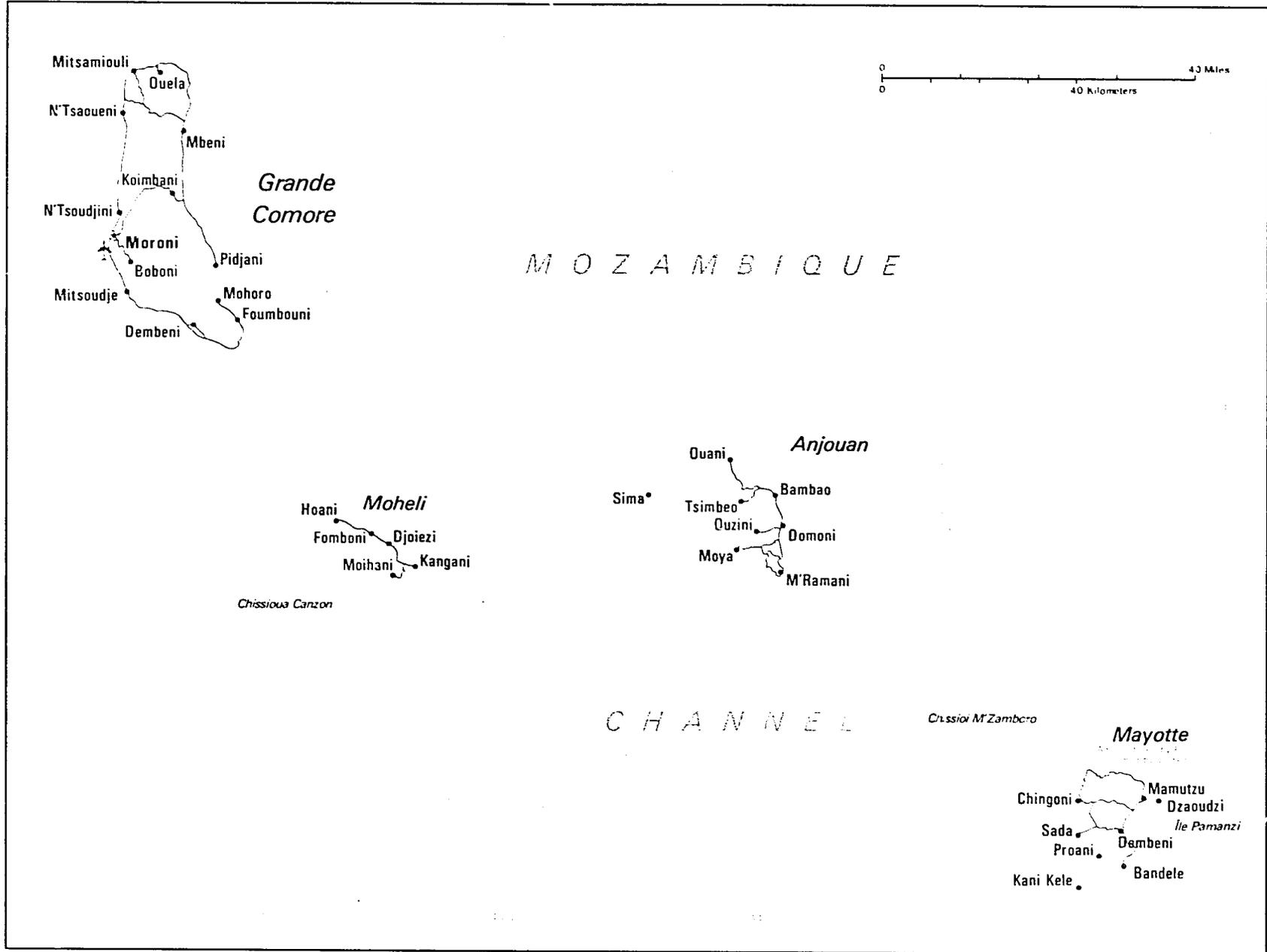
In May 1984, 41 representatives from the eight member countries of the RA I Tropical Cyclone Committee for the Southwest Indian Ocean met to discuss and propose disaster prevention and preparedness measures that could be taken to mitigate the destructive impact of cyclones that threaten the region. The conference, entitled "Subregional Training Seminar on Disaster Prevention and Preparedness", was held in Port Louis, Mauritius, and was sponsored by the League of Red Cross Societies, the U.N. Disaster Relief Coordinator, the W.M.O., and the Office of U.S.

Foreign Disaster Assistance. The four day conference included presentations by participants from each country and recommendations on how the participants might improve disaster prevention and preparedness capabilities by regional cooperation. Recommendations resulting from the conference included the following:

- Member-states develop national disaster plans and national preparedness and relief agencies, if they have not already done so.
- Training opportunities should be provided to personnel in meteorology, hydrology, disaster management, and relief operations.
- Public information on what precautions the average citizen should take in the event of a cyclone should be disseminated to the population by the mass media and educational programs.
- Land use policies, zoning regulations and building codes should be reviewed and upgraded to mitigate damage risks from tropical cyclones.
- Back-up procedures and systems should be instituted to insure the dissemination of cyclone warnings.
- Regional telecommunication systems should be improved to facilitate efficient exchange of data and processed information as required in support of timely and effective tropical cyclone warnings.

So far, no method has been found to prevent the formation of tropical cyclones. Inconclusive experiments have been conducted by the United States in seeding hurricanes in the Caribbean with silver iodide crystals to reduce wind speeds and accelerate rainfall before the hurricane reaches land. For now, the best defenses against cyclonic storms are a well developed early warning system, effective national disaster plan and organizations, and disaster mitigation measures resistant to cyclone damage. In the southwest Indian Ocean, where topical cyclones usually affect more than one country, regional cooperation is essential for the collection and dissemination of information that could reduce property damage and save lives.

# Comoros



202709 9 77 5422901  
 Lambert Conformal Projection  
 Standard parallels 6° and 30°  
 Scale 1:1,200,000

1. General Information1.1 Geographic Codes

AID Standard	602
AID Region	AFR/EA/STIOS
State Region	AF/E

1.2 Host Mission in the U.S.

Embassy: There is no Comoran diplomatic representation in the United States, but the Ambassador to France is accredited to the U.S. The Embassy of the Comoros in France is:

15 rue de la Neva  
Paris 75008

1.3 U.S. Mission in the Comoros

Embassy: The U.S. does not maintain resident diplomatic representation in the Comoros. The U.S. Ambassador in Madagascar is accredited to the islands. The address of the U.S. Embassy there is:

14-16 Rue Rainitovo, Antsohavola  
B.P. 620  
Antananarivo, Madagascar  
Tel: 212-57, 209-56 (no direct dial service)  
Telex: USA EMB MG 22202 ANTANANARIVO

1.4 Time Zones

GMT + 3; EST + 8

1.5 Currency

The Comoros belongs to the African franc zone and the Comoran franc (equivalent to the CFA - communaute financiere africaine) is

convertible into the French franc. As of September 30, 1984, the exchange rate was 442.8 CFA to U.S. \$1.00.

1.6 Travel and Visa Information

Passport and Visa: A valid passport and visa are required; visas may be obtained on arrival. Immunization for yellow fever is required.

1.7 Calendar and Holidays

New Year's Day.....	January 1
Easter Monday.....	*
Independence Day.....	July 6
Christmas Day.....	December 25
Id-el-Kabir.....	*
Maoulida.....	*
Miradji.....	*
Id-el-Fitre.....	*

\* Dates vary annually  
Fiscal year = calendar year

1.8 Treaties and Agreements

The U.S. has no treaties or agreements with the Comoros.

1.9 International Organization Memberships

African Development Bank (ADB), Economic Commission for Africa, FAO, G-77, ILO, International Fund for Agricultural Development (IFAD), NAM, Organization of African Unity (OAU), UN, UNESCO, UPU, WHO, WMO, World Bank (IBRD, IDA, IMF).

### 1.10 Geography

The four main islands and numerous islets and coral reefs which comprise the Comoros are of volcanic origin. They are located in the Mozambique Channel between northern Madagascar and Mozambique, close to 12°S latitude and 44°E longitude. The total land area of the four main islands is 2,236 sq. km. The capital, Moroni, is located on the eastern coast of Grande Comore, the largest island. The other three islands, Moheli, Anjouan, and Mayotte run in a northwest-southeast axis from Grand Comore. In 1977, the names of the islands were officially changed to Njazidja, Mwali, Nzwani, and Mahore, respectively, but the old names are still more widely used. (For more information see Section 2.1, Overview of the Physical Environment.)

### 1.11 Ethnic and Sociocultural Groups

The people of the Comoro Islands are a mixture of Bantu, Arab, and Malayo-Indonesian groups. The Arabs are descendants of the Shirazi settlers, who came from the Persian Gulf region in significant numbers in the fifteenth century. The Shirazis dominated the islands both culturally and politically from their arrival until the French occupation in the twentieth century. Two Bantu groups have settled in the Comoros, the Cafres, who came to the islands before the Shirazis, and the Makoa, who are the descendants of slaves brought by the Arabs from the East African coast. The Malayo-Indonesians are divided into three groups: the Oimatsaha, the Antalotes, and the Sakalava, the latter mostly settled on Mayotte. Into this already complex ethnic mixture are people of Portuguese, French, Dutch, Chinese, Indian, and Creole descent. There has been much inter-marriage and distinctions among the groups are not rigid. Status and class in the Comoros are based more on wealth than on descent.

### 1.12 Language

The language of the islands is Comoran, a mixture of Arabic and Swahili written in Arabic script. French remains important as the international language and classical Arabic is important for religious reasons. There are a few small communities, principally on Mayotte, which speak a Malagasy dialect.

### 1.13 Religion

The vast majority of the population is Sunni Muslim. Religious tenets are strictly observed and almost all young children attend a Koranic school for two or three years. There are over 600 mosques in the Comoros.

### 1.14 History and Government

**Official Name:** Federal Islamic Republic of the Comoros.

**History:** The Comoros have been invaded by a succession of peoples over the centuries and little is known of the original settlers. The various groups - Bantus, Arabs, Persians, and Indonesians - intermarried, but Arab culture predominated from the 15th century. From then until the final French occupation at the beginning of the 1900s, there was almost continual conflict among the islands. In the 1700s and 1800s the islands were also frequently plundered by Malagasy pirates.

France has had a presence in the Indian Ocean since the early 1600s but it was not until 1908 that all four islands of the Comoros became French colonies. Slavery, which had been a central institution for centuries, was abolished and health standards improved. Overall, however, the effects of French administration were mixed. Private French companies that established cash crop plantations came to dominate the economy and food crop cultivation was neglected. Profits

from the plantations were diverted to France while the Comoros remained undeveloped.

**Recent History:**

The independence movement on the islands started in the early 1960s and negotiations with France on the subject were carried out in 1973 and 1974. In a referendum held in December 1974, 95% of Comorans supported independence, but 65% of the people on the island of Mayotte voted to stay under French administration.

After the referendum, a dispute developed with France as to whether the vote was valid for the islands as a whole or only on an island-by-island basis. This controversy revolved around Mayotte, which had had a much longer association with France than the other three islands. On July 6, 1975, the Comoros declared independence unilaterally for the entire archipelago. The French reacted by cutting off all financial aid and bringing legionnaires to Mayotte to forestall any possible invasion. When the United Nations admitted the Comoros as a member, however, it recognized its claims over Mayotte.

Ahmed Abdallah was elected president of the new state, but he was overthrown in a coup less than a month later. The new head of state, Ali Soilih, launched an ambitious social revolution modeled somewhat after the Cultural Revolution in China. Many of the radical changes were resisted, however, and in May 1978, Ali Soilih was himself overthrown in an unopposed coup. The coup was carried out by European mercenaries on behalf of Ahmed Abdallah, who was once again installed as president. He has followed more moderate policies, and France has resumed aid. Both the Comoran and French governments have postponed making a final decision on the status of Mayotte, which remains under French control.

**Administrative structure:**

After Ahmed Abdallah took over the government again, a new constitution was written creating a Federal Islamic Republic. Federal institutions comprise the Presidency, the Council of Government, the Federal Assembly, and the Supreme Court. Each island has an elected governor with a certain amount of autonomy.

**1.15 Population**

The figures in the chart below are based on a census taken in March 1980.

	<u>Population</u>	<u>Density (per sq. km.)</u>
Grande Comore	189,000	164.6
Moheli	19,000	65.5
Anjouan	148,000	349.1
Mayotte	52,000	139.0
TOTAL	408,000	182.5 .

Source: Europa Yearbook, 1982.

	<u>Percent</u>
Population aged 1-15:	43.7
Population aged 15-24:	20.6
Population in labor force:	35.9
Population aged 7-12 in primary school:	100
Population aged 13-15 in secondary school:	36
Population aged 16-19 in upper school:	8

Source: World Bank, 1982.

The quality of primary education is poor and only 25% of all primary school teachers are fully trained. Secondary schools have similar problems. Annually, about 600 Comorans study at universities in foreign countries.

1.16 Health

Vital Statistics:	Life expectancy at birth (1982):	48 years
	Crude birth rate/1000 (1977):	40
	Crude death rate/1000 (1977):	18

The health situation in the Comoros is very poor. It is estimated that one-half of all children die before the age of four and that most children suffer from malnutrition and intestinal parasites. Tetanus also contributes to the high rate of child mortality. The most serious illness affecting the adult population is malaria, which strikes 80% of the population. There is also a high incidence of tuberculosis and leprosy.

The average daily per capita caloric intake is 2,100; coconut, rice, banana, and cassava account for 78% of this intake. Rice is the preferred staple despite the low level of domestic production, and close to 50 kg. per person is imported annually to meet demand. There is a significant lack of animal protein intake and local custom discourages feeding fish to children. Much of the water supply is contaminated.

1.17 Economy

Basic Indicators:	GNP (1979):	\$92.4 million
	GNP per capita (1982):	\$340
	GNP average annual growth rate (1960-82):	0.9%
	Average inflation rate (1970-82):	11.7%
	Exports of goods, NFS (1980):	\$12.8 million
	Imports of goods, NFS (1980):	\$44.8 million
	Current account balance as % of GDP (1980):	-20.9

- Agriculture:** Agriculture is the largest sector in the economy and contributes over 40% to the GDP, employs 80-90% of the population, and accounts for practically all export earnings. Nearly 60% of production is for subsistence, the main food crops being coconut, rice, cassava, and pulses. About 10% of the cultivated land is planted with cash crops, mainly ylang-ylang (perfume essence), coconut, vanilla, and cloves. Fertilizers are not used, and productivity is very low. The limited modern agriculture is concentrated on export crops.
- Industry:** The industrial sector accounts for less than 4.5% of the GDP and employs about 1,000 people. Most industry is linked to the processing and conditioning of the export crops and consists of stills for ylang-ylang distillation and kilns for drying copra and vanilla. The domestic-oriented industries include 20 sawmills, a printing plant, a soft drink bottling plant, a soap factory, and a small plastics plant. Industrial development is hampered by several factors, including poor infrastructure, high transport costs, and an untrained labor force.
- Exports:** Four agricultural commodities -- ylang-ylang, vanilla, cloves, and copra -- account for 98% of Comoran exports. The Comoros produces 80.4% of the world total of ylang-ylang (Madagascar accounts for the rest). Over the last several years, world demand has declined and prices have remained constant. Most copra, the other major export, is sold to Madagascar. World demand for vanilla has been rising, but the Comoros supplies only 7% of the world market. They also supply only a small share of the clove market, Indonesia being the main importer.
- Imports:** About 70% of Comoran imports are food and consumer goods. Rice, the largest import, usually accounts for more than 20% of the total.

### 1.18 Communications

- Radios:** Radio and telegraph links between the islands are poor. Communications with the outside world depend on a one-way radio link with Antananarivo (Madagascar) and two two-way radio links with Paris. In the Comoros, there are two AM stations and one FM. Most broadcasting is in Comoran with some service in French, while international broadcasting is in Arabic, French, and Swahili. In 1982, there were an estimated 37,750 radio sets. On Mayotte, radio broadcasts are in French and Mahorian (a local dialect), and in 1982 there were about 12,500 radio sets.
- Television:** There is no television in the Comoros.
- Press:** There is no local press or press agency. Newspapers from Madagascar are available.

### 1.19 Transportation

- Roads:** The volcanic origin of the Comoro Islands has made their topography rugged and rocky. Constructing an adequate road network is therefore both difficult and costly. However, the Government of the Comoros has given priority to completing coastal ring roads, which are vital to transporting cash crops to the ports. Between 1970 and 1980, the paved road network had increased more than fourfold to 451 km. Paved roads are generally in good condition because most were built very recently and carry little traffic. In mid-1977, there was a total of 316 km of earth roads (excluding Mayotte). These are often in poor condition and usually require four wheel drive vehicles.
- Railroads:** There are no railroads in the Comoros.

**Ports:**

The Comoros have been off the beaten track for quite a while, their isolation compounded by the lack of a deep water port or a natural site for port development. Most cargo must be transshipped through the ports of neighboring countries (such as Majunga, Madagascar). The Comoros has two small ports: Mutsamudu on Anjouan which can handle ships of up to 600 tons, and Moroni on Grande Comore which can handle ships of up to 400 tons. Less than one ship a day on average is handled at either port.

Intra-island transportation is also difficult and only a few beaches are safe enough for boats to anchor. About 10 to 12 coasters (300-400 tons capacity) service the Comoros while 50 to 60 dhows (5-20 tons capacity) carry lighter and inter-island traffic.

**Air Transport:**

Air transport is used for only about 2% of total foreign trade by volume, but it can be an effective way of overcoming the delays and inconveniences of sea transport. There is an international airport on Grande Comore and each of the other islands has an airport with tarred airstrips. Air Comores is the national airline and operates a Fokker 27 (which has a 24-seat capacity). The company flies inter-island routes and to Madagascar, Kenya, and Tanzania.

The other air links to the outside world consist of a weekly Air France 727 flight from Paris and two weekly Air Tanzania flights from Dar es Salaam. These flights do not operate regularly, however.

## 2. Disaster Vulnerability

### 2.1 Overview of the Physical Environment

The Comoro Islands are of relatively recent volcanic origin, and there is, in fact, still an active volcano on the largest island, Grande Comore. Each of the four main islands has distinct geological, topographical, and climatic characteristics related to their geologic age. The Comoran coastline features rocky black lavas and basalts and offers no natural harbors. There are no geographic links with either Madagascar or the east African coast.

Climate: The Comoro archipelago is halfway between the equator and the Tropic of Capricorn; the climate is marine tropical. There are two seasons: it is hot and humid between November and April due to the northeast monsoon, and cooler and drier the rest of the year. Along the coast the average monthly temperatures range from 23°C to 28°C, while the average annual precipitation is 2 meters. Inland on the islands the weather is cooler and wetter. The Comoros are prone to cyclones during the hot and humid season.

Grande Comore: Grande Comore, the largest island, is 67 km long and 27 km wide for a total land area of 1,148 sq. km. Its prominent topographical features are two volcanoes, La Grille in the north and Kartala (or Karthala) in the south. La Grille is extinct and mostly eroded, while Kartala erupted as recently as 1977 and is 2,361 m. high. Between the two volcanoes lies a plateau with an average height of 600 to 700 m. Grande Comore is the most recently formed of the four islands and therefore its soils are thin and rocky and cannot hold water despite the heavy rainfall. There is some rain forest vegetation on the slopes of Kartala.

Moheli: Moheli, 40 km south-southeast of Grande Comore, is the smallest of the Comoro islands, measuring 30 km long and 12 km wide for a total land area of 290 sq. km. Moheli has a central mountain chain which measures 860 m above sea level at its highest point. The island's capital is Fomboni, in the northeast.

Anjouan: Anjouan is about 40 km east of Moheli. It is triangularly shaped, measuring 40 km from apex to base, with an area of 424 sq. km. Three mountain chains extend from a central peak, Mtingui, which is 1,575 m above sea level. The mountain chains are called Sima, Nioumakele, and Jimilime. Anjouan's capital is Mutsamudu, a port on the northwest coast.

Mayotte: Mayotte, 39 km long and 22 km wide with a total area of 374 sq. km, is the southernmost island of the archipelago. It is the oldest island and therefore its soils are relatively rich in some areas. Mayotte also has a well-developed coral reef which protects ships and fish. The French are still in possession of this island.

## 2.2 Volcanic Eruptions

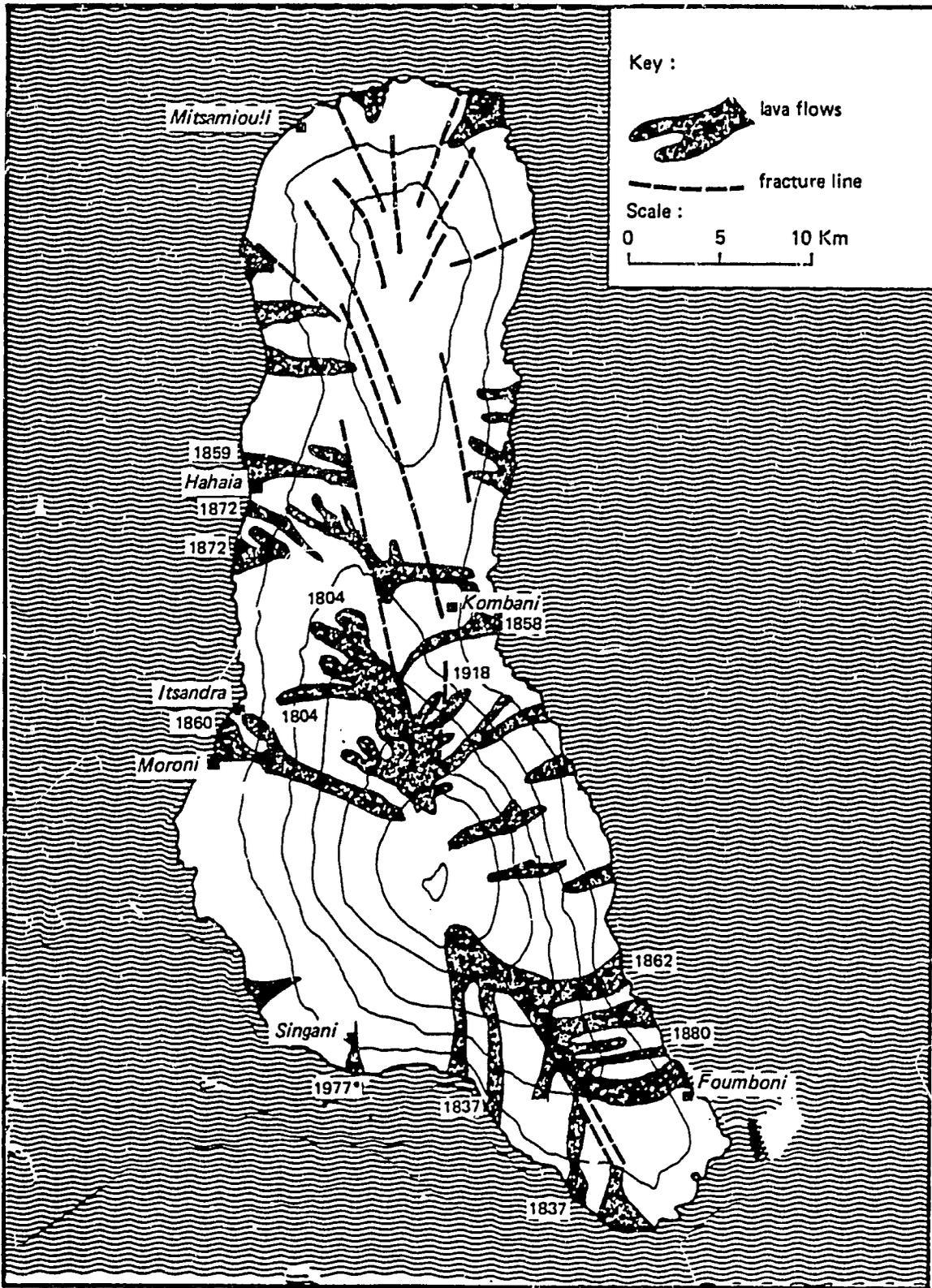
Volcanic eruptions are a factor only on the island of Grande Comore, but on that island they have been a frequent occurrence. Since 1828 when recordkeeping on the Comoros began, there have been 24 volcanic eruptions. Almost all included lava flows and some involved explosions of ash. Not all the eruptions have come from Kartala's peak; in fact, most have resulted from fissures which radiate from the central cone along the length of the island, which is itself the projecting peak of a subterranean volcano. When the lava erupts through these fissures, it usually flows down a series of well-defined long and narrow paths towards the sea. Therefore, damage is restricted to these paths, which are usually predictable. (See the figure on the following page.)

The volcanic eruptions on Grande Comore have traditionally caused little concern because of the predictability of the lava flows and because the flows are sometimes slow enough to allow for evacuation when people or villages lie in their path. However, as efforts are made to increase the amount of cultivable land, more of the island will become vulnerable to lava flows. This potential for increased vulnerability can be seen by the most recent eruption in April 1977. Although there was only one recorded death, at least 5,000 people were made homeless and there was extensive damage to fruit trees. Another cause of this relatively high damage was that Kartala's eruptions flowed down its southwest flank, a relatively unusual direction. This eruption was especially disruptive to the national economy which was already strained to meet the needs of 17,000 citizens repatriated from Madagascar earlier that same year.

## 2.3 Cyclones

The Comoro Islands are not in a very high risk cyclone zone and the country has been hit only eleven times in the 120 years between 1864 and 1984. Although not frequent, when cyclones have occurred their effect has been heightened by their grouping and timing. There were two cyclones in 1898, two in 1904-1905, and two more in 1950-51. The cyclones of February and April 1898 hastened the disappearance of the sugar industry on the Comoros and also destroyed a great number of buildings. A smallpox epidemic on the heels of the cyclones further devastated the population.

The cyclones of December 1904 and December 1905 damaged a significant portion of the vanilla, coffee, and subsistence crops. The latter cyclone caused 30 deaths and 150 injuries. Food shortages followed the cyclones and deaths attributable to famine reached 490. The French government allotted a "credit extraordinaire", part to repair government buildings and part as direct compensation to victims.



After Battistini (1967)

\* Approximate location

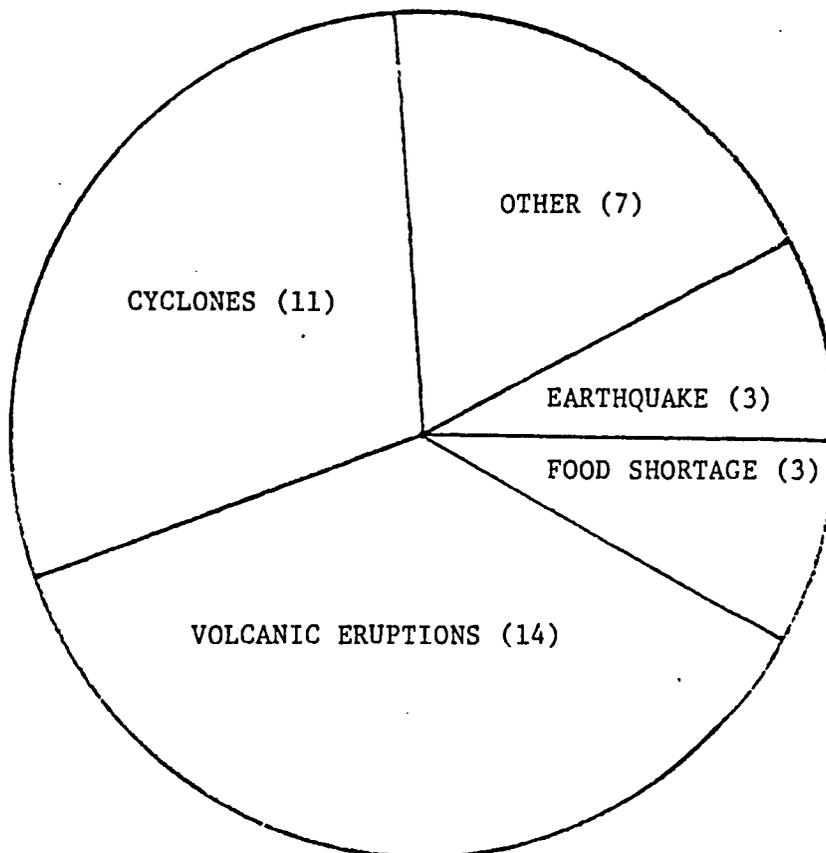
Source: UNCTAD, The Incidence of Natural Disasters in Island Developing Countries, 1983.

The most recent storm to hit the Comoros was Cyclone Elinah in mid-January 1983. It was one of the strongest cyclones in recent years, lashing the islands, particularly Moheli, with high winds and heavy rains. The storm destroyed more than 90% of Moheli's banana trees, a staple, and more than 50% of the clove trees. This was a particularly heavy blow because clove trees take eight years to mature. Close to 30,000 people received emergency assistance.

Although cyclones are not a frequent occurrence, they can cause great devastation, especially to the agricultural sector. Tropical cyclones usually tend to occur when maturing plant growth is most vulnerable to hurricane-force winds and torrential rains. Certain exotic crops, such as clove trees, are very vulnerable to wind damage.

#### 2.4 Disaster History

From 1864 through 1984, the Comoros suffered 38 disasters, 25 of which were either cyclones or volcanic eruptions. Several others were also attributable to these phenomena. The pie chart below shows the distribution of disaster types.



Disasters in the Comoros from 1864

<u>Date</u>	<u>Event</u>	<u>Location and Effects</u>
Oct. 25, 1864	Cyclone	Damage to buildings
1865	Volcano	Kartala
1867	Fire	Sugar factory in Dembeni, Grande Comore
1872	Volcano	Kartala: NW flank Plateau de Diboini
1876	Volcano	Kartala
1880	Volcano	Kartala: SE flank: Massif du Badjini
Mar. 1883	Volcano	
1884	Volcano	
1889	Volcano	Lava flows on north side; no casualties
Feb. 27-28, 1898	Cyclone	Collapse of sugarcane plantations; damage to vanilla and other crops; many buildings destroyed
Apr. 22-23, 1898	Cyclone	Compounded effects of February cyclone
1898	Epidemic	Smallpox; after the cyclones
Feb. 25, 1904	Volcano	Kartala: 1 lava flow to the west and 2 to the east; tremors and earthquakes; 2 deaths; some cattle lost
Dec. 14, 1904	Cyclone	Mayotte, Anjouan, Moheli; damage to vanilla, coffee, food crops, buildings, and roads
Dec. 16, 1905	Cyclone	Anjouan, Moheli, Grande Comore; 30 deaths and 150 injuries
1904-1905	Food shortage	Followed cyclones of 1904 and 1905

Disasters in the Comoros from 1864 (con't)

<u>Date</u>	<u>Event</u>	<u>Location and Effects</u>
Feb. 3, 1908	Storm	Anjouan
Apr. 14, 1908	Cyclone	Anjouan, Moheli, Grande Comore; damage to cloves, coconuts, and food crops; 9 deaths
Aug. 8	Volcano	Kartala; earthquakes; ash column of 5,000 m
Apr. 1948	Volcano	Kartala: north shaft within caldera
Dec. 22-23, 1950	Cyclone	Anjouan, Moheli; 585 deaths, 70,000 injuries, and 40,000 homeless; 1 1/2 million vanilla and ylang-ylang plants destroyed; 2 million francs damage to buildings and roads
Feb. 20, 1951	Cyclone	500 affected
Feb. 1952	Volcano	Kartala
1953	Earthquake	Grande Comore
Jul. 1965	Volcano	Kartala
Apr. 1967	Earthquake	Grande Comore
Jul. and Sep. 1970	Earthquake	Grande Comore
Sep. 1972	Volcano	Kartala: north end of summit crater
1975	Food shortage	
1975-76	Civil Strife	Coup
Jan. 1977	Returnees	Forced repatriation of 17,000 citizens from Madagascar
Nov. 1980	Cyclone	
1981	Drought	Grande Comore
1982	Drought	Grande Comore, Anjouan; reduced crop yield

Disasters in the Comoros from 1864 (con't)

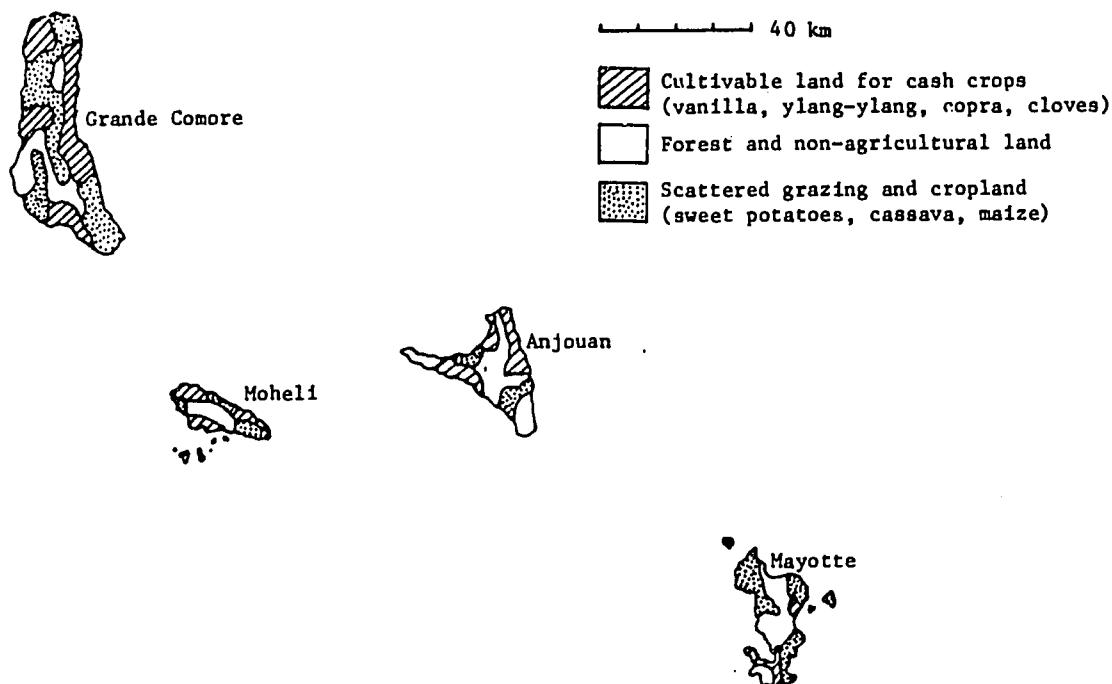
<u>Date</u>	<u>Event</u>	<u>Location and Effects</u>
Jan. 10-12, 1983	Cyclone	Moheli, Anjouan, Grande Comore; much damage to clove trees, bananas, other crops, buildings, and roads; 33 deaths, 52 injuries, and 30,000 homeless; \$23.1 million damage

Source: UNCTAD, The Incidence of Natural Disasters in Island Developing Countries, 1983.

2.5 Vulnerability of Agriculture

Most agricultural production is concentrated on foodstuffs for local consumption. The main crops are coconut, rice, cassava, and pulses. About 10% of the land is used for the high value cash crops of ylang-ylang, vanilla, cloves, and coconut. These crops account for virtually all export earnings. Good agricultural land is not abundant in the Comoros, but yields could be greatly increased by improved production methods. The islands are not self-sufficient in food and much has to be imported, particularly rice.

Land Use 1981



Source: Frederica M. Bunge (ed.), Area Handbook: Indian Ocean, 1982, p. 188.

Because food crops are insufficient to feed the population, there is intense land use competition between cash crops and food crops. This land pressure has often forced farmers to expand the area under food crop cultivation to soil which is suitable only for tree crops. In addition, colonial companies established some of the tree crop plantations on land more suited to food production.

Erosion and deforestation have become serious problems as population pressures have increased. Many farmers have started to extend cultivation to higher slopes of the hills. On Anjouan, the most densely populated island, forest land declined 69% between 1968 and 1974. In some areas of Anjouan, slopes of over 30° are being cultivated without terracing, and rapid erosion has resulted.

The main export crops are grown on all four islands but each island has tended to specialize. Grande Comore is the vanilla island, Anjouan has cloves and ylang-ylang, Moheli concentrates on copra, and Mayotte has cinnamon. Over the decades, there has been a pattern of change with one crop gaining in prominence while another declines. At present, vanilla and cloves are the most important crops.

Principal Exports by Island, 1974  
(in metric tons)

	<u>Grande Comore</u>	<u>Anjouan</u>	<u>Moheli</u>	<u>Mayotte</u>
Ylang-ylang	19	50	2	21
Vanilla	115	15	2	4
Cloves	17	235	2	-
Copra	1,128	392	1,576	878
Coffee	5	-	23	-
Cocoa	34	-	5	-
Cinnamon	7	-	-	95

Source: World Bank, The Comoros: Problems and Prospect of a Small, Island Economy, July 1979.

Coconut is the principal crop of the Comoros and is the source of food, drink, cooking oil, thatching material, and copra. In 1979, Grande Comore, Moheli, and Anjouan contained close to 1.64 million coconut trees on 30,000 hectares, or 37% of the cultivated land. The average density is 55 trees/hectare, but on the most efficient plantations a density of 150 trees/hectare can be obtained.

Coconut trees grow along the coast and inland up to a maximum altitude of 500 m. An average tree produces 45 nuts per year. Of the approximately 77 million nuts a year, about 28 million, or 36%, are destroyed by rats.

The flesh of the coconut is converted into copra by a drying process. They can be sun-dried but it is faster to use ovens. Eighty ovens have been built, of which half are on Moheli.

Production of clove, now considered to be the best cash crop prospect, has increased rapidly in recent years. There were about 140,000 trees on 900 hectares in 1973, of which 100,000 were on Anjouan and 30,000 on Moheli. Clove trees are fragile, however, and are grown in the highlands on exposed slopes. Pickers should use ladders during the July through November harvesting to avoid breaking branches, but few farmers have ladders and pickers must climb the trees instead. The 1983 cyclone damaged 50-70% of the clove trees on Moheli, a particularly devastating loss because the trees take eight to nine years to mature.

Vanilla is currently the second most important cash crop. It was introduced to Mayotte in 1873 and later spread to all the islands. Today, 82% of the vanilla crop is grown on Grande Comore. In 1979, the Comorans cultivated 14 million vanilla vines on 4,192 hectares, of which 11.5 million were on Grande Comore and 1.5 million on Anjouan. Poor cultivation practices have resulted in very low yields; a Comoran farmer produces an average of about 50 grams per vine while his Malagasy counterpart produces ten to twenty times that amount.

Vanilla vines are usually grown intermingled with food crops under the shade of coconut and other trees. The crop is extremely labor-intensive from start to finish and is cultivated almost exclusively by small farmers. The season starts in September with planting and weeding. When the flowers appear, they must be pollinated by hand. The pods are picked between July and September, and then they are dried and readied for export.

The ylang-ylang tree was introduced from Indonesia in the early 20th century, but its cultivation really expanded after 1950. The advantage of ylang is that it grows satisfactorily on soil unsuited to food crops. However, yields do vary according to soil fertility. Grande Comore cultivates 600,000 trees, Anjouan 500,000, and Mayotte 260,000, but Mayotte produces as much essence as Grande Comore while Anjouan produces twice as much.

3. Disaster Preparedness and Assistance3.1 Host Country Disaster Preparedness

The major natural threat to the Comoro Islands is tropical cyclones. With proper warning and preparation, casualties and damage can be reduced dramatically. The Comoran authorities receive weather information from the U.N. World Meteorological Organization and therefore receive warning of an approaching cyclone. Though the government of Comoros does not have a national disaster relief organization, it does have a plan, called Plan ORSEC (le Plan d'Organisation des SECours) which calls for the establishment of a temporary disaster committee in the event of a cyclone. The plan also identifies what precautionary measures should be taken in each warning phase. Plan ORSEC is summarized as follows:

Phase 0: In this stage, a cyclone has been pinpointed in the southwest Indian Ocean but is not yet a menace to any part of the Comoros. A warning bulletin is given simultaneously to the General Secretariat of the Presidency, the Cabinet of the Prime Minister, and the Minister of Transportation. This group constitutes the Principal Command Post (le Poste de Commandement, or P.C. Principal).

Phase 1: This stage comes about 24 hours before a cyclone might hit the islands. By this time, the cyclone has been identified and localized, but the danger facing the country is still vague and imprecise. The Cabinet of the Prime Minister informs the President and all the ministers of the danger, while the General Secretariat contacts the airline company (Societe Nationale des Transports Aeriens), the shipping company (Societe Nationale Maritime des Comores, SNMC), the police, prefects, health clinics and hospitals, the telephone and telegraph company (P.T.T.), and all schools.

Phase 2: At this stage, the cyclone poses a threat to the Comoros, but is still about 12 hours away. The P.C. Principal sets up quarters at the Defense Ministry and takes measures to ensure contact with the meteorological service. At all times, the P.C. has two soldiers with vehicles at its disposal.

The P.C. Principal gives instructions to Radio Comores, P.T.T., health centers, the Army, SNMC, and teachers. It also sends an alert bulletin to the local governors and asks them each to form a P.C. Secondaire. Each regional P.C. then evaluates the danger for its local area. Also, each P.C. Secondaire is expected have the following information permanently on file: a list of all transport (vehicles, boats, and airplanes) at the government's disposal, food stocks, and public shelter. As soon as the P.C. Secondaires are put on a state of alert, they verify that these documents are available. At the same time, they should organize two operational groups: a mobile team for immediate emergency intervention and a group to augment hospital services. Finally, they must contact the chiefs of the local P.T.T., public works, police, and Radio Comores and tell them to stay at their posts.

Phase 3: This is the highest stage and is invoked when the cyclone is a definite threat. The P.C. Principal puts out a "Phase 3 Plan ORSEC" alert. The P.C. Secondaires then use all possible means to disseminate information to the public. All children are immediately taken back to schools for shelter.

These phases are not always distinct, and one can be much longer than another. However, the Command Posts remain operational throughout the cyclone threat period.

In the aftermath of Cyclone Elinah in January 1983, local relief efforts included provision and distribution of supplies by Caritas Comoros and the Comoran Red Crescent. The Army (Forces Armees de Comores) cleared roads of fallen trees in Moheli.

At the Sub-Regional Training Seminar on Disaster Prevention and Preparedness in Mauritius in May 1983, a representative from the Comoran Red Crescent proposed that the international disaster assistance community provide training to its volunteers. After taking a course of study, these volunteers could then give brief courses to educators, policemen, public administrators, and anyone else who has contact with the general public. More thorough courses would be given to first aid workers, with a particular focus on techniques of relief aid and emergency health intervention. The Comoran Red Crescent would also like to have trained teams of first aid workers who could carry out emergency evacuations and assist in relief operations.

### 3.2 Early Warning

The Comoros is a member of the U.N.'s World Meteorological Organization (WMO) and of its Regional Association I (Africa). The RA I Tropical Cyclone Committee has formulated a Tropical Cyclone Operational Plan for the countries of the southwest Indian Ocean, which include Madagascar, Malawi, Mozambique, Mauritius, Tanzania, the Comoros, Reunion (France), and Seychelles. This plan defines the forecasting and warning responsibilities of each member and sets up procedures for information sharing and the provision of observational data.

Different members are responsible for relaying cyclone information and other observational data to specific countries. The Comoros exchanges cyclone advisories and related information with Reunion, which has a weather radar. Cyclone advisories are exchanged at intervals of three hours.

For more information on the WMO RA I plan for cyclone warning, please see Overview: Regional Disaster Prevention and Preparedness.

The address of the meteorological office in the Comoros is:

B.P. 78  
Moroni  
Telephone: 25-19 or 23-13

### 3.3 Health Resources

The health situation in the Comoros is very poor and there are high rates of malnutrition, tetanus, and malaria. There is also a high incidence of tuberculosis and leprosy.

Medical resources are extremely limited with a critical shortage of physicians, nurses, equipment, and medicine. In 1980, there were only 28 physicians, 108 nurses, 13 midwives, and 100 auxiliary personnel in the Comoros, and in 1976 hospital beds in the islands (excluding Mayotte) numbered 755.

Before independence there were two components to the health system. The local authorities operated hospitals, clinics, and health posts (with French technical assistance), while the French government financed a basic public health system. When independence was achieved in 1975, France withdrew all of its medical personnel and the Comoros was left with virtually no staff for its medical facilities. French financial assistance was also drastically reduced and health facilities deteriorated. The U.N.'s World Health Organization has attempted to fill the gap somewhat by contributing to the cost of the medical staff and establishing a training center at the hospital in Moroni. Italy, Canada, and France have also provided some medical staff and assistance. Other organizations have contributed large amounts of medicine, but there is only enough for the bare minimum of treatment.

Scholarships to study medicine abroad have been awarded in recent years to reduce the critical shortage of physicians. However, it is difficult to persuade these students to return, particularly when there is not always enough money to pay their salaries.

Each of the islands has a small hospital, with Grande Comore and Anjouan also having a functioning health center. There are ten secondary hospitals and four maternity centers. Drugs must be bought from private drugstores or medicine peddlars.

### 3.4 Housing

More than 75% of the houses in the Comoros are single-story one-room wooden frame structures with palm thatch roofs. The dimensions average 3 meters in width and 4 to 5 meters in length. Most of the rest of the houses are either mudwall structures with palm thatch roofs, or stone or coral-wall buildings with thatch or tin (galvanized steel) roofs. Because most dwellings are small and constructed of locally available materials, reconstruction or rebuilding is basically a simple process. The repair of stone or block dwellings takes longer and is more costly but is also not difficult.

### 3.5 Water Supply and Energy Resources

Electrical power, used mostly for lighting purposes, is supplied by thermal power stations operated by a parastatal company, Electicite et Eaux des Comores (EEDC). Total available capacity on Grande Comore is 2,400 kW and on Anjouan is 1,350 kW. Moheli is supplied only by isolated generators. Electricity consumption island-wide reached 5,100 kWh in 1980 after growing at a 6% annual rate from 1975-1979.

Most of the traditional sector of the economy uses fuel wood and charcoal. The uncontrolled use of wood is rapidly depleting the limited forest resources. The Food and Agriculture Organization estimates that at the current rate of consumption forest resources will soon be completely used up unless the government of the Comoros undertakes a reforestation program.

Petroleum accounted for 10% of total imports in 1980, and the price is close to US \$3.00/gallon. The islands have inadequate storage facilities and therefore the supply is uncertain.

Overall, the water supply is insufficient in the Comoro Islands. Perennial water streams on Anjouan and Moheli do provide an ample water supply but, for people who live far from the streams, getting water is a problem. Many villagers must carry water to their homes from sources several kilometers away. The archipelago has very few natural springs or man-made wells. Drilling capacity is insufficient to reach aquifers. This problem is particularly acute on Grande Comore, where the lava rocks are too porous to support any permanent water course. The cost of drilling wells is prohibitive because of the island's basaltic soil, which requires that wells be drilled between 30 and 90 meters deep.

Water tanks have been constructed to hold the water which wells up from underground sources along the coastline (called "fombous") and coconut milk ("coco-boire"). Storage tanks are used to collect rainwater. However, many tanks contain contaminated water, a prime source of gastroenteritis and other intestinal diseases. Most tanks are old, in need of repair, and were built with substandard materials. On Grande Comore, the tanks are often cracked by seismic shocks because they are buried at too shallow a depth.

Major towns have their own water systems. Moroni and environs get water all year round from public reservoirs which have water pumped into them from a well sunk 2 km inland. The People's Republic of China and various multilateral organizations have financed the installation of water tanks in rural towns. The Comoran government is also looking into ways to extend the water supply systems on Anjouan and Moheli.

### 3.6 Road Networks

The construction of roads in the Comoros is difficult and expensive because of the rugged topography. The government made the development of coastal ring roads a top priority and consequently, the paved road network was expanded fourfold in a decade, from 105 km in 1970 to 451 km in 1980. More than 200 km of this network is on Grande Comore, with the next largest amount on Anjouan. The vehicle fleet is estimated at 1,800, making the vehicle density one of the lowest in the world. Grande Comore has by far the greatest number of vehicles per 10,000 inhabitants of the three islands.

Because the paved road network is adequate for the country's needs at this time, the government is now promoting the construction of 250 km of secondary and tertiary roads by 1985 so that the interior can be connected to the coastal towns. At present, some villages can only be reached by narrow paths or tracks requiring four-wheel-drive vehicles.

Funding for the roads has largely been provided by Saudi Arabia, Kuwait, the African Development Fund, and the OPEC Fund. Concessional loans from these sources have totalled \$45 million. The International Development Agency of the World Bank started a \$5 million road maintenance project in 1979.

### 3.7 Ports

None of the four islands in the Comoran archipelago is blessed with a harbor suitable for a large volume of ocean-going traffic. The best port facility is at Dzaoudzi on Mayotte, which is under French administration.

Port facilities are inadequate to handle ships over 400 tons at Moroni on Grande Comore or over 600 tons at Mutsamudu on Anjouan. Larger ships must anchor offshore and be loaded and unloaded by dhows. There is also a very small port at Fomboni on Moheli, which is visited by small coasters only, with loading and unloading done by dhows. During the cyclone season (November to April), all four of these ports are often unusable.

About 10 to 12 coasters (300-400 tons capacity) service the Comoros and 50 to 60 dhows (5-20 tons capacity) carry lighter and inter-island traffic. The national shipping company, the Societe National Maritime des Comores (SNMC), was created in 1977 and operates three ships which can navigate between islands and to Madagascar and Mombasa, Kenya. Dhows are operated by the Compagnie Maritime Comorienne, a subsidiary of the SNMC.

### 3.8 Airports

Each of the four Comoran islands has a small usable airstrip. Also, an international airport has recently been completed on Grande Comore. This new Hahaia International Airport has a 2,800-m runway and can accommodate Boeing 707s. The airports on Mayotte and Anjouan can accommodate DC-4s.

Air Comores, the national airline, received two DC-4s at independence which are now out of service. These have been replaced with a Fokker 27, which can carry about 24 passengers. Air travel is expensive within the Comoros but about 85% of inter-island passenger traffic is by air due to the inadequacy of passenger shipping.

The Comoro Islands are also linked to the outside world by air. The chart below shows the Comoran air traffic schedule.

<u>Route</u>	<u>Carrier</u>	<u>Flights per Week</u>
Paris - Moroni	Air France	1
Nairobi - Moroni	Air Mauritius	1
Dar es Salaam - Moroni	Air Tanzania	1
Mauritius - Moroni	Air Mauritius	1
Dzaoudzi - Moroni	Air Comores	2
Dzaoudzi - Reunion	Air Reunion	3
Moroni - Moheli - Anjouan	Air Comores	3

3.9 USAID Program

The U.S. Agency for International Development does not have a mission in the Comoro Islands and does not provide direct assistance. Instead, AID uses CARE, an American private voluntary organization, as a conduit for U.S. aid. For the six years FY 84-FY 90, CARE will receive a total of \$4.5 million to operate four projects involving rural penetration roads, garage maintenance training, land conservation, and health education. CARE received \$400,000 for these projects in FY 84 and will receive \$750,000 in FY 85.

In addition, AID contributes P.L. 480 Title II food commodities to the Comoros for food-for-work projects sponsored by the World Food Program. The food-for-work program is linked to each of the four projects managed by CARE to defray local salary costs. The amount of food totalled 1,050 MT in FY 84 at a cost of \$385,000. The cost for FY 85 is expected to total \$413,000.

Since the archipelago achieved independence in 1975, there have been two natural disasters severe enough to warrant considerable international aid. The chart below shows the aid which the United States government (USG) donated.

<u>Date</u>	<u>Disaster</u>	<u>Commodity/Service</u>	<u>Provided Thru</u>	<u>Cost</u>
April 1977	Volcano	Cooking Utensils	League of Red Cross Societies	\$5,000
January 1983	Cyclone	Cash	Government of the Comoros	\$25,000
TOTAL of USG emergency assistance to the Comoros				\$30,000

3.10 Voluntary Agencies and International Organizations

The major U.S. volag working in the Comoros is CARE, whose projects were outlined in the previous section. Its activities in the archipelago began in FY 84.

B.P. 1183  
Moroni  
Program Director: Christy Gavitt

Several agencies of the United Nations have offices in the Comoros. These include the U.N. Development Program (UNDP), the World Health Organization (WHO), the World Food Program (WFP) and the U.N. Fund for Population Activities (UNFPA). Their addresses are:

## UNDP

B.P. 648

Moroni

Street address: Route du Bord de Mer; Moroni

Telephone: 27-28, 27-29, and 24-90

Telex: 216 UNDP MORKO

Cable Address: UNDEVPRO

MORONI (COMOROS)

Resident Representative: Louis K. Darboux

## WHO

B.P. 435

Moroni

Telephone: 24-20

Telex: 221 KO

Representative: Dr. A.C. Mouhtare

WFP and UNFPA share offices with the UNDP.

WFP Project Officer: Mr. T. Zekrya

UNFPA Director: Claude Jean Paulet (based in Madagascar)

The UNDP's Resident Representative is the resident coordinator of U.N. development activities. The UNDP concentrates on agricultural projects, social and economic planning, education, professional formation, and water and infrastructure development. About 49% of UNDP's resources is absorbed by farming, forestry, fishing, and other rural development projects. Another 19% goes to general development, policy, and planning.

Assistance in the health sector is provided by WHO, UNICEF, and UNFPA. From 1977-1981, WHO provided \$1.9 million for general health services, fellowships, and promotion of environmental health. During the same period, the UNFPA contributed \$1.46 million to develop basic health services, upgrade maternity clinics, develop mother and child health statistics, and conduct a census. UNICEF spent part of its \$1.48 million program on basic health and training of midwives.

WFP spent \$2.99 million from 1977-81 on its development projects. These involved food programs for schools and hospitals, education and health assistance, and food-for-work projects.

Other major donors and lenders are the World Bank, the African Development Bank, France, Kuwait, Saudi Arabia, Oman, United Arab Emirates, Canada, Belgium, and Tunisia. As mentioned in section 3.6 Roads, the World Bank is involved in a \$5 million road project. France, Canada, Italy, West Germany, and the Netherlands provide health assistance.

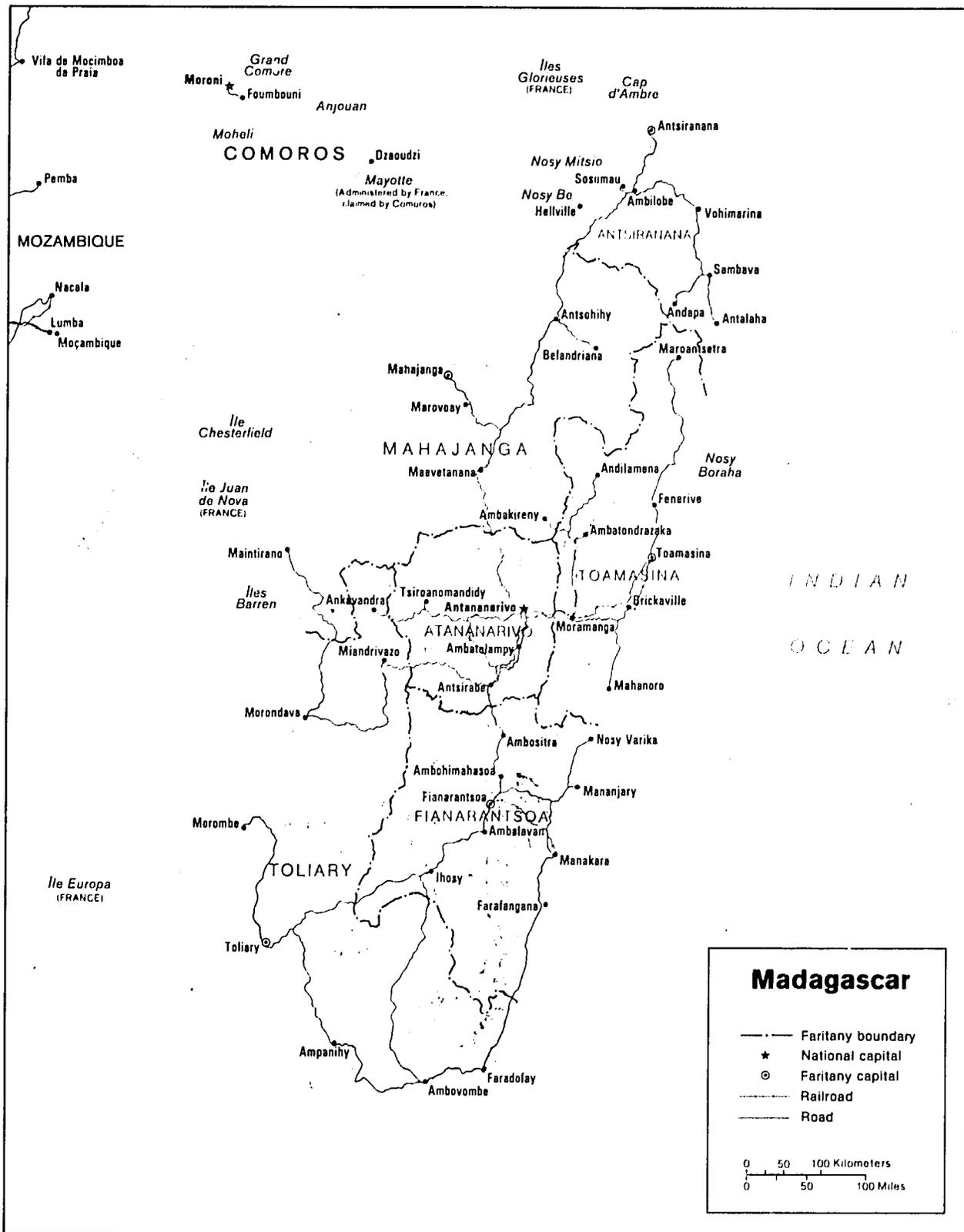
In the aftermath of a disaster, most emergency assistance comes from the Comoros' principal donors. After Cyclone Elinah swept through the Comoros in mid-January 1984, UNICEF and WHO donated medical supplies worth a total of \$64,000. WFP organized a six-month emergency feeding program for 30,000 people (5,000 each on Anjouan and Grande Comore and the entire population of Moheli). The program required 2,660 MT of rice and 164 MT of oil. WFP has use of the Comoran government's warehouses. It also has two light (5-6 MT) trucks on Moheli and several on Grande Comore. The total value of the food, including ocean freight, came to \$1.6 million.

### 3.11 Mitigation and Development

The Republic of the Comoro Islands is one of the poorest and least developed countries in the world. It has no industrial base, is not self-sufficient in food, and is very dependent on outside aid. Cyclones and an active volcano pose frequent threats to the archipelago. Given this very low level of development, small projects have the greatest chance of success. Training and educating people in basic health and improving the quality and quantity of the water supply need to be high priorities if living standards are to be raised.

Better basic health care and trained personnel would also contribute to disaster mitigation because emergency medical aid could be provided more quickly and effectively. The completion of the Comoran government's secondary and tertiary road project should greatly reduce the isolation of inland villages. The problem of erosion and deforestation also needs to be addressed and an improvement would contribute to both disaster mitigation and development.

Much needs to be done to improve the Comoros' dismal statistics. Time and the successful implementation of projects to improve infrastructure, education, and agriculture should eventually lift the Comoro Islands out of the Fourth World.



1. General Information1.1 Geographic Codes

AID Standard	687
State Region	AF
FIPS	MA

1.2 Host Mission in the U.S.

Embassy of the Democratic Republic of  
Madagascar  
Chancery: 2374 Massachusetts Ave, NW, 20008  
(265-5525 and 5526)

For current information on the Embassy staff,  
refer to the U.S. Department of State,  
Diplomatic List.

1.3 U.S. Mission in Madagascar

Antananarivo (E), 14 and 16 Rue Rainitovo  
Antsahavola; B.P. 620  
Tel. 212-57, 209-56  
Telex USA EMB MG 22202 Antananarivo

For current information on the U.S. Embassy  
staff in Madagascar, consult the most recent  
edition of the U.S. Department of State,  
Key Officers of Foreign Service Posts.

1.4 Time Zones

GMT+3; EST+8

1.5 Currency

Malagasy francs 606.7 = 1 US dollar  
(October 1984)

**1.6 Travel and Visa Information**

**Passport and Visa Requirements:**

Passport and visa required. Visa for stay up to 72 hours, 1 entry, \$23.80; for stay up to 1 month, 1 entry, \$47.61 or 2-3 entries, \$71.42, four photos, plus return postage for registry. No personal checks. All travelers must have onward/return ticket. Check Embassy, Wash. D.C. 20008 for specific requirements.

**Health Requirements:**

Cholera vaccination certificate required of travelers over six months of age arriving from infected area; yellow fever certificate required of travelers one year of age or over arriving from infected area.

**1.7 Calendar and Holidays**

New Year's Day.....	January 1
Commemoration of March 29, 1947..	March 29
Easter Monday.....	*
Labor Day.....	May 1
Ascension Day.....	*
Whit Monday.....	*
Independence and National Day....	June 26
Assumption.....	August 15
All Saints' Day.....	November 1
Christmas.....	December 25
Anniversary of the Republic.....	December 30

\* moveable religious holidays.

Fiscal year: January 1-December 31

**1.8 Treaties and Agreements**

Agricultural Commodities, Aviation, Commerce, Economic and Technical Cooperation, Investment Guaranties, Self-Help and various ad hoc A.I.D. agreements, Visas

### 1.9 International Organization Memberships

EAMA, FAO, G-77, GATT, IAEA, IBRD, ICAO, ICO, IDA, IFAD, IFC, ILO, IMCO, IMF, INTELSAT, IRC, ISO, ITU, NAM, OAU, OCAM, UN, UNESCO, UPU, WFTU, WHO, WMO, WTO

### 1.10 Geography

- Location and Area:** The Democratic Republic of Madagascar, with an area of 587,041 sq. km, comprises the fourth largest island in the world and several smaller islands in the Indian Ocean. It is located about 500 km off the coast of Mozambique, is 1,580 km long and 580 km at its widest. The coastline extends 4,828 km.
- Geographic Type:** There are five distinct geographical regions: the east coast consisting of a narrow band of lowlands and an intermediate zone of steep bluffs; the Tsaratana massif region in the north containing Mt. Tsaratana (2,800 m), the island's highest peak; the central highlands with a widely varied topography; the west coast with broad alluvial plains and well-protected harbors in the northwest; and the semi-arid south.
- Climate:** Madagascar lies in a tropical zone, but much of it has a temperate climate owing to the altitude of the interior highlands. Mean temperatures range from 21°C to 26.6°C in the coastal regions and from 13°C to 19.4°C in the central plateau. The wet, tropical east coast is exposed to the southeast trade winds and to monsoons. There is no truly dry season on the east coast, and cyclones are an annual menace. The west coast has distinct wet (summer) and dry (winter) seasons. The central plateau is a transition zone, and the extreme south is generally dry and prone to drought.

### 1.11 History and Government

#### Historical and Political Background:

The date of the earliest settlement in Madagascar has not been precisely determined, but archeological evidence points to the tenth century A.D. or later. The origin of the settlers is likewise subject to speculation. The most commonly accepted theory is that the proto-Malagasy were Malayo-Polynesian immigrants who crossed the Indian Ocean along the Asian littoral and made semi-permanent settlements on the east coast of Africa before reaching Madagascar. Although a fairly homogeneous culture had developed by the sixteenth century, when the first European contact was made, it was not until the early nineteenth century that a degree of political unity was achieved under the Merina rulers of the central highlands. In 1896, a decade after Britain had accepted the imposition of a French protectorate over the island, French control was established by force and the Merina monarchy was abolished.

Growing Malagasy demands for self-government during the ensuing decades culminated in a revolt against French rule in 1947 in which the number of people killed has been variously estimated between 11,000 and 80,000. The French subsequently instituted some reforms and in 1960 granted full independence to the island. The country's first president, Philibert Tsiranana, leader of the Parti Social Democrate (PSD), held office for ten years before relinquishing power in April 1971 in the wake of violent anti-government demonstrations. Social tensions continued to mount under succeeding governments in the face of a deteriorating economy and ethnic discord. Following the assassination of a newly installed president in February 1975, an 18-man military directory ruled for a time under martial law. In June 1975, a new interim government was formed by former foreign minister, Didier Ratsiraka, described as the chief architect of Madagascar's "turn to the left". A referendum held on December 21, 1975, approved a seven-year presidency for

Ratsiraka, a new constitution, and the Little Red Book, the charter of the Malagasy Socialist Revolution. Despite the country's severe economic problems, President Ratsiraka was returned to office in the November 1982 elections, but with a smaller than expected margin. His only opposition came from the ultra-nationalist, Monja Jaona, of the MONIMA party, who was arrested when a general strike he called to protest the election results erupted in violence.

**Government Structure:**

The 1975 constitution provides for the following government institutions: a President elected for seven years by universal adult suffrage; the Supreme Revolutionary Council (SRC), "the guardian of the Malagasy Socialist Revolution", of which the President is chairman; the National People's Assembly elected for five years by universal suffrage; the Cabinet headed by a presidentially appointed Prime Minister; the Military Development Committee; and the seven-member Constitutional High Court. The constitution also provides for a single national unity party, the National Front for the Defense of the Malagasy Socialist Revolution (FNDR). Seven parties, of which the government party AREMA is the most influential, are allowed political activity within the FNDR and are represented on the Supreme Revolutionary Council.

**Regional Organization:**

Administrative decentralization has been implemented through a revival of traditional village-based institutions (fokonolona). Six faritany have replaced the former provinces: Fianarantsoa, Mahajanga (Majunga), Toamasina (Tamatave), Antseranana (Diego-Suarez), Toliary (Tulear), and Antananarivo (Tananarive). Faritany are divided into 110-115 councils at the prefecture and subprefecture levels called fivondronam-pokontany; about 1,250 councils at the county level called firaisam-pokontany; and some 11,400 village and urban ward councils called fokontany. Each unit is governed by a general assembly or council whose members must belong to the FNDR.

Please note: Consistent with the policy of Malagasization, many place names have been changed since 1975. In addition to those noted above, the city of Fort Dauphin is now Taolanaro or Farodofay. The old names are still widely used.

#### 1.12 Ethnic and Sociocultural Groups

The Malagasy people are mainly a blend of Malayo-Indonesian and African elements with some Arab and European (French) admixture. There is no pure racial type and the broad classification of coastal people (cotiers) as mixed Negroid, and highlanders as predominantly Malayo-Indonesian is misleading. Although some 18 to 20 "tribes" can be identified, the population of Madagascar is culturally and linguistically homogeneous. Each ethnic group might better be defined as a group of clans whose uniqueness derives in part from its geographical location. Despite a common cultural heritage, traditional tribal rivalry - particularly between the cotiers and the highlanders - remains a divisive factor. Society is also divided into three fairly rigid strata: nobles, commoners, and descendants of slaves.

The largest groups are as follows: about two million Merina in the central highlands (26% of the total population); more than one million Betsimisarka on the east coast, who are predominantly cultivators; nearly one million Betsileo in the south central highlands, farmers and craftsmen; over 500,000 Tsimihety in the northern highlands, primarily cattle raisers; and some 500,000 Sakalava on the west coast, mainly pastoralists and seafarers.

French and Comorans made up the largest group of foreigners in the early 1970's, but their numbers have declined. Of 60,000 Comoro Islanders, about 18,000 were repatriated in 1977 after racial riots; French nationals numbered some 17,000 in 1981. Other aliens include about 10,000 Indian nationals and an equal number of Chinese.

1.13 Languages

Malagasy, of Malayo-Polynesian origin, is the official language. Different dialects spoken in different regions are mutually intelligible. The Merina dialect is the written form. French and English are understood and taught in the schools. Both Malagasy and French are used in government publications.

1.14 Religion

An estimated 57% of the Malagasy adhere to traditional beliefs which are based on the idea of the interrelatedness of individual human beings and the close tie between the living and the dead. Ancestors are considered the originators and guardians of customs and the most important and authoritative members of the family. Innumerable taboos, the commands of ancestors, are precise proscriptions for which foods not to eat, which words and actions to avoid, etc. They apply to individuals, families, kinship, and ethnic groups.

About 40% of the population is Christian, divided almost evenly between Protestant and Catholic; a small minority is Muslim.

1.15 PopulationNational Demographic  
Characteristics:

An enumerated population of 7,603,790 was arrived at by the 1975 census. Recent estimates put the population in the range of 9 to 10 million.

Average annual growth rate (1975-79)	2.8%
Density per sq. km.	14.8
Density per sq. km of agricultural land	23.6
Percent urban	18.9
Urban growth rate	5.2%
Age structure (percent)	
0-14 years	43.8
15-64 years	52.9
65+	3.3

Source: World Bank estimates (1979-81).

**Regional Distribution:** Population is concentrated in the central plateau region and is relatively dense along the east coast. The most sparsely settled areas are the west coast and, especially, the south. About 60% of the urban population in 1975 lived in the six main cities which are also faritany capitals. Antananarivo, the national capital, accommodated nearly half of the urban population in 1982 with a central city population of 595,000 and another 250,000 in suburban districts. The port city of Toamasina has a population of about 100,000; two other major urban centers, Mahajanga and Antsiranana, have populations of approximately 130,000 and 106,000 respectively.

### 1.16 Health

<b>Vital Statistics:</b>	Births/1,000 population	46.7
	Deaths/1,000 population	17.9
	Infant mortality/1,000 live births	69.5
	Life expectancy at birth, years	47.5
	Access to safe water (1975) (percent of population)	
	urban	76.0
	rural	14.0
	Population per physician (1978)	10,170
	Population per nursing person (1978)	3,660
	Population per hospital bed (1977)	400

Source: World Bank estimates (1979-81).

#### Major Health Problems:

Malaria, despite eradication campaigns, remains the most serious health problem with its locus in coastal regions, especially the east; maximum transmission September-March. Schistosomiasis is highly prevalent in the lowlands. There is a high incidence of tuberculosis as well as diphtheria, typhoid and paratyphoid, venereal diseases, tetanus, hepatitis, and gastroenteric parasites. Leprosy is endemic. Bubonic plague appears sporadically on a small scale; a number of isolated cases were reported in the high plateau area in the aftermath of the January 1982 floods.

**Diet and Nutrition:** The usual diet is generally unbalanced, deficient in quantity and quality, and based on rice, which has replaced cassava and other tubers as the traditional staple. Only the Antanosy, Antandroy, and other southern peoples use cassava and other tubers as the main food, although rice is becoming increasingly popular. There is marked variation in caloric intake and dietary composition depending on geographic location and time of year. PEM (protein energy malnutrition) is a common condition, especially in children. Other reported nutritional problems: Vitamin A deficiency; scurvy in the high plateau region; beri-beri in urban and coastal populations; goiter in some areas.

### 1.17 Economy

<b>Basic Indicators:</b>	Gross domestic product	\$2,900 million
	GNP per capita (1982)	\$320
	Average annual growth rate (%) (1960-82)	-0.5
	Average annual inflation rate (%) (1970-82)	11.5
	Exports (1982)	\$433 million
	Imports (1982)	\$522 million

Source: World Bank. World Development Report 1984.

**Overview:** There is wide disparity in wealth and development levels among geographic regions, with the central plateau area being considerably more advanced than the coastal areas of the west and the south. Despite a wide range of resources and relatively favorable climate, Madagascar is ranked among the poorest nations of the world with a GNP per capita income of about \$320 in 1982. The years 1970-1982 saw virtually no growth in real GDP, with much of that period being marked by the pursuit of official policies which sought to restructure the economy along socialist lines and reduce foreign involvement. By 1981, the state controlled 75% of

the economy. At the same time, world market conditions were not favorable for the growth of Madagascar's primary exports. The country's poor growth and development performance prompted the adoption of a new economic policy orientation in 1978 which greatly expanded public sector investment through external borrowing. The resulting deterioration in balance of payments and government budget positions forced a further policy reappraisal. Since 1982, the government has worked with the International Monetary Fund (IMF) and the Paris Club of western creditors in an effort to restore economic stability.

**Agriculture:**

Agriculture is the leading economic sector, employing 85% of the population and accounting for about 35% of GDP and 80% of export earnings. A low production growth rate, averaging less than 2% annually since the beginning of the 1970s, has inhibited economic development and necessitated increased food imports, especially rice and edible oils. The long-term potential for agricultural development is excellent, but improved infrastructure is a primary requirement. Highly diversified production includes a variety of staple foods, industrial crops (cotton, groundnuts, sugarcane), and export crops (coffee, vanilla, cloves, pepper). The leading crop, paddy rice, occupies about one half of total area under cultivation. Cattle are raised on vast areas of natural pasture throughout the island.

**Industry:**

Industry operates well below capacity, contributing about 19% of GDP, and providing only about 4.5% of total employment. Production of food and textiles is mainly for the domestic market. Other activity on a small scale includes the manufacture of tobacco products, chemicals (soap, matches), construction materials (cement, corrugated sheets), and petroleum refining. Mica, graphite, and chromite are the principal minerals. Offshore petroleum deposits have been discovered and exploration is continuing. Industrial production, including mining, has dropped sharply since 1979.

- Imports:** Capital goods, food and beverages, other consumer goods, mineral fuels, and other intermediate goods are the primary imports.
- Imports of capital goods (machinery, electrical equipment, vehicles, etc.) grew rapidly in volume and value between 1977 and 1980. However, severe foreign currency shortages obliged the government to reduce imports in 1981 by about 26%. Import restrictions were expected to be relaxed somewhat in 1982 to allow the purchase of desperately needed spare parts and agricultural inputs which were among the categories most affected by the ban. Food imports continued to grow as bad weather, including serious floods in 1982, reduced rice harvests. Rice imports exceeded 350,000 tons in 1982.
- Suppliers:** France, Fed. Rep. of Germany, Italy, Belgium/Luxemburg, Japan, Netherlands, U.K., USA and others.
- Exports:** Coffee, vanilla, and cloves are the principal export earners. Others include cotton, pepper, sugar and other processed agricultural products, textiles and shoes, fish, meat, chromite, graphite, mica and petroleum products.
- The volume of exports stagnated during 1978-1982, reflecting world market conditions, poor production performance, and increasing domestic demand.
- Export Markets:** France is the leading purchaser, followed by the U.S.; others include Reunion, Japan, Fed. Rep. of Germany, U.K., USSR, Algeria, and the Netherlands.

### **1.18 Communications**

- Radio/Television:** Radio-Television Malagasy (RTM) is the state-owned broadcasting company. Radio broadcasts in French, Arabic, and Malagasy from 28 transmitters. Television broadcasts in French and Malagasy from 22 transmitters. There were 855,000 radio receivers and 70,000 television receivers in 1982.

**Telecommunications:** There are 37,100 telephones in use or 0.4 per 100 inhabitants. The system, which is described as "fair", includes open-wire lines, co-axial cables, and radio-relay links. There is one Indian Ocean satellite station.

**Press:** Madagascar has seven daily newspapers. Madagascar-Matin, printed in French and Malagasy, and Le Courrier de Madagascar have circulations of 32,000 and 22,000 respectively.

### 1.19 Power

Total installed electric power capacity is approximately 220 MW, of which about 44% is hydrobased since the completion of the Andekaleka hydropower project in June 1982. Electricity is used primarily in industry; household use is limited essentially to lighting in the cities. Outside the central plateau, which has the only extensive power grid, industries generate their own electricity, mostly with diesel-powered generators. JIRAMA is the state-owned enterprise responsible for power and water distribution.

### 1.20 Transportation

The transportation network has suffered serious deterioration in recent years and is considered an obstacle to development in its present state. The road network consists of some 49,650 km of roads: 4,890 km of paved roads; 5,260 km of engineered earth and gravel roads; and 39,500 km of feeder roads and tracks. The main road is a north-south artery interconnecting Mahajanga, Antananarivo, and Fianarantsoa. Regional capitals are connected by national roads; regional roads link smaller towns and villages. The Ministry of Transport, Supplies, and Tourism (MTRT) is responsible for road, rail, air, and water transport. The Ministry of Public Works (MTP) is in charge of planning, building, and maintaining highways, ports, and airports.

**Railways:**

The railway consists of two unconnected single track systems totaling 860 route-km. The northern line (about 700 km) links Toamasina on the east coast with Antsirabe in the interior via Antananarivo. A branch line north connects with the agricultural region of Lake Alaotra and the chromite mines. The southern system (165 km) links Fianarantsoa and the agricultural areas in the southern plateau with the port of Manakara. The railroad authority is the Reseau National des Chemins de Fer Malagasy (RNCFM).

**Inland Waterways:**

Inland water transport is extremely limited. Some of the rivers in the west are navigable for short distances. The 600 km-long series of lagoons along the east coast (Pangalanes Canal), interrupted by sand and rocky ridges, can be navigated by light barges for limited stretches and is used to move agricultural products along the east coast.

**Ports:**

Toamasina, on the east coast, is the primary international port, handling 66% of the traffic; Mahajanga, Antseranana, and Toliara are secondary international ports. In addition, there are about 20 primary and secondary coasting ports.

**Shipping:**

The Societe Malgache des Transports Maritimes (SMTM), the state-controlled international line, is the only domestic company engaged in overseas trade. Coastal shipping is handled primarily by the Compagnie Malgache de Navigation, which is 92% state-owned.

**Airports:**

Because of the difficult terrain, the dispersed settlement pattern, and the relatively poor surface transport system, air transport plays an important role in internal as well as international communications. There are about 121 usable airfields; 56 are designated airports, of which 17 are built to all-weather standards and five can handle international flights. The principal airport, Ivato, near Antananarivo, accounts for 50% of all traffic.

**Airlines:**

**Air Madagascar, 80% government-owned, provides domestic service to all principal towns and international service to France, the Soviet Union, Tanzania, Kenya, Mauritius, and Djibouti. Agreements are pending with several other countries.**

**Please note: A more detailed discussion of transportation in Madagascar is found in sections 3.7, 3.8, and 3.9.**

## 2. Disaster Vulnerability

### 2.1 Overview of the Physical Environment

Madagascar can be divided into five or six fairly distinct topographic regions. The dominant feature is a great central highland, approximately 1,160 km long and 386 km wide with an average elevation of 1,200-1,400 m. The term, "plateau", often applied to this region, is misleading for the topography is widely varied. Rolling eroded hills are interspersed with granite outcroppings, extinct volcanoes, and alluvial plains and marshes. A rift valley runs north to south and includes the 40 km-long Lake Alaotra, the island's largest inland body of water. Earth tremors are frequent along this geological region. There are three major mountain peaks rising above the highlands: Tsaratana in the north, a granite mass covered by lava and the country's highest peak at 2,880 m; Ankaratra, a volcanic massif reaching 2,644 m in the center of the island; and Andringitra, an eroded granite mass of 2,666 m, located south of Ambalavo. The Anjafy Plateau and the volcanic formation of Itasy are other distinctive features. Several major rivers originate in the highlands. Those flowing to the east coast include the Mananara, the Mangoro, the Bemarivo, the Ivondro, and the Mananjary. Flooding is sometimes severe along these rivers because of deforestation and the steepness of the slopes. The main rivers on the west coast, which tend to be longer and slower, are the Sambirano, the Mahajamba, the Betsiboka, the Mangoky, the Mania, the North and South Mahavavy, and the Onilahy. The Ikopa, a tributary of the Betsiboka, runs past Antananarivo.

The highland area drops off abruptly to the east coast along a 500 m high escarpment. A narrow alluvial plain, 16-80 km wide, extends from the Bay of Antongil in the north to Taolanaro (Fort Dauphin) in the south. The Pangalanes Canal, an 800 km-long series of lagoons, is the prominent feature of the almost straight coastline. Hazardous conditions on the east coast, which faces an empty ocean, have tended to increase the country's isolation. Offshore reefs, high wind velocity, frequent hurricanes, and few protected coves add to the dangers and expense of trade and travel here.

On the western side of the island, the central highlands descend gradually to a broad belt of alluvial plains and low plateaus. The west coast is more deeply indented than the east coast, providing a greater number of natural harbors, especially in the northwest.

A tropical, fertile area in the northernmost part of the island is separated from the rest of the country by the rugged topography just to the south. The dry southwest region is bordered by the Ivakoany Massif on the east and the Isalo Ruiniform Massif on the north.

The climate of Madagascar is almost as varied as the topography. Although generally described as tropical marine, the climate is influenced by altitude and exposure to prevailing winds. There are four principal

weather zones. The east coast has a subequatorial climate characterized by heavy rainfall, high humidity, and high temperatures. There is no truly dry season in this area which is most directly exposed to the trade winds. The central highlands are both drier and cooler with distinct wet summer and dry winter seasons. The dry season is more prolonged in the west and south, the trade winds having discharged much of their moisture by the time they reach this region. The south and southwest are semi-desert areas, receiving only infrequent precipitation.

Mean Monthly and Annual Rainfall (mm)  
at Selected Stations in Madagascar

<u>STATION</u>	<u>Elev</u> (m)	<u>Jan</u>	<u>Feb</u>	<u>Mar</u>	<u>Apr</u>	<u>May</u>	<u>Jun</u>	<u>Jul</u>	<u>Aug</u>	<u>Sep</u>	<u>Oct</u>	<u>Nov</u>	<u>Dec</u>	<u>Annual</u>
Antsiranana	105	277	291	178	50	11	19	16	19	9	16	45	150	1081
Analalava	57	450	382	263	63	14	4	3	5	12	47	186	314	1745
Mahajanga	18	419	373	254	67	7	1	1	5	2	18	113	264	1522
Maintirano	23	361	266	168	29	11	3	3	5	5	16	47	211	1124
Antananarivo	1276	271	206	214	41	16	10	12	14	18	44	171	335	1351
Antalaha	88	336	246	269	218	167	190	170	194	98	81	111	190	2270
Toamasina	6	456	438	488	290	248	276	276	214	111	91	182	317	3386
Toliary	8	95	87	45	12	23	13	5	4	11	8	27	98	428
Mananjary	6	344	342	424	233	200	216	179	166	93	98	233	210	2729
Faradofay (Fort Dauphin)	9	208	161	236	144	142	127	153	122	70	106	148	145	1759

Mean Monthly and Annual Air Temperature (°C)  
at Selected Stations in Madagascar

<u>STATION</u>	<u>Elev</u> (m)	<u>Jan</u>	<u>Feb</u>	<u>Mar</u>	<u>Apr</u>	<u>May</u>	<u>Jun</u>	<u>Jul</u>	<u>Aug</u>	<u>Sep</u>	<u>Oct</u>	<u>Nov</u>	<u>Dec</u>	<u>Annual</u>
Toliary	8	27	27	27	25	23	21	20	21	22	24	25	27	24
Mananjary	6	26	26	25	24	22	20	20	20	21	23	24	25	23
Antananarivo	1276	21	21	21	20	17	15	15	15	15	17	20	21	21

Source: Agroclimatic Conditions and Assessment Methods for Drought/Food Shortages in Subequatorial Africa

## 2.2 Tropical Cyclones

Madagascar lies in an area of considerable atmospheric activity (See Overview), and tropical cyclones and floods are the most common disaster types. Cyclones occur during the austral summer (October to April), with the most intense activity between December and March. The storms originate in the waters east of Madagascar, usually moving southwest and later curving around to the south and southeast. The average yearly frequency in the area is about eleven tropical storms, four of them reaching cyclone strength. Storm winds may exceed 200 km per hour, and damaging floods often accompany the storms. The east coast is more regularly and severely hit, but any part of the island, with the exception of the extreme south, may be affected. Destructive cyclones hit Madagascar most recently during both the 1981-82 and 1983-84 rainy seasons.

## 2.3 Floods

Flooding may result from cyclonic storms or from unusually severe and prolonged seasonal rains. In January-February 1982, for example, torrential rains fell over much of the country for several successive days. The central highlands region was most seriously affected and especially the capital city of Antananarivo which received 809 mm of rain -- three times the normal volume -- during the month of January. Overflowing rivers and landslides in several areas forced thousands of people to flee their homes, disrupted road and rail traffic, and inflicted heavy agricultural losses. Again, during the 1983-84 rainy season, rainfall amounts were 220% of normal in some regions through the month of February, resulting in widespread flooding. In both instances, the situation was exacerbated by the heavy rains accompanying several cyclones. The unchecked expansion of cities into surrounding flood plains has created a direct hazard to thousands of residents of such major urban centers as Antananarivo and Toamasina. In Antananarivo, some flooding occurs every year during the rainy season because of the difficulty of draining low-lying areas of the city. A more serious situation develops when flood waters spill over protective dikes. Several low-income neighborhoods of Mahajanga are located on low-lying areas adjacent to marshes and are also subject to periodic flooding.

## 2.4 Drought

The southwest is an area of chronic drought where irrigation is indispensable for agriculture. Other areas, however, may also be affected by delayed or erratic rainfall. In recent years, for example, drought damaged about 50% of the rice crop in Fianarantsoa Province in 1976, and a prolonged drought affected crops in other regions in 1978. The western regions of Morondava and Maintirano suffered drought in 1980, and the northeast was affected in 1981.

### 2.5 Deforestation and Erosion

The widespread practice of burning forests in order to clear the land for cultivation or grazing has denuded much of the landscape, especially in the central highlands. The result is a soil erosion problem of vast proportions. The World Bank estimates that as much as one million hectares per year are lost to productive agriculture through soil erosion. Erosion also results in the siltation of irrigation systems.

### 2.6 Epidemics and Degradation of Water Supplies

Only 25% of the population nationwide has access to a safe water supply. The urban population is better served than the rural, with some 76% having access to treated water supplies compared with 14% of the rural population. A lack of adequate waste disposal systems in many small communities, along with inadequate protection of the water source, allows the rapid spread of waterborne diseases. This is also a problem in some of the major urban areas (e.g., Antananarivo and Toamasina) where inadequate sewage facilities and poor drainage of low-lying areas combine to create environmental hazards. Flooding compounds the problem. Higher than normal incidences of common ailments and endemic diseases have been reported in the aftermath of disasters. After the 1983-84 cyclones, for example, dysentery reached epidemic proportions in Mahajanga, Antsiranana, and Toamasina. There were some reported cases of typhoid and two suspected, though unconfirmed, cases of cholera.

### 2.7 Volcanism and Seismicity

Madagascar has no history of volcanic eruptions or destructive earthquakes in modern times. Formations of volcanic origin (Itasy, Ankaratra, and Tsaratanana) are evidence of past volcanic activity, however, and earth tremors are frequently felt along the rift valley of the central highlands.

### 2.8 Other Disaster Types

Other possible disaster types are lightning damage, fires and other accidents, insect infestation, and civil strife.

Madagascar experiences thunderstorms 100 or more days a year. The storms occur during the rainy season and are frequently severe. Lightning reportedly kills more than 60 people each year.

As recently as March 1981, about 300,000 hectares were damaged by locusts. Other insects attack particular crops, such as cotton.

Traditional rivalry between ethnic groups, particularly the highlanders and the cotiers, has been a cause of civil discord in the past. Violence also occurred when student unrest led to strikes and rioting in the nation's capital in 1972 and again in 1980 and 1981. Thus, civil strife remains a potential and recurring threat.

### 2.9 Disaster History

<u>Disaster</u>	<u>Location</u>	<u>Date</u>	<u>Number Killed</u>	<u>Number Affected</u>	<u>Damage (\$000)</u>
Fire	Anivorano & Bamenejika	9/01/64	0	500	250,000
Cyclone	Andapa & Tulear (Toliary)	1/00/68	29	65,000	3,100
Cyclone	E-W/Nosy Varika	2/05/69	81	40,000	5,000
Cyclone	C&S Madagascar	2/23/70	70	100,000	11,400
Civil Strife	Tananarive Univ.	5/17/72	34	100	n.a.
Cyclone	Central region	2/14/72	91	2,500,000	12,420
Cyclone	S. Madagascar	1/18/75	n.a.	n.a.	n.a.
Cyclone	Tamatave (Toamasina)	3/08/75	7	10,000	76,100
Cyclones	North	1/10/76	16	500,000	44,140
* Drought	Fianarantsoa	5/00/76	n.a.	n.a.	n.a.
Cyclone	5 Provinces	2/01/77	10	30,000	n.a.
Cyclone	N, NW, Majunga (Mahajanga)	2/01/78	15	12,800	6,057
* Drought	Madagascar	4/00/78	n.a.	n.a.	n.a.
Cyclone	Tulear (Toliary)	12/28/78	70	18,000	29,000
Cyclone	E, NE, Tamatave	1/20/80	2	1,700	714
* Drought	Morondava/Maintirano	6/00/80	n.a.	n.a.	n.a.
* Insect Infestation	South	3/00/81	0	n.a.	n.a.

Disaster History

<u>Disaster</u>	<u>Location</u>	<u>Date</u>	<u>Number Killed</u>	<u>Number Affected</u>	<u>Damage (\$000)</u>
Flood/ Cyclones	Countrywide/ Antananarivo	12/20/81 to 3/10/83	107	118,000	250,000
Cyclones	N. Madagascar/ E. Coast	12/10/83	42	13,560	25,000
Cyclone	Antsiranana/ Mahajanga	4/09/84	68	100,000	n.a.

\* There are no statistics to indicate that these events were disasters, but they are known to have had an impact on the food situation.

Sources: OFDA Disaster History on file in Washington, D.C.; Agroclimatic Conditions and Assessment Methods for Drought/Food Shortages in Subequatorial Africa

2.10 Vulnerability of Infrastructure

Madagascar's infrastructure has deteriorated in recent years due primarily to a lack of needed materials and spare parts. Damage inflicted by flooding and cyclones exacerbates an already serious situation.

The transportation sector, and in particular the inland transport infrastructure, is inadequate in many respects and highly vulnerable to storm damage. Although the regional capitals are connected by all-weather roads, many potentially productive areas on the east and west coasts are not easily accessible to the rest of the country under the best weather conditions and may be totally cut off during the rainy season. Some roads in the north also pass through flood plains. Road links to the south are poorly maintained earth roads or tracks which, however, are generally passable because of the prevailing dry climate in that region.

Vital supply lines may be severed and whole villages isolated when roads and bridges in cyclone and flood prone areas are washed out or weakened during storms. The main road link between the capital city of Antananarivo and the major port city of Toamasina, for example, has often been impassable following cyclones in that region. Due to the poor condition of this "lifeline" highway (which is currently undergoing reconstruction), there is heavy reliance on the rail service between the two cities. Not infrequently, however, service on this line is also interrupted by cyclone-induced flooding and landslides. Restoration of service is always a top government priority in disaster rehabilitation efforts.

Small coastal vessels may be the best alternative to road and rail traffic after a flooding disaster, although many of the ports are hampered by inadequate connections with the areas they serve. Ports are also subject to damage from the high winds and rains of cyclones. Those on the east coast are more frequently affected, but other ports are vulnerable as well. Port facilities in both Antsiranana (on the north coast) and Mahajanga (in the northwest), for example, were damaged by Cyclone Kamisy in April 1984.

Seventeen of the country's airports have reportedly been built to all-weather standards and air transport of supplies is also a possibility in emergencies. Some of the smaller airfields, however, may be inundated during heavy rains.

Communications lines are frequently knocked out by cyclonic winds, making damage assessment difficult. Power lines may also be cut and water supplies interrupted. Irrigation canals, dams, dikes, and retaining walls may be damaged in severe flooding, causing further inundation of surrounding land.

The housing sector is extremely vulnerable to wind and flood damage. Low-income neighborhoods located in low-lying areas of some of the major cities (Mahajanga, Antananarivo, and Toamasina) are subject to periodic flooding. In addition, flimsy buildings of corrugated iron sheets commonly seen in urban areas are not cyclone resistant. During Cyclone Kamisy, almost all buildings with roofs of galvanized iron sheets in the Mahajanga and Antsiranana areas lost at least part of their roofs. These included larger public buildings such as schools and hospitals as well as dwellings. Roofs of tile fared little better because no cement had been used to affix the tiles to the roofs. The majority of rural houses, constructed either of wattle and daub (in Mahajanga) or of wood pole and raffia (Antsiranana), were demolished in the cyclone as well. There is less information available on building practices in other regions, but housing has been destroyed or damaged in all parts of the country during past cyclones.

### 2.11 Vulnerability of Agriculture

Because of agriculture's dominant place in Madagascar's economy (35% of GDP, 80% of export earnings, and 85% of employment), its vulnerability to the natural disasters which beset the country is especially significant. Rainfed cultivation of most crops is possible in the north, east, and highlands, but irrigation is indispensable to agriculture in the dry southwest and a boon to production in some other areas. About one-third of the cultivated area of three million hectares is now irrigated. Official (i.e., government-managed) systems serve some 250,000 ha, while about 700,000 ha are irrigated by traditional methods using some form of water control. Rice is the main irrigated crop; sugar and cotton are also

irrigated in some areas. Despite the fairly widespread use of irrigation, drought persists as a disaster type. Although it occurs most often in the normally dry areas, delayed or erratic rainfall may reduce crop output in other areas as well.

The effect of cyclones and flooding on crops and agricultural infrastructure is generally more dramatic. The growth rate of agricultural production has varied over the past 15 years. This is explained in part by changes in world prices for key exports; however, weather conditions have also played a large role. The average annual growth rate of agricultural production between 1966 and 1980 was 2.1%, but wide fluctuations occurred within this period, most notably in 1969-71, 1976, and 1978-79 -- years when the country suffered severe cyclone damage. In 1969 Cyclone Dany, in a sweep from the east to the west coast, did over \$5 million worth of damage to cotton, coffee, and rice crops. Cyclone Jane followed in 1970, hitting central and southern Madagascar, and causing crop damage of over \$7 million. Damage to crops and farm animals totaled \$8.6 million in 1972 when Cyclone Eugenie battered the provinces of Toamasina, Antananarivo, and Mahajanga. And two cyclones in 1975 and three in 1976 caused \$1.6 million and \$14 million worth of damage respectively to crops and domestic animals. In this decade, cyclones and flooding devastated wide areas of the country in 1981-82 and 1983-84. Rice imports exceeded 350,000 tons in 1982 (up from 191,000 tons the previous year) to make up the deficit caused largely by cyclone damage. Rice and other crops were again affected in 1983-84.

Besides the direct damage to crops through high winds and flooding, cyclones also inflict heavy damage on roads, irrigation systems, storage facilities and other infrastructure. By contributing to the deterioration of the road system, cyclones and flood disasters further limit access to agricultural areas. Additionally, cyclones and flooding wash away valuable top soil exposed by the practice of burning bush to produce grass for grazing. The siltation of irrigation systems which results from soil runoff increases maintenance problems and further impedes agricultural development.

#### Agriculture by region and major crops

Agricultural production is highly diversified in Madagascar owing to the wide variety of topographic and climatic conditions. Rice cultivation and livestock raising are found throughout the country. Other activities tend to be concentrated in specific areas: in the highlands, rice is the dominant crop, supplemented by food crops, fruits, vegetables, and cattle; on the east coast coffee is the dominant cash crop and rice the staple food crop; in the northern area, sugarcane, cocoa, spices, and essential oils are produced; the cultivation of cotton and groundnuts and livestock production are the chief agricultural activities on the west coast; and livestock raising is the main pursuit in the south.

<u>Crops</u>	<u>Location</u>	<u>No. of growers</u>	<u>No. of hectares</u>	<u>Annual production</u>
<u>Food crops</u>				
Rice	Throughout country except in south	70% of population	1.2 million	Approx. 2 mil. tons paddy (1983)
Manioc	Throughout country on hillsides	Most farmers	315,000	1.6 mil. tons (1980)
Maize			135,000	145,000 tons (1980)
<u>Industrial Crops</u>				
Cotton	Western areas	20,000 families	18,000	25,870 tons (1982)
Sugar	Coastal areas east (rain-fed) northwest (irrigated)	14,000	30,000	105,000 tons (ave.)
<u>Exports crops</u>				
Coffee	East coast	350,000	220,000	79,275 tons
Cloves		80,000	63,000	9,700 tons (ave.)
Pepper	Near Ambanja, Toamasina, Manajary, Farfanga, and eastern Nosy Be	80,000	8,000	
Vanilla	Near Antalaha	70,000	20,000-30,000	
Cocoa	Near Ambanja	2,000	4,000	1,925 tons (1980)

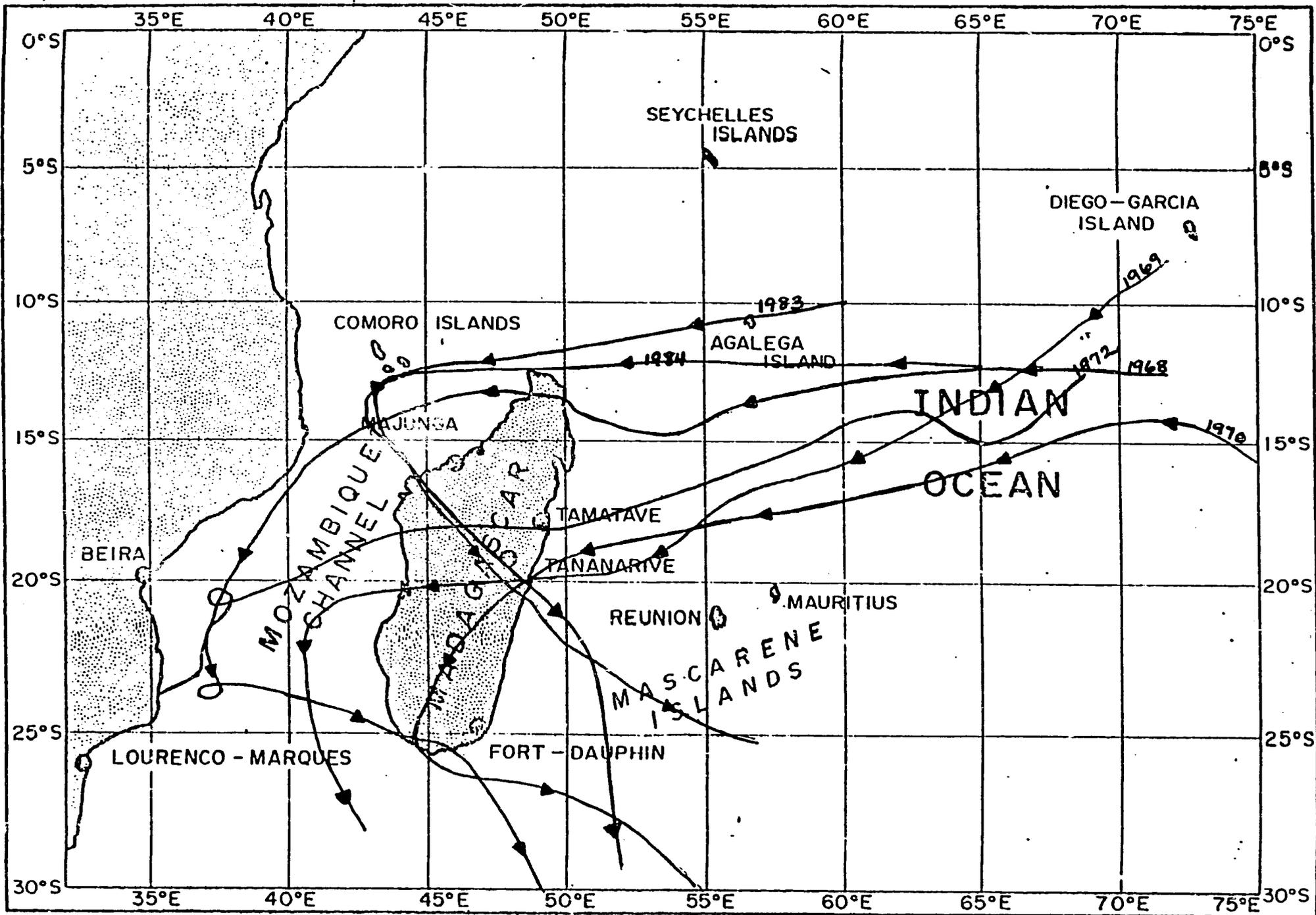
<u>Crops</u>	<u>Location</u>	<u>No. of growers</u>	<u>No. of hectares</u>	<u>Annual Production</u>
<u>Livestock</u>	All areas but especially in south, west, and high plateau			Herd size (1978): 10.1 mil. cattle 1.8 mil. sheep 1.1 mil. pigs

Crop Calendar

<u>Commodity</u>	<u>September - November</u>	<u>Harvesting season</u>
<b>Beverages:</b>		
Coffee (mainly Robusta)	- - -	June - November.
Cocoa	- - -	Throughout year.
<b>Cereals and grains:</b>		
<b>Corn:</b>		
First crop	November - January	February - May.
Second crop	March - June	July - October.
Rice (irrigated)	Throughout year	1/ Throughout year.
<b>Fibers:</b>		
Raphia	November - December	May - November.
Sisal	Throughout year	Throughout year.
<b>Fruits:</b>		
Bananas	- - -	Throughout year.
<b>Oilseeds:</b>		
Castorbeans	November - December	June - January.
<b>Peanuts:</b>		
First crop	November - December	March - June.
Second crop	April - May	August - September.
Tung	- - -	June - November.
<b>Miscellaneous crops:</b>		
Black pepper	December - February	July - September.
Cloves	March - April	October - December.
Ginger	March - April	October - December.
Vanilla	December - March	May - August
<b>Sugarcane</b>	Throughout year	2/ May - December.
<b>Tobacco, Maryland, flue-cured, etc.</b>	October - May	March - October.

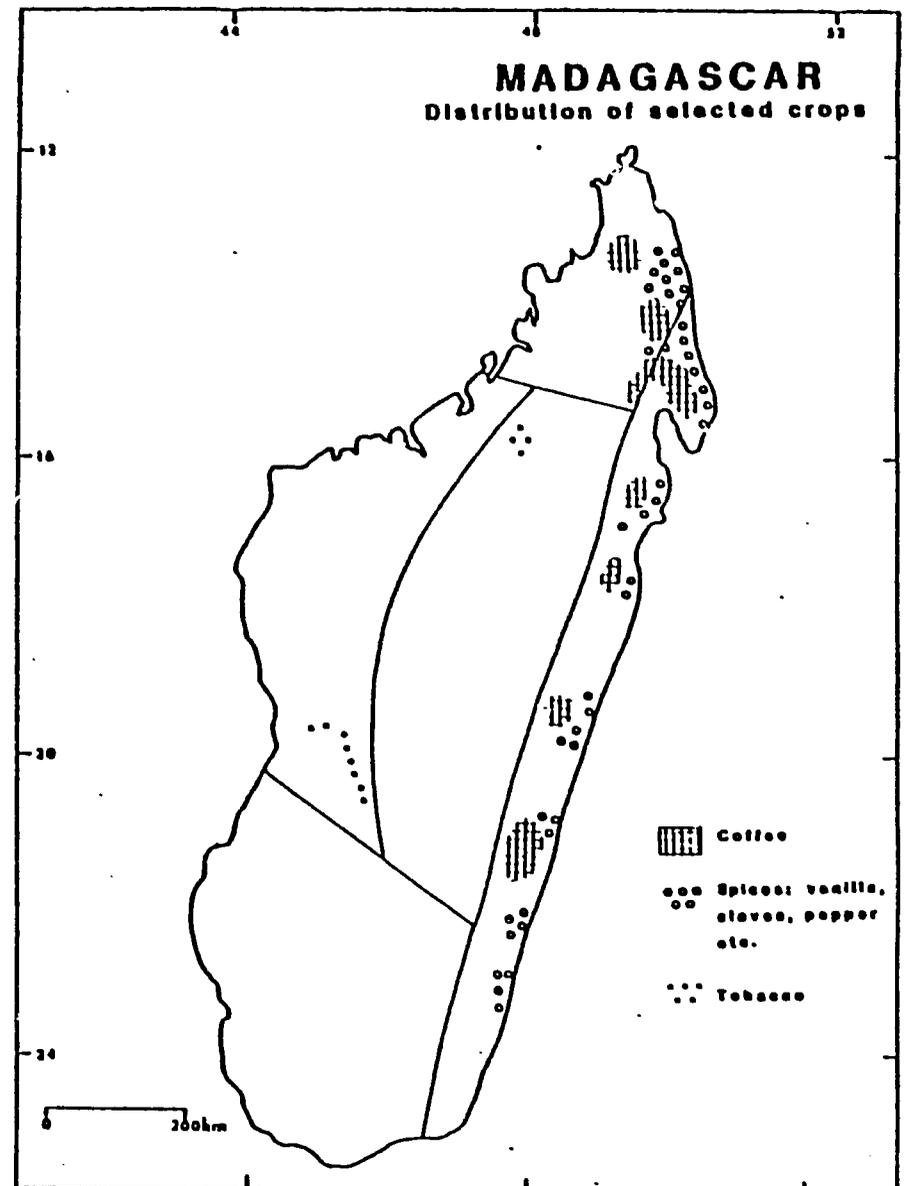
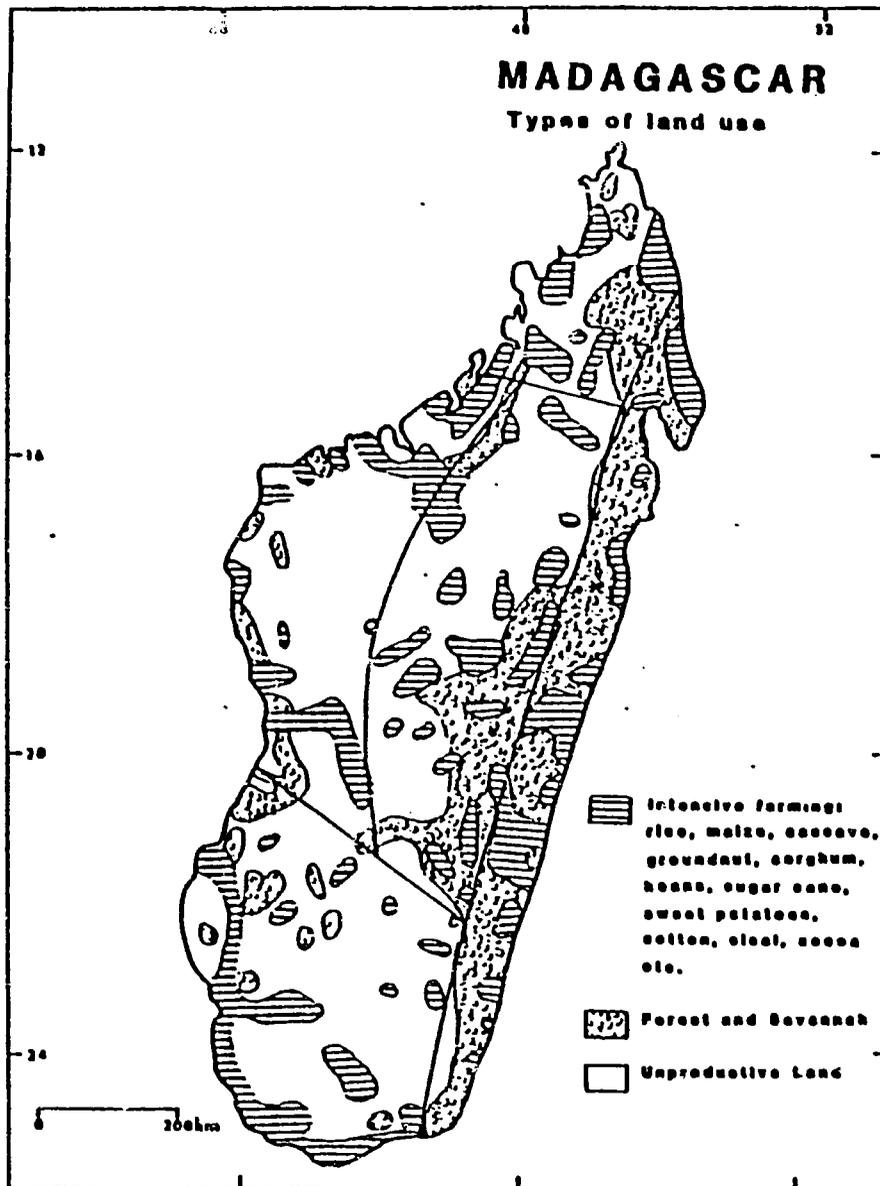
<u>Commodity</u>	<u>September - November</u>	<u>Harvesting season</u>
Vegetables:		
Cape peas (butterbeans)	January - May	September - October.
Dry beans (haricots):		
First crop	October - December	February - April.
Second crop	January - May	June - September.
Other beans and peas	March - April	September - October.
Manioc (cassava)	Throughout year	June - November.
Irish potatoes:		
First crop	September - November	February - May.
Second crop	March - June	July - October.

1/ Main crop March - June. 2/ Harvested from 12 to 18 months after planting.



Tracks of some of the major cyclones affecting Madagascar 1970 - 1984.

Sources: Tropical Cyclones of the Southwest Indian Ocean: Tracks and Synoptic Consideration and Tropical Cyclones of Mauritius



Source: Agroclimatic Conditions and Assessment Methods for Drought/Food Shortages in Subequatorial Africa

CROP CALENDAR FOR MADAGASCAR

Six symbols (//////) indicate a month; three symbols (///) indicate half month; two symbols (//) indicate ten days

////// - sowing

000000 - ripeness

Agroclimatic Region	Mean Regional Rainfall, Crop	Season	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
Central	Rainfall Maize Rice Rice	Dry Season	337	291	230	66	23	19	14	16	16	52	147	270
		Wet Season	000000 //////	000000 ///	000000	000000	000000	000000	000	000000	000	//////	//////	//////
West	Rainfall Maize Rice Rice	Dry Season	393	313	230	57	8	3	3	5	10	36	110	224
		Wet Season	///		000	000000	///	//////	///			000000	000000	///
North	Rainfall Maize Rice Rice	Dry Season	397	350	252	97	23	20	18	19	17	36	108	253
		Wet Season	///		000	000000	///	//////	///			000000	000000	///
Northeast	Rainfall Rice Rice	First	356	375	387	307	210	218	198	168	115	83	145	260
		Second			000000	000000		///	//////	///			///	000000
Southeast	Rainfall Rice Rice	First	340	355	378	203	160	176	134	114	86	72	142	240
		Second			000000	000000		///	//////	///			///	000000
Southwest	Rainfall Rice Maize Sorghum		144	124	74	18	16	17	8	6	10	20	52	123
					000000	000000	000000	000000						//////

Source: Agroclimatic Conditions and Assessment Methods For Drought/Food Shortages in Subequatorial Africa

**3. Disaster Preparedness and Assistance****3.1 Host Country Disaster Preparedness**

By a 1972 decree, the government set up a Plan of Organization of Assistance for cyclone emergencies. The plan provides for a National Relief Council composed of government agencies and private organizations and chaired by the Ministry of the Interior. The Council is responsible for administering and coordinating disaster relief at the national level. Among other duties, the Council determines priorities of needs and methods of distributing assistance. The Council also decides on the composition of collection committees which are responsible for soliciting emergency funds. An Executive General Staff under the Armed Forces is responsible for the execution of relief activities. A permanent disaster coordination center is located at the Ministry of the Interior, 3rd Floor "Salle des Operations," tel: 249-48. Its official name is "l'Etat Major Mixte Operationnel." Local authorities have responsibility for preparing for the cyclone season.

**Other GDRM Contacts**

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### 3.2 Early Warning

#### Tropical Cyclones

The RA I Tropical Cyclone Committee for the South-West Indian Ocean, of which Madagascar is a member nation, formulated a tropical cyclone operational plan in 1981 under the auspices of the World Meteorological Organization. The plan is expected to improve regional coordination in the detecting, monitoring, forecasting, and warning of tropical cyclones.

Madagascar's cyclone warning system is described in the national disaster plan. When it appears that a cyclone may affect Madagascar or when a change occurs in the development of a cyclone for which a preliminary warning has already been issued, the Cyclone Forecasting Center in Antananarivo issues a bulletin to be broadcast by Radio Television Malgache.

The Meteorological Service issues three categories of warnings:

- Preliminary warning - A warning is issued whenever a cyclone has been detected that could threaten Madagascar in the days ahead.
- Warning of threat - A warning is issued when a cyclone directly threatens a part of Madagascar but the danger is not imminent.
- Warning of imminent danger - A warning is issued when a cyclone is threatening a part of Madagascar and constitutes a danger for the population.

The steps to be taken to prepare for cyclones are also described. In the alert phase, local authorities are to ascertain that all measures to reduce risk and facilitate assistance have been taken. When the cyclone represents an imminent danger, the communications network is put on standby and the National Relief Council and defense committees are convoked.

#### Drought/Food Shortage

A program supported by A.I.D.'s Office of U.S. Foreign Disaster Assistance (OFDA) and entitled "Global Climatic Assessment Technology for Disaster Early Warning and Technical Assistance in the Developing World" is being conducted by the National Oceanic and Atmospheric Administration. The program was expanded in 1982 to include eighteen countries in sub-equatorial Africa, including Madagascar.

The objective of the project is to develop an Early Warning Program capable of providing reliable information on potential food shortages triggered by climatic events. Each country is divided into several climatically homogeneous regions (six in the case of Madagascar). Weather data are interpreted by applying regionally appropriate agro-climatic indices which indicate potential crop production. The potential

for abnormal food shortages can then be identified. The Early Warning Program gives a 3-6 month warning prior to drought-related food shortages.

### 3.3 Diet Summary and Host Food Resources

There are conflicting reports on the nutritional status of the population, but malnutrition is widely reported in medical surveys, especially in children. According to UNICEF estimates, at least half of the child population is moderately malnourished. Rice provides 70% of calories and 60% of proteins; manioc (cassava) is also a dietary staple and a common substitute for rice in rural areas when rice is not available. Meat, animal products, and fish are consumed only in small quantities and milk is a luxury food. Thus, the average diet is deficient in protein as well as certain vitamins and calcium. Nutritional problems may be related to large family size, skewed ownership patterns of subsistence crop land, and socio-cultural factors (particularly food taboos).

#### Staple Foods

- Grains and starches:** rice (preferred by most as main food), maize, sorghum, yams, taro, cassava, sweet potatoes, wild roots, and tubers.
- Cooking oil:** very little fat used; some groundnut oil and palm oil, mutton and beef fat.
- Legumes:** cow peas, dried beans, groundnuts; lima beans (pois du cap) grown for export.
- Vegetables:** tomatoes, onions, leafy vegetables (cassava, pumpkin, wild cress) go into popular sauce; green beans, carrots, turnips, leeks, califlower, cucumbers, lettuce, cabbages.
- Fruits:** fruit grows wild and is eaten as between meals snack; bananas (may be boiled or dried, pounded and mixed with rice and fried in peanut oil), citrus, pineapples, peaches, plums, apricots, apples, pears, grapes, lychee.
- Meat/fowl:** meat generally limited to occasions of sacrifice at traditional ceremonies (funerals), or in honor of a guest. Poultry also used in religious sacrifices or as gifts. Few eggs eaten, but kept for hatching.
- Fish:** regular consumption (fresh or preserved) in coastal areas; less available in interior.

**Beverages:** coconut milk is important cooking ingredient; milk consumed mainly in South (as yogurt with lemon); national beverage is ranopango (water boiled with rice that has become stuck to side of pot, always drunk after meals); coffee (popular but expensive); a strong alcoholic drink made from sugarcane and tree bark.

Madagascar exported 10,000 to 20,000 tons of luxury rice a year until 1972, but it has since become a net importer. It is expected that demand will increase by about 30,000 tons annually, more or less in line with the population growth rate of 2.8%. Although the government has supplied rice to disaster victims in the past, food stocks are very limited. In the event of a major disaster, such food items as rice, corn meal, vegetable oil, and powdered milk would probably be required from outside sources.

### 3.4 Health Resources

Medical and health infrastructure is unevenly distributed and personnel are concentrated in urban areas. The population per hospital bed is about 400 nationwide: 240 urban and 520 rural, and the population per physician and nursing person is approximately 10,170 and 3,660 respectively. (World Bank - most recent estimates based on 1977 data) Efforts are being made with donor assistance to increase the effectiveness and distribution of health services. Some 1,500 health care trainees are involved in a program supported by UNICEF.

Outside health personnel -- doctors, nurses, paramedics, and sanitary engineers -- might be needed in case of a major disaster. Also, the following health supplies and equipment would likely be required: surgical implements, penicillin and other antibiotics, vaccines (polio, cholera), malaria pills, vitamins, drugs to treat intestinal disorders (colds, flu, and infections), water purification tablets, water cans, and water treatment personnel and equipment.

#### Health Care Centers

	<u>Antana-</u> <u>narivo</u>	<u>Fianar-</u> <u>antsoa</u>	<u>Toama-</u> <u>sina</u>	<u>Toli-</u> <u>ary</u>	<u>Maha-</u> <u>ianqa</u>	<u>Antsi-</u> <u>rana</u>	<u>Total</u>
<u>Public</u> <u>Health Centers</u>							
General hospital	2	-	-	-	-	-	2
Provincial hospital	-	1	1	1	1	1	5
Urban dispensary	13	4	2	6	-	2	27
Secondary hospital unit	14	13	12	6	8	5	58

	<u>Antana-</u> <u>narivo</u>	<u>Fianar-</u> <u>antsoa</u>	<u>Toama-</u> <u>sina</u>	<u>Toli-</u> <u>ary</u>	<u>Maha-</u> <u>janqa</u>	<u>Antsi-</u> <u>rana</u>	<u>Total</u>
<b>Public</b>							
<b><u>Health Centers</u></b>							
<b>Medical-surgical</b>							
hospital	2	2	2	3	-	2	11
Medical centers	23	18	11	18	19	8	97
Sanitary centers	90	69	76	45	46	20	346
Health rooms	36	13	6	26	27	35	143
Maternity centers	9	30	5	15	18	9	86
Primary health care centers	56	98	95	93	93	41	476
<b>Hygiene municipal</b>							
office	2	1	1	1	1	2	8
Maternal and child health	4	6	6	6	5	2	29
School sanitary inspection	2	1	1	1	1	1	7
Specialized medical centers	8	2	2	1	4	4	21
<b>Private health centers:</b>							
Hospitals and clinics	10	-	-	-	-	-	10
Maternity clinics	3	-	-	-	-	-	3
Dispensaries	138	-	-	-	-	-	138
Leprosy centers	8	-	-	-	-	-	8
Others	8	-	-	-	-	-	8
<b>Total</b>	<b>428</b>	<b>258</b>	<b>220</b>	<b>222</b>	<b>223</b>	<b>132</b>	<b>1,483</b>

### 3.5 Housing

Styles and building materials vary with the region. Traditional beliefs dictate shape (most houses are rectangular), orientation along a N-S axis, and the kind of roof (steeply pitched, two sided).

In the Imerina and Betsiho areas, houses are usually two stories, of sun-dried mud bricks. Typical dwellings in the Ankaratra region, southwest of Antananarivo, have roofs extending to the ground to preserve heat. Thatched houses predominate in the south and east, while the Tsimihety in the north add thatched roofs to houses of sun-dried mud brick caked over a framework of raffia palm ribs. Houses built entirely of wood are common in forest regions and in some parts of the extreme south. In regions of heavy rainfall, houses are raised on posts. In all parts of the country, family tombs are often the most substantial structures in a community.

Buildings constructed of flimsy galvanized iron sheeting or of unreinforced concrete blocks with corrugated iron (CI) sheet roofs are common in low income areas of the major urban centers. Such housing in Antsiranana and Mahajanga proved to be highly vulnerable to wind damage during Cyclone Kamisy. (See section 2.10, Vulnerability of Infrastructure.) The small size of the wood poles (about 5.08 cm in diameter) used in framing the metal houses, as well as the poor quality of the sheeting and the weak connections between roof trusses and walls, gave them little wind resistance. Houses made of indigenous materials in rural areas (wood frame and raffia in Antsiranana and wattle and daub in Mahajanga) were also almost totally demolished by Kamisy's strong winds. The latter type of housing has the advantage, however, of being inexpensive to replace and less likely to be life-threatening to inhabitants if it collapses.

There is a general lack of building materials in Madagascar. A rolling mill for CI sheeting in Toamasina does not produce sufficient quantities for the country's needs. Wood is also in short supply as are nails and iron rebar for reinforcing concrete. Some wood is available from government reforestation schemes, but sawn timber is scarce. There are two cement factories in the country. The factory in Mahajanga was damaged in Cyclone Kamisy but was soon back to 60-80% of normal capacity.

OFDA is supporting a housing rehabilitation program in the areas most affected by Cyclone Kamisy. Besides procuring building materials -- cement, roofing sheets, and nails -- in Kenya, the U.S. is providing technical assistance to train local officials in cyclone-resistant design and construction. (See section 3.14, Disaster Mitigation and the Development Process.)

### 3.6 Energy Resources

Despite rapid deforestation in some areas, Madagascar's extensive forests, covering some 125,000 sq. km, remain the major energy resource. The country's considerable hydro-electric potential is largely unexploited, with present installed capacity only about 100 MW. There is evidence of oil and gas reserves in the western part of the island as well as some uranium and geothermal resources in remote areas.

At the present time, traditional fuels (mainly wood and charcoal) account for 80% of energy use. Other sources are petroleum (16%, used mainly in industry and transport), bagasse (2.5%), hydropower (0.5%), and imported steam coal and coke (1%).

Electricity is used primarily in industry, with the only extensive grid being in the central highlands. Total installed electric power capacity is about 220 MW, of which hydropower accounts for 44%.

Generators, pumps, lanterns, and flashlights might be requested of outside donors in the event of a major disaster.

### 3.7 Surface Transportation

#### Road Network

The paved road network consists of a main north-south artery (RN 4 and RN 7) extending from Mahajanga in the north to Fianarantsoa in the south-central region via the capital city of Antananarivo. Other paved roads branch off from the central highway or serve the areas around major coastal towns. The regional capitals are linked by all-weather roads (paved and engineered earth/gravel), but many areas on the east and west coasts and in the northern and southern ends of the country do not have year-round access to the plateau area.

The road system has seriously deteriorated in recent years due to a combination of poor maintenance, overloading of trucks, and repeated damage from flooding. In many cases, the roads were built to inadequate original standards. The World Bank estimates that 80% of the paved roads show signs of deterioration (uneven surfaces, ravelled edges, and washed away shoulders). About 50% of these require full rehabilitation and another 30% need resurfacing to avoid further deterioration. Many rural roads are in such poor condition that they are not passable to motorized traffic. The GDRM is receiving assistance from external donors in the reconstruction of the country's highways but most is presently directed at the paved network. The World Bank is helping rehabilitate 10,000 km of the most economically important roads. This network consists of about 90% of the paved roads, including the 1,100 km north-south axis, 60% of the engineered earth roads, and 6% of feeder roads and tracks.

#### Surface Miles (in km)

Anbilobe - Fenerive	105
Antsirabe - Malaimbandy	334
Arivoninamo - Analavory	67
Fanjakamandroso - Tsiroanomandidy	55
Mahandro - Vatomandry	66
Mananara - Maroantsetra	112
Toamasina - Fenerive	105
Antananarivo - Miarinarivo	124
Antananarivo - Antsirabe	132
Toliary - Sakaraha	133

#### Vehicles

A total of 30,000 vehicles in the country includes 13,000 light vehicles and 17,000 commercial vehicles (11,000 utility, 1,000 buses, and 5,000 heavy trucks). Of this total number, fewer than 25,000 were serviceable in December 1982. A shortage of foreign exchange halted the

import of new vehicles and spare parts in recent years, causing little to no growth in the country's vehicle fleet.

Because of the shortage of transport equipment, outside donors might be asked to provide cargo aircraft, helicopters, small boats, and 4-wheel drive vehicles in a major disaster.

#### Rail Network

The railway network, totaling 860 route-km, consists of two separate systems. The northern system (700 km) connects Toamasina on the east coast with Antsirabe in the interior via Brichaville, Moramanga, and Antananarivo; a branch from Moramanga to Vohidiala divides to Lake Alaotra and Morarano to collect chromium. The southern system links Fianarantsoa to the port city of Manakara.

The railway is in generally poor condition, though a track rehabilitation program is gradually being implemented. At present, the major part of Madagascar's cargo traffic moves on the Toamasina-Antananarivo line. The line carries nearly 1,000 tons a day, about half of which is rice and the rest petroleum products. This monopoly is expected to end when reconstruction of the parallel road is completed. Traffic on the Antananarivo-Antsirabe and the Fianarantsoa-Manakara lines is low at present, the latter system being in an extremely deteriorated condition.

#### Rail Distances

Antananarivo - Toamasina:	376 km.
Moramanga - Lake Alaotra:	168 km.
Antananarivo - Antsirabe:	154 km.
Fianarantsoa - Manakara:	165 km.

### 3.8 Ports

Toamasina is the primary international port, serving the economically important central highlands via the railway to Antananarivo. There are three secondary international ports: Mahajanga, Antsiranana, and Toliary. Some 20 primary and secondary coasting ports handle coastal shipping which offers an alternative to difficult overland transportation. Most of the country's ports serve only neighboring areas because of inadequate connections with the rest of the country.

Toamasina (lat. 18°10'S; long. 49°32'E) - has a commodious harbor and safe anchorage from April to November. Depth at entrance is 10.97 m. East coast winds and waves can be high, and cyclones occur from December to March. The port has 37,000 sq. m of covered storage in warehouses and transit sheds.

Mahajanga (lat. 15°43'S; long. 46°17'E) - on the northwest coast, can accommodate ocean going vessels and large coasters, but they must remain at anchor in a safe road opposite the town for loading and discharging by lighter.

Antsiranana (lat. 12°16'S; long. 49°17'E) - has an excellent deep water port and dry dock facilities. The width and depth of entrance are 300 m and 15.24 m respectively. The port is, however, subject to very strong northeast winds from May to October, and it has limited connections with the interior. Storage capacity is 1,500 tons.

Toliary (Tulear) (lat. 23°22'S; long. 43°40'E) - can accommodate vessels with drafts up to 10.06 m in the harbor, but the jetty, 145.1 m long, has a maximum safe draft of 9.29 m alongside.

(Consult Lloyd's of London, Ports of the World, for more detailed information on Madagascar's ports.)

The Societe Malgache des Transport Maritimes, the state-controlled international shipping line, operates four ships of 14,000 to 16,000 tons. Coastal shipping is handled mainly by the state-owned Compagnie Malgache de Navigation which has a fleet of nine vessels ranging from a 5,300 ton cargo boat to a 250 ton LCT. In addition, there are 11 privately owned vessels, all smaller than 2,000 tons, and five small tankers owned by the state oil company, SOLIMA.

**3.9 Airports**

Because of the difficult terrain and generally inadequate surface transport network, Madagascar has developed the most extensive domestic air transport system of any country in Africa. There are about 121 usable airfields, of which some 56 are open to public air traffic; 17 airports are reportedly built to all-weather standards. The main international airport at Antananarivo (Ivato) can accommodate B-747s; three other airports, Mahajanga (Amborovy), Nosy Be (Fascene), and Toamasina, can handle large jet aircraft (B 737s).

<u>City/Aerodrome</u>	<u>Location/ Coordinates</u>	<u>Aircraft/ Strength</u>	<u>Aircraft/ Length M</u>
ANTANANARIVO/ Ivato	18°47'43"S	B 747	3100
	47°28'35"E	B 747	282
		B 707-320C	121

Alternate aerodromes: Dar Es-Salaam, Mahajanga, Maputo, Mauritius, Saint Denis

<u>City/Aerodrome</u>	<u>Location/ Coordinates</u>	<u>Aircraft/ Strength</u>	<u>Aircraft/ Length M</u>
MAHAJANGA/ Amborovy	15°39'57"S 46°21'03"E	B 737-200 B 737-200	2200 46

Alternate aerodromes: Antananarivo, Mahe, Mauritius, Moroni

<u>City/Aerodrome</u>	<u>Location/ Coordinates</u>	<u>Aircraft/ Strength</u>	<u>Aircraft/ Length M</u>
NOSY BE/ Fascene	13°19'05"S 48°19'37"E	B 737-200 B 737-200	2190 46

Alternate aerodromes: Mahajanga

<u>City/Aerodrome</u>	<u>Location/ Coordinates</u>	<u>Aircraft/ Strength</u>	<u>Aircraft/ Length M</u>
TOAMASINA	18°06'55"S 49°23'34"E	B 737-200 B 737-200	2200 46

Alternate aerodromes: Antananarivo

Air Madagascar, the national carrier, provides internal service to all the principal towns and external service to Nairobi, Mauritius, Reunion, Seychelles, Paris, Marseilles, and Djibouti. The company's fleet comprises one B 747 for European service and two B 737's, two H 748s and five DHC 6-300 Twin Otters for regional and/or domestic service. In addition, five Aztecs, two Navajos, and one Cherokee are available for taxi/charter service. Madagascar is also served by Air France and Aeroflot.

Air Miles (Statute Miles)

Antananarivo (Ivato) to:	Tsaratoana	142
	Tsiroanomandidy	94
	Antsiranana	483
	Fianrantsoa	167
	Mahajanga	239
	Paris	5,428
	Rome	4,745
Fianarantsoa to:	New York	8,668
	Johannesburg	1,234
	Tusaka Intl.	1,292
	Maputo	969
	Mauritius (Plaisance)	685
Mombasa	1,304	

Fianarantsoa to:	Nairobi Intl.	1,550
	Reunion Is.	543
	Salisbury	1,068
	Seychelles Intl.	1,289
Mahajanga (Amborovy) to:	Mandritsara	170
	Mauritius (Plaisance)	812
	Moheli	291
	Morafenobe	178
	Moroni	345
	Nairobi Intl.	1,180
	Nossi Be	187
	Paris (Orly)	5,197
	Soalala	89
Tsaratanana	113	

(See also sections 1.20, Transportation and 2.10, Vulnerability of Infrastructure.)

### 3.10 Host Voluntary Agencies

The Malagasy Red Cross Society  
Rue Patrice Lumumba  
Tel: 221-11

The national Red Cross is small and limited in financial resources; however, the League of Red Cross Societies is implementing a project which will promote the society's development and provide it with basic equipment and a warehouse to improve its ability to conduct relief operations. OFDA is supporting the project by funding the services of a delegate for one year.

Fikrifama  
Lot II H 4-bis  
Iadiambola, Ampasampito  
Tel: 405-75

Fikrifama primarily organizes small development assistance projects but could, through its technical expertise, provide limited help in disaster situations.

Caritas  
Lot IV-G-199  
Antanimena  
Tel: 213-91

Caritas maintains limited stocks of relief items (food, clothing, medicines, and blankets).

### 3.11 U.S. Mission Disaster Plan

The U.S. Mission in Madagascar has a small staff at the present time and resources available to the Mission are very limited. Any USG material assistance has to be flown in from abroad. The Mission coordinates U.S. contributions with A.I.D.'s Regional Economic, Development, and Service Office (REDSO) in Nairobi.

The functions of the various members of the Mission Disaster Relief Team in an emergency correspond to the general responsibilities of each person as a member of the Country Team. The Defense Officer handles arrangements for rescue and relief assessments/operations if U.S. military aircraft is to be involved. The Mission Disaster Relief Officer coordinates relief efforts with other embassies, international organizations, and Malagasy authorities and handles administrative and reporting requirements. The Chief of Mission and Deputy Chief of Mission are responsible for monitoring overall activity.

### 3.12 U.S. Resources

Under Public Law 480, the USG has provided food assistance to the GDRM since 1962. Catholic Relief Services (CRS) is the sponsor for the P.L. 480 Title II program in Madagascar, which has over 62,000 recipients in MCH (mother/child health), school feeding, and food-for-work programs. The CRS program has a total annual value of about \$1.3 million. When a disaster strikes, CRS may be authorized by the U.S. Embassy to release stocks from its regular program for emergency distribution. The USG has also provided Title II commodities on a bilateral basis in direct response to disaster needs. Beginning in fiscal year 1985, the Adventist Development and Relief Agency International (formerly SAWS) is expected to begin a small MCH program, using \$280,000 worth of P.L. 480 commodities.

P.L. 480 Title I programming began in Madagascar in 1981. Concessional Title I sales are expected to amount to \$8 to \$10 million annually for the period 1986-1990, with wheat and vegetable oil gradually replacing rice as the principal commodities. Local currency generated by the sale of P.L. 480 Titles I and II has been used for development projects and for disaster rehabilitation following cyclones in 1982 and 1984.

There is no local A.I.D. office in Madagascar; however, a new program is being planned, and a small staff will be assigned in the summer of 1984. The Mission will receive continuing support from REDSO/ESA. The proposed A.I.D. program will focus on the agricultural sector and include such activities as balance of payments support, rice research for increased yields, and the rehabilitation and maintenance of selected rice irrigation systems and/or of rural roads.

**3.13 Voluntary Agencies and International Organizations****International Organizations**

Several governments and multinational organizations are assisting development projects in Madagascar. These include France, Germany, Norway, Switzerland, N. Korea, the Soviet Union, and China as well as the World Bank, the African Development Fund (AFDE), the International Fund for Agricultural Development (IFAD), the UNDP/FAO, Funds for Aid and Cooperation (FAC), Caisse Centrale Cooperation Economique (CCCE), the Arab Bank for Economic Development in Africa (BADEA), and the European Development Fund. Resources already in-country from some of these projects could possibly be diverted to disaster rehabilitation.

The following resident international organizations are usually active in disaster relief operations:

UNDP (representing UNDRO)  
26 Lalana Razafimahandy  
Antananarivo 101  
Cable: UNDEVPRO ANTANANARIVO (MADAGASCAR)  
Telex: 22345 MG  
Tel: 219-07; 234-90

World Food Program  
22 Rue Rainitovo  
Tel: 232-91

World Health Organization  
13 Rue Patrice Lumumba  
Tel: 225-82

**U.S. Voluntary Organizations**

Adventist Development and Relief Agency International (ADRA)  
(Development Department of Seventh-day Adventists)  
Boite Postale 700  
Antananarivo, Madagascar  
Tel: 404-65

Program: Medical services, supplies, and equipment

Missionaries of Africa (M. Af.)  
B.P. 1673  
Antananarivo, Madagascar

Program: Agricultural extension and training; cooperatives; self-help projects; educational funding; medical services; social welfare

American Lutheran Church  
Malagasy National Lutheran Council on Health (SALFA)  
B.P. 880  
Antananarivo, Madagascar  
Tel: 252-01

Rural Development Department of the  
Malagasy Lutheran Church (S.A. F.A. F.I.)  
B.P. 49  
Antsirabe, Madagascar

Program: Community development; integrated rural development;  
appropriate technology; water; medical services; nutrition; education;  
family planning; medical supplies

Catholic Relief Services - United States Catholic Conference  
P.O. Box 1673  
Antananarivo, Madagascar  
Tel: 206-66

Program: Food/food products (P.L. 480 Title II sponsor); mother/  
child programs; clothing; medical supplies; bridges; water

Church World Service  
Fikrifama  
B.P. 3875  
Antananarivo, Madagascar

Program: Integrated rural development; water

World Vision Relief Organization, Inc.  
National Bank Building  
Harambee Avenue  
Nairobi, Kenya

Program: Sanitation; self-help programs; counseling; agricultural  
training; preventive medicine; public health education; health care teams;  
clinics; children

Young Women's Christian Association of the U.S.A.  
YWCA of Madagasikara  
Boite Postale 1140  
Antananarivo, Madagascar  
Tel: 24062

Works in cooperation with the World YWCA.

The following U.S. voluntary agencies also provide program support in Madagascar:

Catholic Medical Mission Board  
Center for Development and Population Activities  
Cooperation in Development, Inc. (CODEL)  
Damien Dutton Society for Leprosy Aid, Inc.  
Darlen Book Aid Plan, Inc.  
Interchurch Medical Assistance, Inc.  
MAP International  
Operation Bootstrap - Africa  
Private Agencies Collaborating Together (PACT)  
United Methodist Committee on Relief

### 3.14 Mitigation and Development

As is true in many developing countries, recurring disasters in Madagascar impede progress in development. Scarce resources that could be used to improve and expand the country's road network, for example, or agricultural infrastructure, or health care facilities must repeatedly be diverted to repair cyclone and flood damage. The cumulative effect of successive cyclones and floods is the further deterioration of the roads, the impoverishment of the soil, the weakening of houses, dikes, dams, and bridges, and the blockage of drainage canals, all of which render the country ever more vulnerable to new disasters.

But if natural disasters slow a country's development, the development process itself can serve to mitigate the effects of disasters. In the case of Madagascar, some of the projects being carried out with bilateral and multilateral assistance should help lessen the impact of those disasters which cannot be entirely prevented.

As stated previously, progress is being made with external help in improving the country's (and region's) forecasting capability in tropical cyclones and drought/food shortages. (See section 3.2, Warning Systems.) The increased warning time in the case of drought should permit early intervention to avoid scarcities. In addition, much of the development assistance at present is directed toward the agricultural sector where over 90 separate projects are being implemented. The emphasis is on rice and food crop production, with many projects aimed at rehabilitating and expanding irrigation systems and feeder roads. The use also of various farm inputs, and particularly of high-yield varieties of rice and other crops which have not previously been permitted in Madagascar, should help reduce the possibility of food shortages resulting from natural disasters. (Madagascar maintains a quarantine against imported plant material, but it appears that some relaxation of regulations may be allowed in the near future to permit use of new hybrid strains developed elsewhere.)

Reforestation and erosion control projects, though not presently being carried out on a large scale, are likewise important to mitigation efforts. While curbing the depletion of essential top soil, these projects relieve the problem of siltation in rivers and drainage canals which contributes to flooding. The relationship between mitigation and development can also be seen in projects such as that being undertaken in Antananarivo by the World Bank to improve and develop the water supply, sewerage, and draining facilities. This project will reduce health hazards and also alleviate the threat of flooding in low-lying areas of the city.

Projects being carried out in the transportation sector are addressing some of the problems that constrain economic development. Roads and bridges rebuilt to higher standards and subsequently maintained should be better able to withstand the assaults of nature as well as normal heavy use.

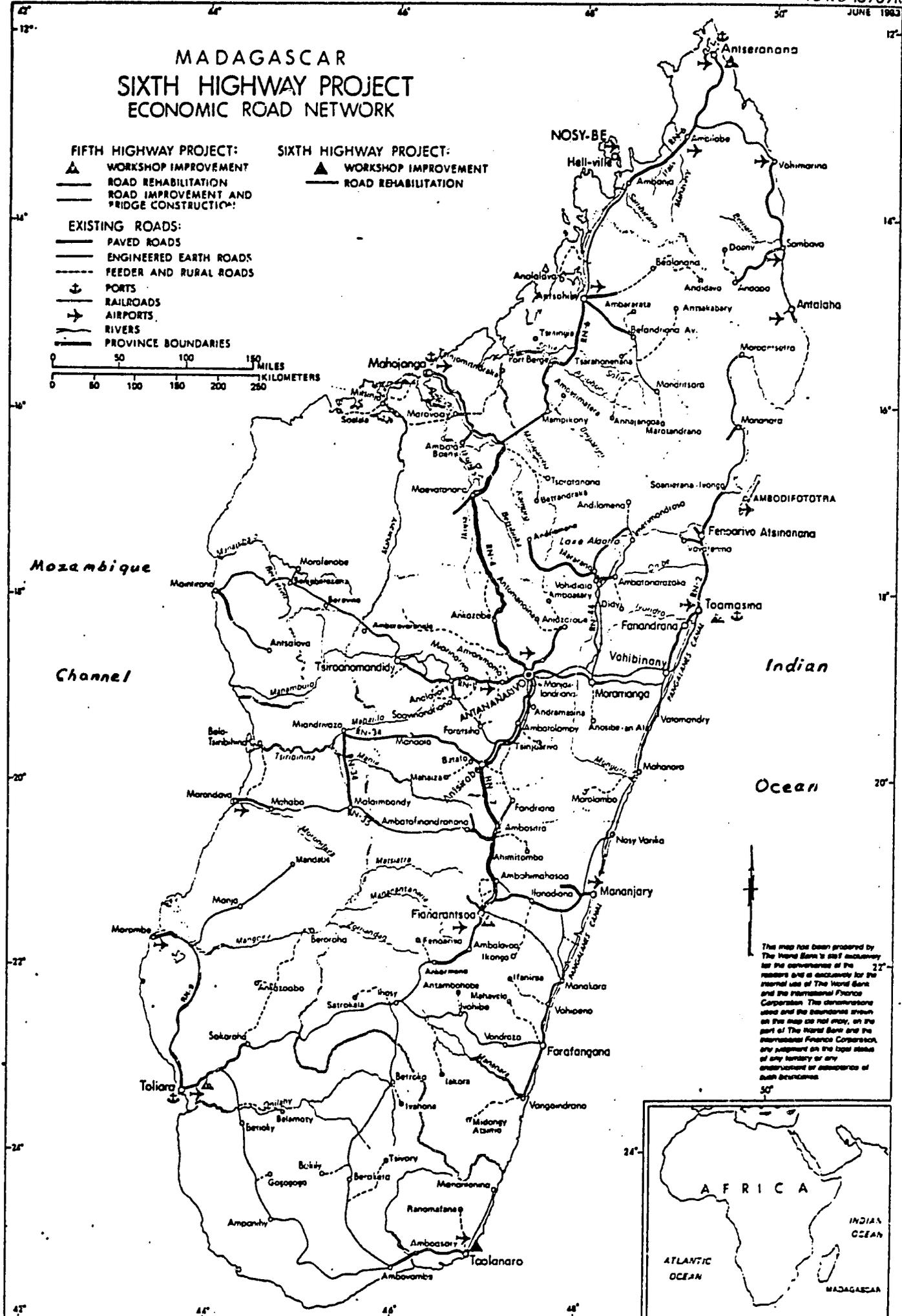
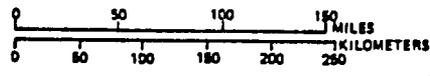
The severe damage traditionally sustained by the housing sector in cyclones and flooding has been a great cost in both economic and human terms. Houses built in flood-prone areas or of poor-quality materials with little wind resistance have obviously endangered the lives of those who inhabited them. After Cyclone Kamisy damaged or destroyed thousands of dwellings and public buildings in Antsiranana and Mahajanga in April 1984, A.I.D./OFDA undertook a housing repair and construction training program to reduce future risk. The intent is to apply disaster mitigation and prevention techniques directly to the repair and reconstruction process. The program calls for an educational campaign to promote safer building practices. While this is a rehabilitation activity and not a development project, it is expected that the benefits derived from the training component will carry over to future shelter construction.

# MADAGASCAR SIXTH HIGHWAY PROJECT ECONOMIC ROAD NETWORK

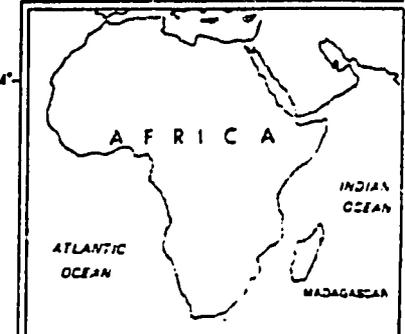
**FIFTH HIGHWAY PROJECT:**  
 ▲ WORKSHOP IMPROVEMENT  
 — ROAD REHABILITATION  
 — ROAD IMPROVEMENT AND BRIDGE CONSTRUCTION

**SIXTH HIGHWAY PROJECT:**  
 ▲ WORKSHOP IMPROVEMENT  
 — ROAD REHABILITATION

**EXISTING ROADS:**  
 — PAVED ROADS  
 — ENGINEERED EARTH ROADS  
 - - - FEEDER AND RURAL ROADS  
 ⚓ PORTS  
 ✈ AIRPORTS  
 〰 RIVERS  
 — PROVINCE BOUNDARIES



This map has been prepared by The World Bank's staff exclusively for the convenience of the readers and is not to be used for the normal use of The World Bank and the International Finance Corporation. The boundaries shown on the map do not imply, on the part of The World Bank and the International Finance Corporation, any judgment on the legal status of any territory or any acknowledgment or acceptance of such boundaries.





1. General Information1.1 Geographic Codes

AID	642
State Regional	AF

1.2 Host Mission in the U.S.

Embassy of Mauritius  
Chancery: Suite 134  
4301 Connecticut Ave. NW  
Washington, DC 20008  
Tel: (202) 244-1491 and 1492

For current information on the Embassy staff,  
refer to the U.S. Department of State  
Diplomatic List.

1.3 U.S. Mission in Mauritius

American Embassy  
Rogers House, 4th floor  
John Kennedy Avenue  
Port Louis, Mauritius  
P.O. Box 544  
Tel: 2-3218/9, 2-3239

For current information on the U.S. Embassy  
staff in Mauritius, consult the most recent  
edition of the U.S. Department of State  
Key Officers of Foreign Service Posts.

1.4 Time Zones

GMT + 4; EST + 9

1.5 Currency

The local unit of currency is the Mauritian rupee, which is equal to 100 cents.

Coins: 1, 2, 5, 10, 25 and 50 cents; 1 rupee  
Notes: 5, 10, 25, 50 rupees  
US \$1 = Rs 14.04

Travelers are not allowed to take more than 24 rupees into the country.

1.6 Travel and Visa Information

Passport and Visa: Visas are required and may be obtained from the Mauritian Embassy, Washington, D.C. 20008, for no charge except postage. Yellow fever immunization is required and vaccinations for tetanus, typhoid and a malaria suppressant are recommended.

1.7 Calendar and Holidays

- New Year's Day.....Jan. 1, 2
- Yaum-Um-Nabi..... \*
- Cavadee.....\*
- Maha Shivaratee.....\*
- Spring Festival.....\*
- Holi.....\*
- Mauritian Independence Day.....Mar. 12
- Ougadi.....\*
- Easter Monday.....\*
- Varusha Piruppu.....\*
- Labor Day.....May 1
- Id-El-Fitr.....\*
- Assumption Day.....\*
- Ganesh Chaturthi.....\*
- Autumn Festival.....\*
- Id-El-Adha.....\*
- United Nations Day.....Oct. 24
- All Saints Day.....Nov. 1
- Divali.....\*

Ganga Asnam.....\*

Christmas.....Dec. 25

Boxing Day.....Dec. 26

\* Dates of religious holidays vary from year to year.

Fiscal Year: July 1 to June 30

### 1.8 Treaties and Agreements

Agricultural Commodities, Aviation, Consuls, Economic and Technical Cooperation, Extradition, Investment Guaranties, Peace Corps, Property, Trade and Commerce

### 1.9 International Organization Memberships

Commonwealth of Nations, Organization of African Unity (OAU), International Sugar Organization (ISO), International Wheat Council (IWC), Non-Aligned Movement, Afro-Malagasy and Mauritian Common Organization (OCAM), UN and most of its specialized agencies. Mauritius is an associate member of the European Community (EC).

### 1.10 Geography

#### Location and Area:

The main island of Mauritius is located about 805 km east of Madagascar in the Indian Ocean, between longitudes 57°20' and 57°48' E and 19°50' and 20°32' S. The main island is 61 km north to south, 47 km east to west, and has a total land area of about 1,865 sq. km -- approximately the size of Rhode Island. The country also includes the island of Rodrigues, about 560 km off the northeastern coast of the main island, and the tiny dependencies of the Agalega Islands and the Cargados Carajos Shoals (or the St. Brandon Group) to the north. Port Louis is the national capital and largest city in Mauritius.

**Topography:**

The main island of Mauritius is shaped like an oyster and is encircled by a coral reef. The terrain is characterized by a coastal plain in the north, an extensive plateau surrounded by mountains in the center of the island, and majestic mountain ranges, deep ravines, rushing rivers, and high waterfalls in the south.

Rodrigues has a land area of 110 sq. km. The island is composed of basalt and comprised of one long mountain range with an elevation of 600 meters above sea level. The Agalega Islands are two tiny, flat islets connected by a sandbar, approximately 935 km due north of the main island of Mauritius. The uninhabited Cargados Carajos Shoals, also known as the St. Brandon Group, are a group of reefs, shoals and islets 400 km to the northeast of Mauritius.

**Climate:**

Mauritius has a subtropical maritime climate all year round. Southeasterly trade winds bring cooler and drier weather from April to October, while the hot and wet season normally lasts from November to March. Humidity on the island is almost always over 80 percent. Temperatures range from 17°C to 30°C at sea level to 13°C to 26°C in the highlands. Average annual rainfall varies from 900 mm on the western coast to almost 5,000 mm on the central plateau. Cyclone season lasts from November to April.

**1.11 History and Government**

Mauritius was discovered and first settled by the Dutch in 1598 and named after Maurice of Nassau, the Stadtholder of Holland. A small settlement of Dutch convicts brought slaves and introduced sugarcane to the island, but the colony failed and was abandoned in 1710. Between 1715 and 1810, Mauritius was colonized by French settlers, who imported African slaves to work in the sugarcane fields. During the Napoleonic Wars, the British navy occupied the island, and the Treaty of Paris in 1815 brought the nation under British rule. Although few British immigrants came

to the colony, the British succeeded in abolishing slavery in 1835 and developing a prosperous sugar industry. Indentured laborers immigrated from India to work on the sugar plantations. By 1871 over 68 percent of the population was Indian.

With the extension of the franchise in 1947, the Indo-Mauritian majority represented by the Labor Party gained a plurality in the legislature and called for labor reform and national independence. Despite opposition from the Franco-Mauritian and Creole-supported Social Democratic Party, the Labor Party and its coalition of other Hindu and Muslim political parties won a majority in the 1967 Legislative Assembly election. This event precipitated violence between the Creole and Muslim communities, which left at least twenty five people dead and hundreds injured before British troops restored order.

Mauritius gained its independence in 1968, but it has remained a part of the Commonwealth and officially recognizes the British monarch as head of state. The unicameral Legislative Assembly has 70 members, of whom 62 are elected (two from Rodrigues) and eight are appointed from a list of unsuccessful candidates from underrepresented communities. Elections are held every five years. The government is directed by the Prime Minister, the leader of the majority party, and his cabinet of approximately 20 ministers. At the local level, Mauritius is divided into nine administrative districts, with municipal or town councils in urban areas and village councils in rural areas. The dependency of Rodrigues is governed by a resident commissioner and has five parish councils, while Agalega and Cargados Carajos Islands are administered directly from Port Louis.

In the 1982 election, the leftist leaning alliance of the Mauritian Militant Party (MMM) and the Mauritian Socialist Party (PSM) won a landslide victory over the conservative coalition government of Seewoosagar Ramgoolam, who had served as prime minister since independence. The MMM/PSM alliance

captured 60 elective seats in the Legislative Assembly and appointed Aneerood Jugnauth Prime Minister. The government has called for nationalization of the sugar industry, the establishment of a republic within the Commonwealth, and the return of the island of Diego Garcia, now part of the British Indian Ocean Territory and site of a U.S. naval base.

#### 1.12 Ethnic and Sociocultural Groups

Approximately 68% of the population is Indo-Mauritian, descendants of the Indian immigrants who came to the islands as indentured workers. Hindus are the largest group, comprising half the total population, while Muslims make up another sixteen percent. "General population" is the term given to the Creoles and the tiny white "European" minority. Twenty-seven percent of Mauritians are Creoles, of mixed European and African descent. The island of Rodrigues is approximately 89% Creole. The Franco-Mauritians, descendants of the early French settlers, constitute the smallest ethnic group in Mauritius, but have retained most of the economic influence in the country. Approximately three percent of the population are descendants of Chinese immigrants, over half of whom live in the Chinese quarter of Port Louis. Despite this ethnic diversity, Mauritian culture remains distinctly francophone, reflecting French rule during the 18th century.

Occupations tend to be associated with particular ethnic groups. The Indo-Mauritians are still primarily agricultural laborers, but since independence they have begun gaining civil service positions. Muslims have traditionally been traders and industrial workers, but are also involved in real estate and agriculture. Creoles tend to be fishermen, stevedores, and service workers. Most of the Chinese community is engaged in

retail businesses or works in restaurants and casinos. The Franco-Mauritians continue to own most of the plantations, banks, hotels and manufacturing industries in the country.

### 1.13 Languages

Although English is the official language, less than one percent of the population lists it as their mother tongue. Most government documents are written in English and it remains the language of instruction in the schools. French is also required in school and is spoken in the Legislative Assembly. Creole is the lingua franca and is spoken and understood by the greatest number of people. Once regarded as inferior in French-speaking households, Creole has become increasingly popular among the nation's youth. Among the Indian population, Hindi, Urdu, Tamil, Marathi, Gujarati, and Telugu are spoken. Chinese dialects are spoken exclusively by the Sino-Mauritian community.

### 1.14 Religion

Approximately 51% of the population is Hindu. Muslims constitute 16% of the total population, most belonging to the Sunni branch of Islam. Virtually all of the "general population" and most Chinese are Christian, predominately Roman Catholic. Religious minorities include Buddhists, Confucians, Bahais, and Ahmadis.

### 1.15 Population

The population of Mauritius was estimated at 1,002,000 in 1983, based on the last official census in 1972 and an average annual growth rate of 1.6%. The eradication of malaria after World War II caused a population explosion in Mauritius, making it one of the most densely populated areas in the world (455 per sq. km). During the 1960s the

government began promoting family planning programs in cooperation with the private Family Planning Association and the Catholic Church-supported Action Familiale. These programs succeeded in reducing the population growth rate from 2.8 to 1.9 percent annually. However, the population growth rate is expected to rise during the 1980s as children born during the high birth rate period of the 1950s reach child bearing age. Furthermore, emigration has slowed as traditional recipient countries (the U.K. and France) have imposed tougher immigration restrictions.

The age profile of the general population has matured in recent years; some 65% of the population was in the 15 to 64 age group in 1978, compared to 55% in 1962. The unbalanced sex ratio caused by the importation of male laborers has been corrected over the years, so that it has now reached roughly 50:50. The Mauritian population is well educated and has an adult literacy rate of over 80%. Forty-eight percent of the population lives in urban areas and there are five cities with populations over 50,000.

Principal cities and Rodrigues (1983 est.)

Port Louis	148,040
Beau Bassin/Rose Hill	87,520
Curepipe	56,676
Quatre Bornes	56,011
Vacoas-Phoenix	57,613
Rodrigues	35,594

Source: Europa, Africa: South of the Sahara.

1.16 Health

Vital Statistics  
(1982-83):

Births/1,000 population	26.4
Deaths/1,000 population	7.0
Infant mortality/1,000 live births	33.8
Child death rate (ages 1-4)/1,000	4.1
Life expectancy at birth	
Males	66.6
Females	65.3

**Diseases:**

Health conditions in Mauritius have improved considerably since World War II. Before then, Mauritius had experienced epidemics of cholera in the 1850s, malaria in 1867, bubonic plague in 1899, influenza in 1919, and poliomyelitis in 1945. In 1946, the colonial government, supported by the World Health Organization, began a campaign to suppress malaria, the major cause of death in the country, with a program of mosquito control, swampland drainage, and nationwide immunization. Although malaria has been effectively eradicated, other serious health threats, such as tuberculosis, gastroenteritis, and schistosomiasis still persist. An outbreak of typhoid occurred in early 1980, with most of the cases reported in the Cite Roche Bois area of Port Louis. Coming as it did after three cyclones that brought excessive rainfall to the island, contamination of the public water supply was considered the likely cause. The Government of Mauritius appealed for foreign donations of typhoid vaccine and launched an immunization program that brought the epidemic under control.

**Nutrition:**

Each ethnic group in Mauritius has its own dietary habits and taboos. Rice is the staple for the entire population, but Creoles tend to mix it with stewed greens or lentils, while in Indian homes, meat and vegetable curries are the favorite accompaniment. French cuisine is popular among upper-class Creoles and the Franco-Mauritian community. Since 90% of the total cultivable land is planted with sugarcane, Mauritius must import most of its food. The per capita daily intake of food is 2,438 calories, 53.4 grams of protein, 59 grams of fats, and 424 grams of carbohydrates.

1.17 Economy

Basic Indicators:	Gross national product (1981)	\$988 million
	GNP per capita (1982)	\$1,240
	Average annual growth rate (1960-82)	2.1
	Average inflation rate (1970-82)	15.0
	Exports (1981)	\$340 million
	Imports (1981)	\$565 million

Source: World Development Report 1984

## Agriculture:

Mauritius is virtually a one-crop economy, with sugar production accounting for approximately three quarters of foreign exchange earnings, 30% of the GNP, and 28% of employment. During the mid-1970s, soaring world sugar prices boosted the economy and resulted in a trade surplus and an 8.2% annual growth rate in GDP. However, in 1979 and 1980, a series of devastating cyclones cut agricultural production by a third and GDP decreased by 9 percent. The new government has called for nationalization of some of the larger sugar plantations and has introduced austerity measures, including reduction of government expenditures, removal of subsidies on rice and flour, and a spending freeze on certain development projects. As of 1983, two of the 21 large sugar estates on the island are government-owned. Under the protocol of the Lome Convention, Mauritius has an annual quota of 500,000 metric tons of sugar which can be exported to EEC countries at a guaranteed price. Local consumption and stocks account for about 60,000 tons.

Tea is the second largest cash crop and is exported to South Africa, Britain, and the Soviet Union. It is grown in the humid highlands unsuitable for sugar. Tobacco and potatoes are grown for local consumption and are exported in surplus years. Subsistence farming is conducted on a very small scale, but expansion of vegetable cultivation and intercropping of maize, potatoes, and rice with sugar is being encouraged to reduce food imports.

**Tourism and Industry:** Tourism is the second most important foreign exchange earner in the Mauritian economy. The islands' tropical climate, white sandy beaches, and exotic culture attracts an average of 120,000 visitors a year. The tourism industry has been growing steadily since the 1960s with most of the visitors coming from Reunion, France, and South Africa.

The industrial sector accounts for 18% of the GDP and employs 24% of the labor force. The largest industries are sugar, tea, and tobacco processing factories. A fertilizer factory, producing up to 100,000 tons per year, began operation in 1979. The establishment of the Export Processing Zone (EPZ) in 1971 has encouraged small industries to process duty-free imported raw materials and components into export goods, such as textiles, electronics, processed gems, and toys.

### 1.18 Communications

**Telephone Service:** In 1980, there were approximately 36,500 telephones in Mauritius, forty percent of which were found in Port Louis. Telex facilities are available at Cable & Wireless, Chaussee Street in Port Louis (tel: 20221). The telephone dialing code for Mauritius is prefix + 230. There is radiotelegraph service with Reunion, Madagascar, Seychelles, Zanzibar, and other points in Africa. A satellite earth station on the island provides a direct telephone link to the United Kingdom.

**Radio and Television:** Radio and television service is provided by the government-controlled Mauritius Broadcasting Corporation (address: Broadcasting House, Louis Pasteur Street, Forest Side). The radio network operates one medium wave transmitter and two shortwave transmitters and broadcasts programs in English, French, Chinese, and six Indian languages. Television service began in 1965 and broadcasts in English and Hindi.

**Press:** There are twelve daily newspapers published in the country, nine in French and three in Chinese. The two largest are L'Express (circ. 20,000) and Le Mauricien (circ. 22,000). There are also several weeklies and periodicals published in French, English, and Chinese. Mauritius has no national news agency, but both Reuters and AFP (Agence France Presse) have bureaus in Port Louis.

### **1.19 Transportation**

**Roads:** Of the 1,770 km of roads, over 90% are paved and in generally good condition. In municipal council areas, the city engineering departments construct and maintain streets, while rural roads are maintained by the Ministry of Works. Traffic congestion in Port Louis and the other major cities can become quite heavy at times. All bus and taxi service on the main island is privately owned and operated.

**Railroad:** Mauritius has no railroad.

**Ports:** Port Louis is the islands' only major port and was expanded and modernized with a grant from the World Bank. The Port handled 1,690,000 metric tons of cargo in 1977. For more detailed specifications on Port Louis, see Section 3.7.

**Airports and Carriers:** Mauritius' only international airport is at Plaisance, 3 km from Mahebourg, in the south-east corner of the island. The permanent surface runway is over 2,500 meters. Air Mauritius, the national airline, flies daily to Rodrigues and also serves Madagascar, Reunion, Comoros, South Africa, France, and the United Kingdom, in conjunction with other airlines. Other airlines serving Mauritius are Air France, Air India, Air Malawi, British Airways, Lufthansa, South Africa Airways, and Zambia Airways.

## 2. Disaster Vulnerability

### 2.1 Overview of the Physical Environment

Both Mauritius and Rodrigues are of volcanic origin and are part of the Mascarene Island group, which also includes the French department of Reunion. There are three mountain ranges on the main island, all remnants of a collapsed volcanic crater that was formed 12 or 13 million years ago. The Moka mountain range is located in the northwest near Port Louis. In the eastern section of Mauritius, the Grand Port Range stretches alongside the Grand River Southeast, the longest river on the island. The third mountain range is the Black River Range in the southwest quadrant. The highest point on the island is the Little Black River Peak, which rises 826 meters above sea level. The terrain is cut by steeply graded mountain streams and long, winding rivers, interspersed with rapids and waterfalls. Torrential rains and cyclones can cause flash flooding along these rivers and streams.

Mauritius was once covered with ebony forestland, but most of it was cut down to make room for sugarcane cultivation. Scrub, grassland, and acacia trees comprise about 40% of the total land area on the main island. Deer, monkeys, hares, and mongooses were introduced to the island by the early settlers. The large, flightless dodo bird was indigenous to the island, but it became extinct in the 18th century. Rodrigues' mountainous terrain is unsuitable for growing sugarcane, but can support maize, beans and citrus fruits. Farmers on Rodrigues raise sheep, goats, pigs, and poultry for local consumption and export to Mauritius. The two tiny Agalega islands are entirely covered with coconut palms, a source of copra, which is exported to other countries.

The climate on Mauritius can best be described as subtropical maritime. The mean temperatures during the coldest month and the warmest month normally differ only 7°C at any given location on the island. Similarly, the daily temperature range is also normally 7°C. The mean daily high and low temperatures are about 29°C and 21°C respectively on the coast and approximately 24°C and 17°C respectively on the plateau. Table 1 indicates the monthly mean temperature at selected stations in Mauritius.

Precipitation in Mauritius can vary considerably from year to year and in different locations. The mean annual rainfall over the island is approximately 2,400 mm, but during cyclone years it can be much higher. The western and northern plains normally receive around 1,000 mm a year, while the central highlands average more than 4,000 mm. The high rate of evaporation on the island necessitates irrigation of crops at the lower elevations with excess water from the highlands. Table 2 indicates the monthly and annual precipitation amounts at selected stations in Mauritius.

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Table 1

Mean Monthly Temperatures

<u>Station</u>	<u>Jan</u>	<u>Feb</u>	<u>Mar</u>	<u>Apr</u>	<u>May</u>	<u>Jun</u>	<u>Jul</u>	<u>Aug</u>	<u>Sep</u>	<u>Oct</u>	<u>Nov</u>	<u>Dec</u>
Port Louis	27.2	27.8	27.3	26.3	24.3	23.0	22.2	21.8	22.9	23.9	25.4	26.7
Medine	27.5	27.7	27.1	25.7	24.3	22.1	21.5	21.8	22.4	23.4	25.2	26.6
Pamplemousses	26.4	26.6	26.3	25.1	23.1	21.5	20.8	20.5	21.7	23.0	24.9	25.8
Reduit	24.4	24.2	24.1	22.4	20.6	18.8	18.1	18.6	19.1	20.2	21.9	23.7
Vacoas	23.6	24.3	23.9	22.9	20.7	19.3	18.4	17.8	18.8	19.9	21.6	23.0
Union	25.1	24.8	24.9	23.7	22.3	20.5	20.3	19.9	20.3	21.5	22.6	24.3
Curepipe	22.5	22.4	22.2	21.3	20.0	17.6	17.0	17.1	17.7	18.4	20.0	21.2
Plaisance	26.0	25.8	25.6	24.4	23.0	21.3	20.6	20.6	21.1	22.0	23.5	25.0

Source: Data from NOAA/AISC and Meteorology in Mauritius, 1975.

Table 2

Mean Monthly and Annual Rainfall (mm)

<u>Station</u>	<u>Jan</u>	<u>Feb</u>	<u>Mar</u>	<u>Apr</u>	<u>May</u>	<u>Jun</u>	<u>Jul</u>	<u>Aug</u>	<u>Sep</u>	<u>Oct</u>	<u>Nov</u>	<u>Dec</u>	<u>Annual</u>
Plaisance	275	232	351	230	175	118	103	80	71	59	103	179	1,976
Union	287	322	420	284	173	158	139	97	93	67	117	146	2,353
Reduit	243	268	297	153	87	77	72	58	52	41	74	130	1,552
Vacoas	326	328	325	220	135	125	124	107	90	68	105	182	2,135
Curepipe	457	407	456	280	245	233	234	212	173	126	164	255	3,242
Medine	162	182	267	99	45	29	19	9	14	25	49	123	1,022

Source: NOAA/AISC, 1975.

## 2.2 Cyclones

Cyclone season officially begins on November 1st and lasts until May 15th. Between 1960 and 1983, the island-nation was beset by seventeen cyclonic storms. The islands lie in the direct path of most tropical cyclones that spawn over the warm waters of the Indian Ocean between latitudes 5°S and 15°S. These storms initially follow a south-southwesterly course and usually curve back in a south-southeasterly direction. Some cyclones continue on a west-southwest track on into Madagascar, the Comoros, and the southeastern coast of Africa. Rodrigues is even more cyclone-prone than the main island of Mauritius and more susceptible to agricultural and infrastructural damage.

The mountainous terrain of Mauritius tends to intensify the strong cyclonic winds that sweep over the island. Gusts as high as 280 kilometers per hour have been recorded (Gervaise at Mon Desert, February 1975). These strong winds can uproot large trees, level concrete reinforced buildings, and carry heavy objects long distances. The torrential rain from cyclones causes flooding along rivers and streams, and in low lying areas. Storm surges that normally accompany cyclones inundate the coast and can sink ships in port. Since Mauritius is a small island, the entire population is affected by a passing cyclone. When the island has been in the direct path of a cyclone (Carol in 1960, Gervaise in 1975, Claudette in 1979), the level of destruction has been devastating. Figure 1 charts the paths of the major cyclonic storms to affect Mauritius between 1967 and 1983.

### 2.3 Cyclone History

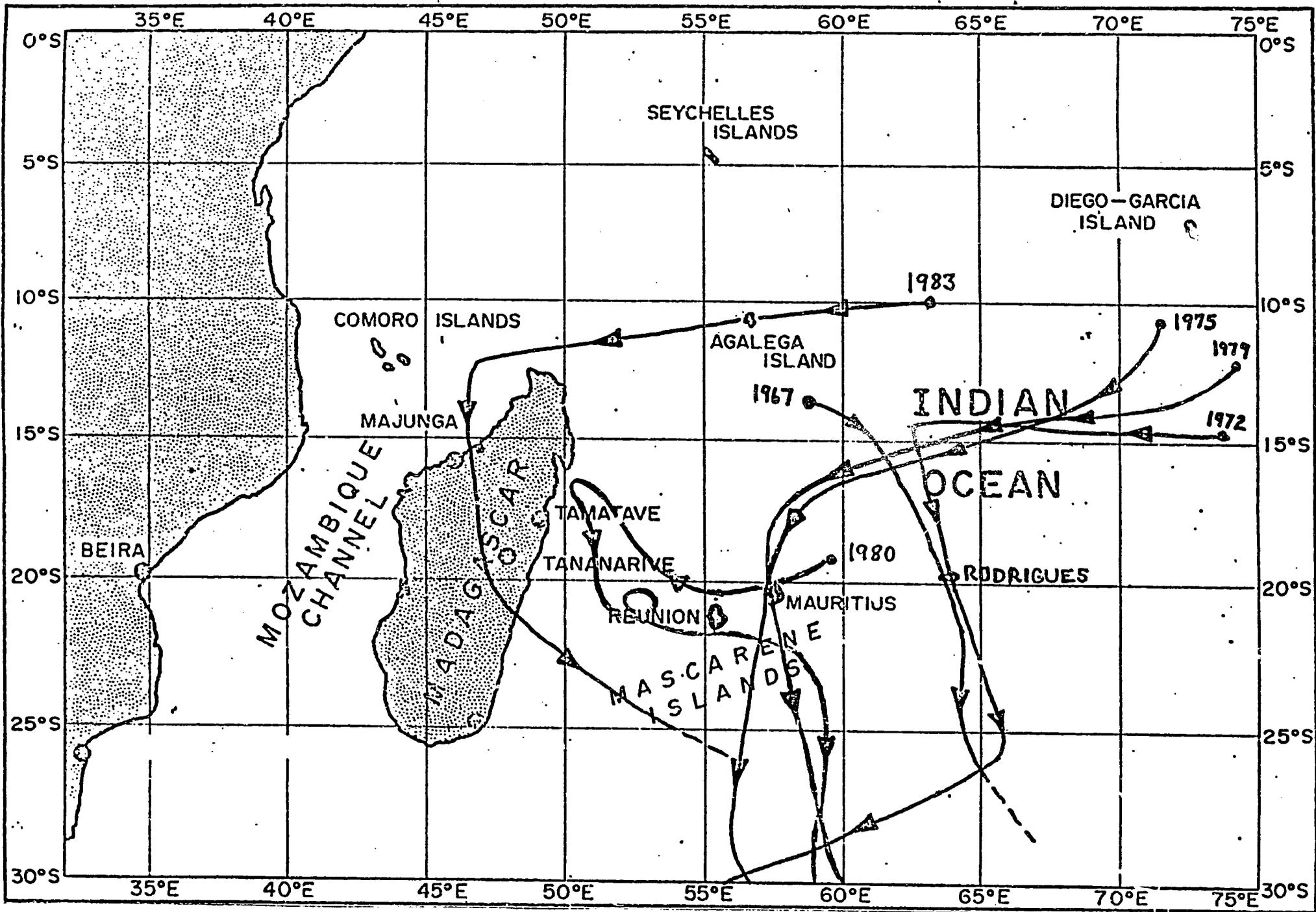
<u>Date</u>	<u>Location and Effects</u>
1615 Feb	The ship "Pieter Both" was sunk.
1638 Dec 16-17	Damage to sheds at Port-South-east and to vessels in its harbor
1644 Feb 4-5	A ship wrecked at Baie aux Tortues; considerable damage to island
1674 Feb 9	Widespread damage, dam destroyed
1695 Feb 9	Violent cyclone with very heavy rain and a sea surge
1698 Mar 29	Roofs of company buildings blown off; trees uprooted, crops damaged
1702 May 2	Severe cyclone accompanied by torrential rain and widespread flooding; plantations devastated, houses destroyed
1727 Dec 23	Storehouse, school, and church destroyed; gunpowder magazine and houses damaged.
1740 Jan 20	Damage to Port Louis harbor; hospital and brick factory wrecked
1748 Jan 21	In Port Louis, ship damaged and houses overturned; in Pamplémousses, hospital destroyed; bridges washed out.
1760 Feb 27	Considerable damage to entire island

2.3 Cyclone History (cont'd)

<u>Date</u>	<u>Location and Effects</u>
1773 Apr 9	Port Louis church and 300 houses destroyed. Some thirty ships ran aground or sunk. Agriculture suffered badly.
1786 Dec 14	Port facilities destroyed and ships sunk. Many large trees uprooted.
1807 Feb 3	Two ships sank with 1,100 men onboard.
1818 Feb 28- Mar 1	Out of 60 ships in harbor, only four left afloat. Stone houses damaged. All crops destroyed. Many trees uprooted
1819 Jan 25	Port Louis and environs. Some sugar factories destroyed.
1824 Feb 23	Many houses and trees blown down. Royal College sustained heavy damage. Many ships wrecked or damaged.
1824 Apr 24	Considerable damage to agriculture.
1834 Jan 20	Many large houses in Port Louis lost their roofs, smaller dwellings completely destroyed. Many large trees blown down. Bridges washed away.
1836 Mar 5	Violent winds swept over island. Numerous buildings in Moka demolished or damaged.
1848 Mar 7	Trees uprooted or broken, houses damaged. Tin roofs carried considerable distances.
1868 Mar 12	St. Mary's Church at Plaine Verte, built with an iron foundation, was completely destroyed. Considerable damage to ships in harbor and to sugar crops. Maximum hourly winds were 105 km p.h. at Pamplémousses.
1874 Mar 26-28	Considerable damage to Port Louis and districts.

2.3 Cyclone History (cont'd)

<u>Date</u>	<u>Location and Effects</u>
1892 Apr 29	Known as "the great cyclone". Gusts reported at 240 km p.h. Port Louis almost completely destroyed. Some 1,200 people were killed under collapsing walls and roofs. Sugar factories, warehouses, plantations, and residential buildings all badly damaged. The worst cyclone disaster in Mauritian history.
1911 Feb 6	Damage to Moka, Vacoas, and Curepipe.
1925 Dec 12	Some houses damaged, trees blown down, and crops battered.
1934 Jan 28-29	Damage to Curepipe market, railway station, and cinema hall.
1945 Jan 16-17	Severe winds up to 105 km. p.h.
1945 Feb 1-2	The second cyclone to hit southern Mauritius in same year.
1945 Apr 7	Third cyclone to hit the island in 1945, this one mainly damaged Plaisance airport.
1960 Jan 20	Cyclone Alix. Port Louis suffered considerable damage. Gusts of 160 to 200 km.p.h.
1960 Feb 28	Cyclone Carol. Most violent storm since the 1892 cyclone. Wind gusts of up to 256 km. p.h. were registered. The storm left 100,000 homeless, destroyed 40% of the sugar crop and a majority of the trees on the island.
1961 Dec 25	Cyclone Beryl. Gusts up to 200 km.p.h. recorded at Prince William.
1962 Feb 28	Cyclone Jenny. Northern part of Mauritius suffered extensive damage.
1964 Jan 20	Cyclone Danielle. Highest gusts were 220 km. p.h. at Plaisance.
1967 Dec 25	Cyclone Carmen. Cyclone hit Rodrigues, leaving 3,500 homeless.
1968 Apr 1	Cyclone Monica. Cyclone grazed Rodrigues island.



Tracks of some of the major cyclones affecting Mauritius 1967-1983

Sources: Tropical Cyclones of the Southwest Indian Ocean; Tropical Cyclones of Mauritius

2.3 Cyclone History (cont'd)

<u>Date</u>	<u>Location and Effects</u>
1972 Feb 17	Cyclone Fabienne. This cyclone passed directly through Rodrigues, damaging roads and buildings and destroying entire corn crop.
1975 Feb 6	Cyclone Gervaise. Hit the main island of Mauritius, destroyed 30% of sugar crop, and damaged island's infrastructure. Nine people were reported killed and 59 injured.
1978 Jan 18	Cyclone Fleur. Wind gusts between 110 and 145 km. p.h.
1979 Feb 1	Cyclone Celine. Hit Rodrigues island.
1979 Dec 22	Cyclone Claudette. High winds and heavy rain caused considerable damage to telephone lines, roads, buildings, and electric and water supply.
1980 Jan 16	Cyclone Hyacinthe. Three weeks after Claudette, this cyclone brought torrential rains to the island and hampered recovery operations from previous cyclone.
1980 Feb 3	Cyclone Jacinthe. A third cyclone in two months further exacerbated situation.
1982 Jan 13	Cyclone Damia. Extensive damage to homes, crops, livestock and infrastructure on Rodrigues.
1983 Dec 8	Cyclone Andry. Passed over the Agalega islands, 950 km north of the main island. The 350 residents were left homeless and most buildings and coconut trees were completely leveled.
1983 Dec 25	Cyclone Bakoly. Passed 30 miles west of Mauritius and caused wind damage to the west coast of island.

Source: Selected from Tropical Cyclones at Mauritius by the Mauritius Meteorological Service. Copies of Disaster case reports of the 1972, 75, 77, 80, 82 and 83 cyclones are available from OFDA.

2.4 Vulnerability of Agriculture

Cyclone season coincides with the ripening period for most crops on Mauritius. Because of the country's almost complete dependence on sugar production, a cyclone that significantly reduces the annual yield can have a devastating effect on the economy. In 1979 and 1980, three successive cyclones were responsible for decreasing agricultural production by a third and the GDP by 9 percent. Sugarcane is the dominant crop on Mauritius because it is less susceptible to cyclone damage than other crops. For this reason, the cyclone threat has impeded the nation's efforts at agricultural diversification.

Summer droughts can also seriously reduce sugar production and usually occur during the years when Mauritius is not affected by cyclones. During extended dry periods, crops are irrigated with water from several man-made reservoirs. Maximum crop yields are produced when passing tropical depressions bring sufficient rainfall to the region, but no tropical cyclones hit the island. The Mauritian Meteorological Service has begun investigating methods of artificial rainmaking in an effort to insure precipitation for its rain-fed crops.

Mauritius has a comprehensive crop insurance program to compensate farmers whose crop yields are significantly reduced by cyclones or droughts. The Cyclone and Drought Insurance Board of Mauritius was established in 1946 and the first premiums paid covered the 1947 crop. Those insured against cyclone and drought were compensated at 75-80 percent of the value of the sugar shortfall after deducting normal costs. In the 1960s, the Board purchased reinsurance coverage to prevent the collapse of the fund.

Table 3  
Area Under Cultivation (1) and Local Production (2)

	<u>1978</u>	<u>1979</u>	<u>1980</u>	<u>1981</u>	<u>1982</u>
Sugarcane					
(1) acres	214,300	211,800	211,400	209,010	209,010
(2) metric tons	6,260	6,313	4,564	5,302	6,582
Tea					
(1) acres	14,400	10,220	9,675	9,370	9,000
(2) metric tons	25,733	25,718	22,438	24,926	26,482
Tobacco					
(1) acres	1,530	1,905	2,160	1,835	954
(2) metric tons	731	705	1,153	1,247	624
Potatoes					
(2) metric tons	12,153	8,329	11,694	15,999	13,500

Source: Mauritius Central Statistical Office, Bi-Annual Digest of Statistics, 1982

### 2.5 Vulnerability of Infrastructure

The infrastructure on the main island of Mauritius is almost always severely damaged by passing cyclones. Electric power and telephone lines are easily blown down by high winds, leaving entire sections of the island without service. The torrential rains and flash flooding that accompany cyclones wash out roads and bridges, impeding access to isolated communities. After two cyclones destroyed 20% of the buildings on the island in 1960, the government adopted stricter cyclone resistant housing standards. Cyclones have also damaged the island's piped water distribution system, causing outbreaks of waterborne diseases. Following the series of cyclones in 1979 and 1980, the country was faced with potentially nationwide epidemics of malaria and typhoid. A team of epidemiologists from the Centers for Disease Control, sent by the Office of U.S. Foreign Disaster Assistance, concluded that the likely cause of the epidemic was the contamination of the public water supply.

3. Disaster Preparedness and Assistance3.1 Host Government Disaster Preparedness

The Cyclone Emergency Scheme is first devised when Mauritius was still a British colony, but it is annually reviewed and revised as necessary. The yearly threat of cyclones mobilizes the government and population to take necessary preparedness measures several months before the start of the cyclone season. Buildings and infrastructure are regularly inspected to see that they conform to government codes, and preventive maintenance is conducted on the country's roads, water and electrical systems, and communication networks. The Cyclone Emergency Scheme designates four main organizations to handle disaster prevention, preparedness, and relief activities.

(1) Central Cyclone Committee - composed of representatives of government ministries, public utilities and other relevant agencies, it meets every year under the chairmanship of the Permanent Secretary of the Prime Minister's Office to review the Cyclone Emergency Scheme and recommend and implement cyclone mitigation measures.

(2) Standing Ministerial Cyclone Committee - chaired by the Prime Minister, its members include the Ministers of Works, Health, Housing, Local Government, and the Deputy Prime Minister. This committee makes all decisions regarding emergency relief operations following a cyclone.

(3) Committee of Officials - comprised of officials from various ministries, departments, and the Prime Minister's office, this support group provides information to the Standing Committee, collects damage assessments from stricken districts, and can make recommendations concerning emergency relief measures.

(4) Local Cyclone Committees - there are eight local committees, chaired by town mayors and chairmen of the district councils and represented by officials of district departments and the local Red Cross chapter. These committees are responsible for setting up temporary shelter and conducting damage assessments immediately following a cyclone.

Early preparations for the cyclone season go into effect in late August or early September each year. The local cyclone committees begin by submitting a list of public shelters (usually government school buildings) to the Central Cyclone Committee and the Ministry of Education, Arts and Culture. The Ministry for Employment equips each shelter with beds, blankets, hurricane lamps, stoves, utensils, etc. and appoints supervisors and caretakers to manage each center. Once a cyclone threat is declared, the Mauritius Meteorological Service (MMS) tracks the storm and the Mauritius Broadcasting Corporation (MBC) issues

regular bulletins (see section 3.2, Early Warning Systems). As the cyclone passes, officers of essential government services such as the police, fire department, MMS, MBC, hospitals, and public utilities stay on duty to provide assistance during the storm. Immediately following the cyclone, the local committees and the Committee of Officials report to the Standing Ministerial Committee, which coordinates relief operations, launches appeals for local and foreign assistance, and implements measures to restore essential services. Prison labor may be utilized to clear roads after the storm.

The Mauritius Red Cross (MRC) has five chapters in Mauritius and one in Rodrigues. The MRC is represented in each of the local cyclone committees and volunteers are usually assigned to the shelters around the country. The MRC is also responsible for transporting the sick and elderly to the centers and furnishing them with food, clothing, and other essentials. Red Cross volunteers are on stand-by to provide whatever assistance is necessary during a disaster.

Mauritius Red Cross  
Ste. Therese Street  
Curepipe, Mauritius  
Cable: MAUREDCROSS Curepipe  
Telex: YBRAT IW 258  
Telephone: 63604

### 3.2 Early Warning

As soon as a tropical depression forms in the southwest Indian Ocean, the Mauritius Meteorological Service begins tracking the storm and forecasts its direction and potential intensity. The MMS, under the aegis of the Ministry of Communications, is headquartered in Vacoas (Telex: METEO VACOAS; Telephone: 861031) and has outstations at Plaisance Airport, Port Louis Harbor, Pamplemousses, Rodrigues, Agalega, Cargados Carajos, and Flat Island. The MMS also shares data with the Diego Garcia Meteorological Station, which is run by U.S. Naval Authorities. Unmanned automatic anemometer stations are installed throughout the islands. Mauritius belongs to the World Meteorological Organization (WMO) and participates in the Regional Association I Tropical Cyclone Committee for the South-West Indian Ocean. Under this regional network, member nations (Mauritius, Madagascar, Comoros, Reunion, Seychelles, Malawi, Mozambique, and Tanzania) share information gathered from meteorological satellites, weather radar, aircraft reconnaissance reports, and ship observations.

Once a cyclone appears to be headed toward Mauritius or its dependencies, the cyclone warning system is put into effect. The warning system consists of a numbered series of cyclone bulletins and of summary statements of the class of warning (4 classes) designed to keep the public informed of the storm's progress.

Class I: issued when there is a risk that gusts exceeding 121 kmph (75 mph) are likely to hit Mauritius/Rodrigues within 36 to 48 hours. One red flag is hoisted on all public buildings to notify the population.

Class II: issued to allow 12 hours of daylight before gusts exceeding 121 kmph occur over Mauritius/Rodrigues. Two red flags are hoisted.

Class III: issued 6 hours before the advent of 121 kmph gusts are expected. Three red flags are raised.

Class IV: issued when gusts of at least 121 kmph have been recorded on the islands and are expected to continue. The three red flags remain hoisted.

Termination: When there is no longer appreciable danger of cyclone-force winds, the red flags are replaced by a single blue flag.

Standard cyclone bulletins are prepared by the MMS and disseminated to all concerned governmental authorities. The Mauritius Broadcasting Corporation relays these bulletins on radio and television, along with a list of precautions to be followed. These bulletins are broadcast in English, French, Creole, and Hindustani at regular intervals. Recorded bulletins are also disseminated to the general public by means of the TELMET service operated by the Telecommunications Department. Any telephone inquirer may listen to a recorded version of the latest bulletin by dialing a special number. In the event of a breakdown in normal communication links, emergency VHF radio repeaters, HF radio-telephone transreceivers, and underground cable teleprinters can be brought into operation.

### 3.3 Health Resources

Medical care is free to all Mauritians. The Ministry of Health administers the extensive national health service, except for several hospitals on local sugar plantations and six private clinics. The Ramgoolam National Hospital contains an intensive care unit and a leprosarium in the northern part of the island. Specialized medical facilities include a psychiatric hospital at Beau Bassin (790 beds), a respiratory ward at Poudre d'Or (96 beds), an ophthalmology clinic at Moka (64 beds), and an ear, nose, and throat (ENT) center at Vacoas (35 beds). All of the hospitals are well-equipped and adequately staffed, but they tend to be overcrowded. The government's emphasis on family planning is reflected by its support of 18 family planning clinics and public school contraceptive instruction. There are approximately 400 physicians practicing in Mauritius, most of whom were trained in Europe and India.

Health Care Facilities' (1982)

	<u>1982</u>
<u>Hospitals</u>	
General Hospitals	7
Specialized hospitals (psychiatric, leper, ENT)	5
Prison hospitals	2
Private hospitals on sugar estates	7
<u>Health Centers</u>	
	3
<u>Dispensaries</u>	
Public dispensaries	54
Prison dispensaries	2
Private dispensaries	27
Mobile dispensaries	55
<u>Clinics</u>	
Dental	12
Social Hygiene	1
Private	7
Public mobile prenatal	1
Public mobile dental	2
Maternal/child health and family planning clinics	68
Family planning (only)	
Clinics	18
Supply centers	33

Table 2: Health Care Personnel (including Rodrigues) 1982

	<u>1982</u>
Total government doctors:	369
Number of specialists:	115
Doctors in private practice:	265
Dentists in government service:	24
Pharmacists	
Government service:	6
Private:	69
Qualified nurses	
Government service:	1,472
Qualified nurses/midwives	
Government service:	622

Source: Mauritius Central Statistical Office, Bi-Annual Digest of Statistics December 1982.

### 3.4 Housing

Approximately 48% of the population is congregated in the urban corridor that stretches between Port Louis and Curepipe. Household dwellings tend to be small and average 5 persons per unit. Wattle and daub houses with thatched roofs are found in the rural areas. Between 1960 and 1972, an average of 7,000 new homes were built each year; through 1979 the average was about 4,000 units per year. Two government agencies are responsible for housing construction and financing in Mauritius. The Central Housing Authority, a parastatal of the Ministry of Housing, has been primarily involved in the reconstruction of low-cost public housing that was destroyed by Cyclone Carol in 1960 and Cyclone Gervaise in 1975. The Mauritius Housing Corporation, under the aegis of the Ministry of Finance, extends loans for middle- and upper-income housing and subsidizes low-cost public housing for cyclone victims. After two cyclones destroyed 20% of the housing stock in 1960, more and more houses were constructed using cyclone-resistant building features, such as concrete roofing, shorter roof overhangs, and metal strapping. However, stricter construction standards and the high price of imported building materials has driven up the cost of housing and produced delays in most projects.

### 3.5 Water Supply and Energy Resources

Mauritius has an extensive and well developed water supply and distribution system. Only 0.75% of the population is without access to piped water. However, over half of the water in the system is regularly lost through leakage before it reaches users. Water is tapped from subterranean reserves and freshwater streams, treated, and stored in several man-made reservoirs. A large new reservoir is to be built near Port Louis and repair work and improvements are being made to the capital's water system, which was damaged by the 1979/1980 cyclones.

The Central Electricity Board (CEB) is responsible for most of the generation and distribution of electricity on the islands. Approximately 70% of the electricity is generated by two diesel power stations, (one at Fort Victoria, the other near Port Louis) which had an installed capacity of 146.8 MW in 1983. The high cost of imported oil has increased the country's reliance on hydroelectric power and steam produced by boilers fueled with bagasse (residue of processed sugarcane). Hydroelectric power from stations on the Grand River South East and the Grand River North West currently account for an installed capacity of 25.74 MW. The 30-MW Plaine Champagne hydroelectric project is expected to generate 10% of the country's electric power once it starts production in late 1984. The government is investigating new energy sources, in particular wave energy generation and the development of the bagasse power potential. A French-financed bagasse pelletization project is currently underway to transform cane byproducts into a year-round fuel; currently bagasse is

only available during harvesting season. The electric current on the island is 220/240 v, 50 cycle, single phase, AC.

### 3.6 Road Networks

Mauritius has an extensive road network, which is generally in good condition despite the mountainous terrain. Over 90% of the roads are paved. Of the total 1,787 km of roads, 27 km are motorway (between Port Louis and Curepipe), 562 km are classified as main roads, 590 km secondary roads, and 608 km other routes. A 16-km four lane expressway connects Port Louis and Phoenix. An 11-km dual highway between Port Louis and Pamplemousses was completed in 1983. Construction has begun on a 1.2-km expressway through the heart of downtown Port Louis and a highway linking Plaines des Roches with Mahebourg. Other highway projects now underway include reinforcing about 75 km of existing main roads and the construction of 21.4 km of new road between Phoenix and Nouvelle France.

In view of the rapid infrastructure development in Rodrigues, the tarred road network of 91 km is quite inadequate. Eighteen kilometers of main roads are currently being upgraded and resurfaced and construction has begun on two new roads, one from Brule to Point Coton and the other from Quatre Vents to Grand Fouche Corail.

### 3.7 Ports

#### Port Louis

Coordinates: 20°9'S 57°30'E

Authority: Mauritius Marine Authority  
Tel: 080871,  
Telex: 4238  
MAUPOINT

Port Louis, a natural, well protected harbor, is the only commercial deep water port. The Mauritius Marine Authority administers the port. During the 1970s, the World Bank helped finance construction of a bulk sugar terminal and five deep water berths. The port is equipped with three mobile cranes of 20, 26 and 30-ton capacity and one 18-ton electric tower crane. Fresh water, fuel supplies (marine diesel oil, gas oil, furnace oil, coal), dry dock repair facilities, and stevedores are available during working hours.

Approach: Harbor entrance depths range from 12.8 m to 36.3 m. The main channel is about 2,136 m in length, with an average width of about 152.4 m. The channel has been dredged to 12.2 m. The berths vary between 192 m and 228.6 m in length. Very large vessels are berthed in the outer channel at the Quarantine Berth.

Accommodations:

Quay No. 1: Length 122 m; maximum draft 11 m. This berth mainly handles off-loading of petroleum and bulk fertilizer. General cargo vessels and passenger ships are occasionally berthed here.

Quay Nos. 2-3: Length 183 m each, maximum draft 10.7 m. These berths are mainly used for general cargo operations.

Quay No. 4: Length 183 m, maximum draft 10.2 m. This berth is used for container handling. A container park of 3.2 hectares is available for storage of containers. Also, equipped with two heavy duty forklifts and one gantry crane for container handling.

Quay C: Length 121 m, maximum draft 5.5 m. This berth is used for most inter-island trade and discharging cattle.

Quay D: Length 150 m, maximum draft 9.3 m, can accommodate vessels up to 183 m in length. This berth is used for unloading petroleum products and loading bulk molasses. Passenger vessels are also berthed alongside the quay.

The bulk sugar terminal is the third largest in the world and is operated by the Mauritius Sugar Corporation. It can accommodate vessels 198 m long with a maximum draft of 11 m and has a storage capacity of 175,000 tons.

Storage: The total covered storage space is 33,368 sq. m. An area of 1.2 ha is available for open air cargo storage. There is no refrigerated storage available in the Port area, but frozen cargo may be kept in privately-owned refrigeration plants in town.

Towage: Two 830-h.p. diesel-engine tugs are available for deep-sea towage and salvage and are fitted with fire fighting equipment and VHF radio. Three smaller tugs of 320 h.p. are also available for harbor work and equipped with VHF.

Port Mathurin Harbor

Coordinates: 19°41'S 63°25'E

The harbor is located on the northern coast of Rodrigues, at the town of Port Mathurin. The Mauritius Marine Authority is also responsible for its operation. The port is mainly used for trade between Mauritius and Rodrigues. The water depth in port is approximately 32 m and the one deep water quay can accommodate ships up to 4,000 tons.

### 3.8 Airports

The only international airport is at Plaisance on the southeastern coast of Mauritius, outside of Mahebourg. It is approximately 48 km from Port Louis. The runway has been strengthened and resurfaced. Runway and approach lights are being upgraded to Category 1 and new navigational aids are being introduced. A new control tower 27 meters high and a new terminal building are nearing completion. The installation of an Instrument Landing System in 1978 has enhanced the safety of flight operations in adverse weather conditions and at night. Aircraft traffic increased by 122% between 1976 and 1982 as a result of the growth in tourism.

<u>Coordinates</u>	<u>Elevation</u>	<u>Runway length</u>	<u>Aircraft/Strength</u>
20°25'40"S	57 m	2600	B707-338C
57°40'31"E			B747

Alternate aerodromes - Mahe, Seychelles; Antananrivo/Ivato  
Madagascar; Majunga/Amboroy, Madagascar; St. Denis/Gillot, Reunion.

The construction of a new airport at Plaines des Roches in the north, proposed in the 1975-80 Development Plan, has been suspended.

Plaine Corail airstrip is located in the southwest of Rodrigues. The airstrip has a concrete surface and is 54 meters long. There are four weekly flights between Mauritius and Rodrigues.

#### Aircraft Entry Requirements

Private and non-scheduled commercial aircraft overflying or landing for non-commercial purposes must obtain prior permission from the Director of Civil Aviation, Plaisance Airport, Plaine Magnien, Mauritius Island (telegraphic address: CIVILAIR MAURITIUS/Telex: None) at least 7 days prior to departure. All requests must include a) name of aircraft operator, b) type of aircraft and registration marks, c) date and time of arrival and departure from Mauritius, d) places of embarkation/disembarkation abroad of passengers and cargo, e) number of passengers and type of and amount of cargo, f) purpose of flight, g) name, address, and business of charterer, if any, and h) cable address of operator. All requests must include provision for prepaid reply.

#### Special Notices:

Doors, windows or bays in the aircraft may not be opened until authorized by health and agriculture quarantine officials.

Due to acute shortage of parking space at Plaisance Airport, all aircraft must provide prior notification to the airport manager at least 7 days prior to arrival. The times of arrival and departure must be agreed upon by the airport manager before the flight.

Airlines

Air Mauritius: P.O.B. 6C, Rogers House, 5, President John Kennedy St., Port Louis; services to Reunion and Rodrigues and to the Comores, France, India, Kenya, Madagascar, Saudi Arabia, Seychelles, South Africa, Switzerland, and the UK; fleet of 2 Boeing 707-430, 2 Twin Otter.

Air Distances (statute miles)

Mauritius to:	Melbourne Int.	5,212
	Mogadiscio	1,761
	Nairobi Intl.	1,924
	New York (JFK)	9,272
	Perth Intl.	3,656
	Reunion Is.	144
	Rome	5,172
	Salisbury	1,740
	Seychelles	1,098
	Singapore	3,468
	Tananarive (Arivonimamo)	694

3.9 USAID Program

The U.S. government's assistance strategy supports the current government's efforts to stabilize the economy and improve the balance of payments situation. The U.S. Agency for International Development is currently funding two projects in Mauritius in support of the IMF/IBRD stabilization program. The Commodity Import Program (CIP) finances the importation of degummed vegetable oil from the U.S. to generate local currency, which is then used to upgrade public water supplies, assist small scale irrigation schemes, and support the GOM Ministry of Tourism. In FY 1983, the CIP was budgeted at \$2 million. The other ongoing A.I.D. project in Mauritius is the P.L. 480 Title I program, valued at \$3.5 million in FY 1983. The P.L. 480 Title I food commodities sent to Mauritius are rice and wheat flour.

USG assistance has also come in the form of disaster relief for cyclone victims. In response to emergency appeals from the Government of Mauritius, the U.S. Government has been quick to provide emergency food, shelter, medical supplies, and technical assistance (see chart below). In the 1967, 1975, and 1983 cyclones, U.S. Navy vessels on tour in the southwest Indian Ocean transported emergency supplies to the affected areas and crew members repaired damaged infrastructure and provided other emergency assistance. The U.S. Mission keeps a Mission Disaster Relief Plan on file to be used in the event of a disaster. The Plan, written in February 1978, contains a delegation of emergency responsibilities for the Mission staff, a description of host government's capabilities and resources, and extensive contact lists of key government personnel.

USG Disaster Assistance to Mauritius

<u>Year</u>	<u>U.S.-Declared Disaster</u>	<u>Commodity/ Service</u>	<u>Provided Thru</u>	<u>Cost</u>
1967	Cyclone Carmen (Rodrigues)	Ambassador's Authority: cash	G.O.M.	\$4,000
		Emergency food (400 MT of corn)	World Food Program	\$43,000
		U.S.S. Ware transported food, clothing, and mattresses; personnel pro- vided emergency assistance.	U.S. Navy	\$8,000
1972	Cyclone Fabienne (Rodrigues)	Housing supplies		\$7,609
1975	Cyclone Gervaise (Mauritius)	Ambassador's Authority		\$25,000
		Personnel from U.S.S. Camden and U.S.S. Enter- prise delivered emergency supplies and provided technical assis- tance and repair work.	U.S. Navy	\$23,200
		OFDA Officer monitored relief operation.	OFDA	\$2,357
		600 tents	OFDA Guam Stockpile	\$116,000
		576 blankets	OFDA Guam Stockpile	\$2,831
		680 water jugs	OFDA Guam Stockpile	\$1,367
		Tetracycline	OFDA Guam Stockpile	\$3,910
		Hand tools	OFDA Guam Stockpile	\$579
		Airlift of Guam supplies	U.S. Air Force	\$50,000

USG Disaster Assistance to Mauritius

<u>Year</u>	<u>U.S.-Declared Disaster</u>	<u>Commodity/ Service</u>	<u>Provided Thru</u>	<u>Cost</u>
1979	Cyclone Celine (Rodrigues)	Ambassador's Authority for building materials	G.O.M.	\$6,000
1979-80	Cyclones Claudette, Hyacinthe, and Jacinthe (Mauritius)	Tents	OFDA Singapore Stockpile	\$46,442
		Airlift of tents	U.S. Air Force	\$141,000
1980	Typhoid Outbreak (Mauritius)	Epidemiologist survey team	Centers for Disease Control	\$10,884
1982	Cyclone Damia (Rodrigues)	Ambassador's Authority used for purchase of fertilizer, road construction equipment		\$27,222
		Local purchase of medical supplies		\$4,393
1983	Cyclone Andry (Agalega Islands)	U.S.S. Fife transported relief supplies.		\$13,066
			TOTAL	\$536,860

3.10 Voluntary Agencies and International OrganizationsVoluntary Agencies

Adventist Development and Relief Agency International  
P.O. Box 18  
10 Salisbury Street  
Rose Hill, Mauritius  
Telephone: 4-2167

Program: Clothing

**CARITAS**

Rue d'Estaing  
Port Louis, Mauritius  
Telephone: 2-3405

Program: Medical care, food, clothing, shelter

Church World Service  
Astor Court  
Lislet Geoffroy Street  
Port Louis, Mauritius  
Telephone: 08-4969

Program: Material aid, blankets, medical equipment, clothing, self-help programs

Save the Children Federation, Inc.  
75 C. Antelme Avenue  
Quatre Bornes, Mauritius  
Telephone: 4-5417

Program: Mother/child health, integrated rural development

Southern Baptist Convention  
P.O. Box 66  
Curepipe, Mauritius  
Telephone: 64224

Program: Vocational education

International Organizations

United Nations Development Program (UNDP) and  
United Nations Fund for Population Activities (UNFPA)  
P.O. Box 253  
Anglo-Mauritius House  
6th floor  
Intendance Street  
Port Louis, Mauritius  
Telex: 4259 UNDRP IW  
Telephone: 2-3726/7  
2-3695

UNICEF  
No. 6 William Newton Street  
Port Louis, Mauritius  
Telex: 1W4259  
Telephone: 2-0257

World Food Program  
P.O. Box 253  
Port Louis, Mauritius  
Telephone: 2-1430

World Health Organization  
P.O. Box 1194  
Port Louis, Mauritius  
Telex: 4440

**3.11 Mitigation and Development**

Mauritius was once considered virtually uninhabitable because of the frequency of cyclones. However, over the years the people of Mauritius have learned to prepare themselves for the inevitability of cyclones. The Cyclone Emergency Scheme contains several preparedness measures designed to reduce some of the risks and hazards associated with tropical cyclones. Several weeks before the start of cyclone season, work crews go out and remove rotten trees and unanchored objects that could become flying debris during a storm. One mitigation measure has been the adoption of more cyclone-resistant building standards. After Cyclone Carol hit in 1960, the population began converting their homes from timber-framed structures with galvanized iron sheet roofing to heavy load-bearing buildings with concrete roofs. The well-developed cyclone early warning system in place on Mauritius notifies the population of approaching cyclones well in advance of the time needed to prepare and seek cover. Over the past couple of decades, since these preparedness measures have been implemented, the damage to buildings and the loss of human life resulting from cyclones has been considerably reduced. In 1960, Cyclone Carol claimed approximately 40 lives and rendered over 100,000 people homeless. In 1975, nine people were killed and roughly 59,000 people left homeless by Cyclone Gervaise.

Mauritius' one crop economy makes it especially vulnerable to the recurrent threat of cyclones. Even though sugarcane is generally resistant to cyclone damage, crop losses of 30% can have a devastating impact on the economy. The government of Mauritius is promoting agricultural diversification, especially the intercropping of maize, potatoes, and other vegetables between sugarcane rows. The Mauritian crop insurance program is another measure aimed at mitigating the economic losses caused by tropical cyclones. Sugar plantation owners covered by the program are compensated for the value of the shortfall. By adopting these preparedness and mitigation measures, Mauritius is making a concerted effort to reduce the impact and subsequent economic disruption caused by tropical cyclones.

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