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DISASTER PREPAREDNESS AND MITIGATION IN THE REPUBLIC OF THE MALDIVES

Prepared for

ASIAN DEVELOPMENT BANK

and

MINISTRY OF PLANNING AND ENVIRONMENT
REPUBLIC OF THE MALDIVES

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TABLE OF CONTENTS

LIST OF FIGURES

TABLE

EXECUTIVE SUMMARY

The Republic of Maldives has a moderate level of exposure to extreme natural events that may give rise to natural disasters. Thus, while disasters may not occur as frequently in Maldives as in some other areas, or perhaps with as great a magnitude, they will nevertheless occur from time to time.

Moreover, it is possible that the vulnerability of the country will increase in coming years as population pressure on resources grows, as the tourism industry expands and if current scenarios of sea level rise as a result of global climate change prove correct.

The Republic of Maldives may also be affected by disasters of technological origin such as a marine pollution incident or an aviation accident.

Presently disasters are dealt with on an *ad hoc* basis. To date, this approach has worked reasonably successfully.

However, if disaster vulnerability is to increase, it will be important that a more formalized approach to disaster management is adopted.

Such an approach, however, should build on existing arrangements and resources for disaster management in the Republic of Maldives.

It is recommended in this report that the Republic of Maldives develop a National Disaster Plan and adopt a national disaster management structure. Both of these should be appropriate to Maldives, reflecting the level of vulnerability and availability of human resources.

1.0 INTRODUCTION

The purpose of this report is to provide an evaluation of the vulnerability of the Republic of Maldives (Figure 1) to disasters, and to provide recommendations for institutional and other measures which may help reduce that vulnerability which does exist. The report has been prepared to assist the Government of Maldives. The project in which the work was carried out was funded by the Asian Development Bank and was hosted by the Ministry of Planning and Environment. Appendix V lists the Government officials interviewed during the course of the report preparation.

The report outlines the salient issues in relation to disaster reduction in the Republic of Maldives. Paradoxically, a particular problem arises from the relative infrequency of environmental extremes that affect the country. Under such conditions it is important to identify activities that can be sustained during relatively long periods free from major disaster, while taking into account the human resource restrictions of Maldives, in common with other similar island countries.

This scenario is somewhat complicated by two long-term trends affecting the country. First, a very high rate of population growth, particularly on Male', but also on a number of other islands is placing increasing pressure on the island resource base. Consequently, the vulnerability of some communities is likely to increase. Second, scenarios of environmental change as a consequence of global warming indicate a gradual increase in global sea levels. This is particularly significant with respect to Maldives, given the low-lying nature of the atoll environment of which the country is composed. While we can be certain that there will be considerable future growth of the Republic's population, there is less certainty regarding the effects of sea-level rise upon coral atolls.

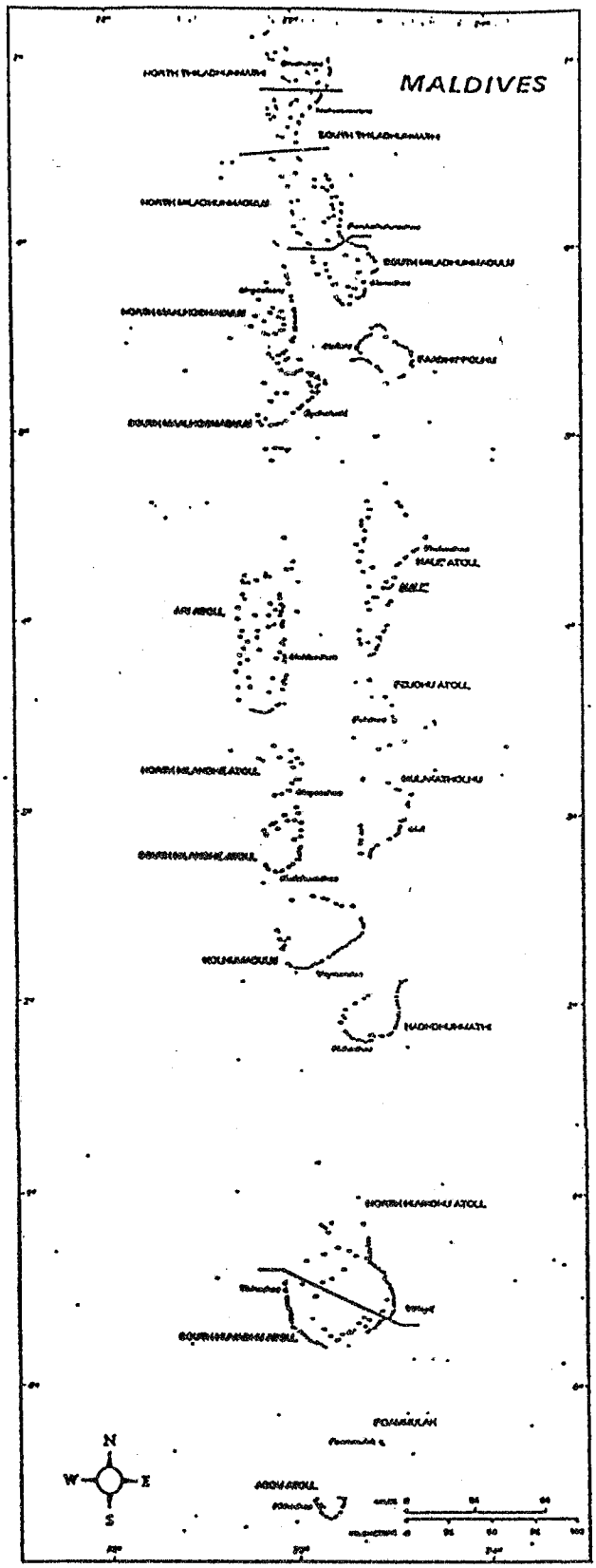

Figure 1. The Republic of Maldives (Ministry of Planning and Environment, 1991).

2.0 DISASTER VULNERABILITY IN REPUBLIC OF MALDIVES

Because the concept of disaster is often used very loosely, it is important to establish a relatively narrow working definition of the term. In this report we use the term DISASTER to refer to an event which causes disruption and losses to a community, to such an extent that the community has difficulty in coping without some kind of external assistance. Disasters are thus not events which cause only inconvenience, nor are they events where only a few individuals, families or homes are badly affected. In these instances the community as a whole should be able to cope.

This definition of disaster can be applied to outer islands or atolls within the Republic, where assistance may come from central government, or even to the nation as a whole, where foreign assistance may be necessary.

The term DISASTER VULNERABILITY refers to the susceptibility to be harmed or to suffer losses during a disaster event.

In determining disaster vulnerability it is important to stress that there are two important sets of components which have to be taken into account (Figure 2). First, we must consider the disaster agents themselves. In the case of natural disasters this refers to those extremes within the natural environment which cause disruption and devastation. In some other instances the disaster agent may actually be a direct result of human action (e.g. an airline crash). Second, however, we must also consider the societal aspects of disaster. These are the actions and conditions within a community that may increase the likelihood that any given disaster agent will cause devastation and disruption. Changes in this second component of disaster can be extremely significant in increasing vulnerability to disasters, even if the disaster agent itself remains unchanged.

In this section of the report the vulnerability of Maldives is evaluated, using information about the physical geography of the country and the historical record of disaster events, in addition to examining the implications of societal and environmental change.

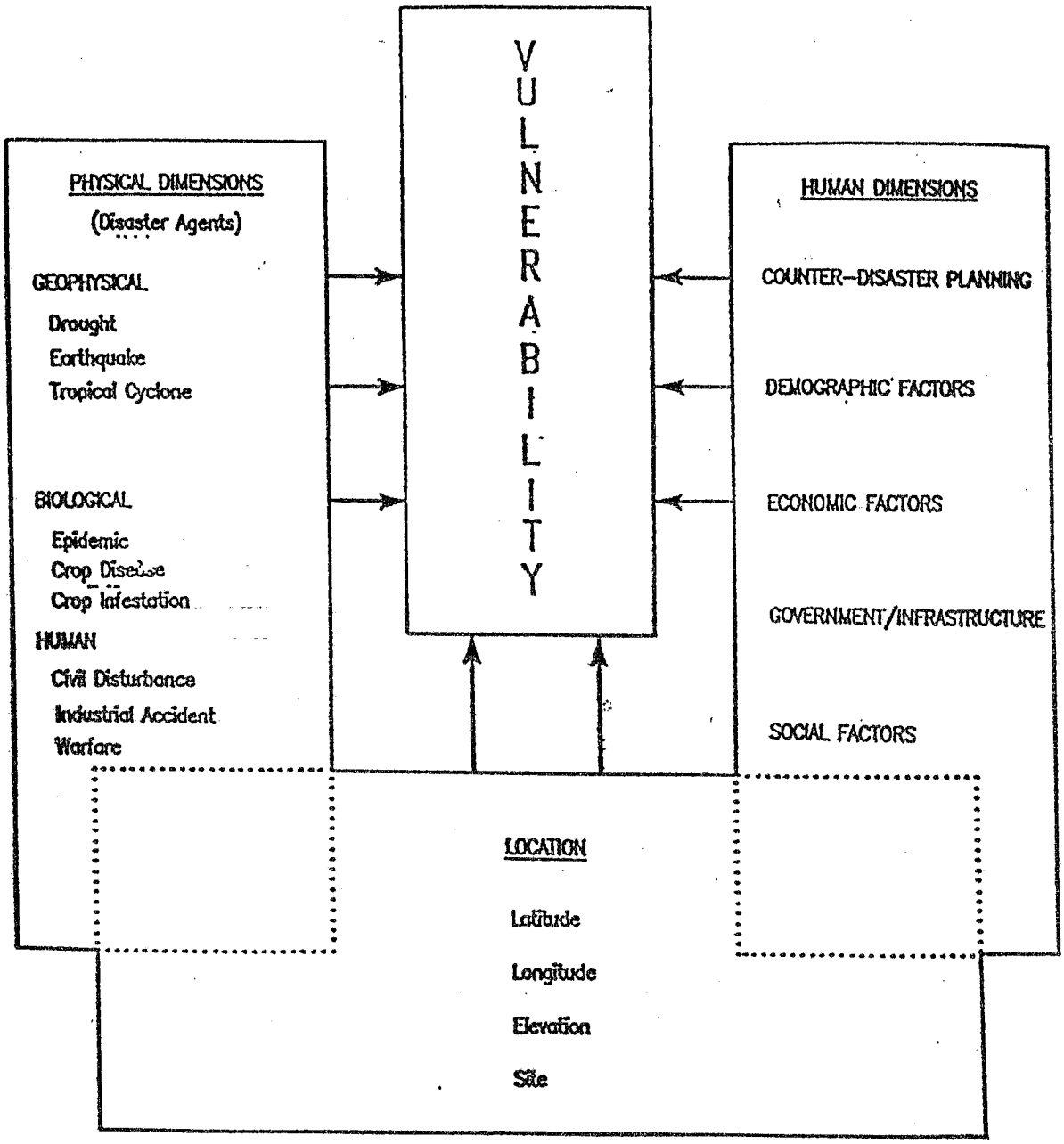

Figure 2. The dimensions of disaster vulnerability.

2.1 THE PHYSICAL ENVIRONMENT

In one sense, the very small size and low elevation of Maldives provide an image of considerable environmental fragility. However, the location of Maldives close to the equator, influenced by the monsoons, and in an aseismic area of the Indian Ocean, ensures that the country is not exposed to a high frequency of environmental extremes, nor are the extreme events that do occur usually of a very high magnitude.

The Republic of Maldives is a chain of atolls extending approximately 870 km from South (0° 42'S) to North (7° 06'N). While there are only 26 atolls they contain some 1190 islands with a total land area of approximately 298 square kilometres. Of these islands 202 are classified as "inhabited" although approximately 75 other islands are used as tourist resorts, or for industrial purposes. All of the islands are low lying. Although no detailed topographic survey has been carried out in Maldives there is very little land in excess of 3.5 m above sea level (Edward's, 1989).

The climate of Maldives is strongly influenced by two monsoon systems. The northeast monsoon is a dry system which is experienced between December and April. Prolonged dry spells have been recorded during this period. The southwest monsoon, in contrast, brings considerable amounts of wet weather and runs from May through November. This pattern which appears more marked for the islands in the North is illustrated in Figure 3a. The annual variation in dry season and total rainfall is shown in Figure 3b.

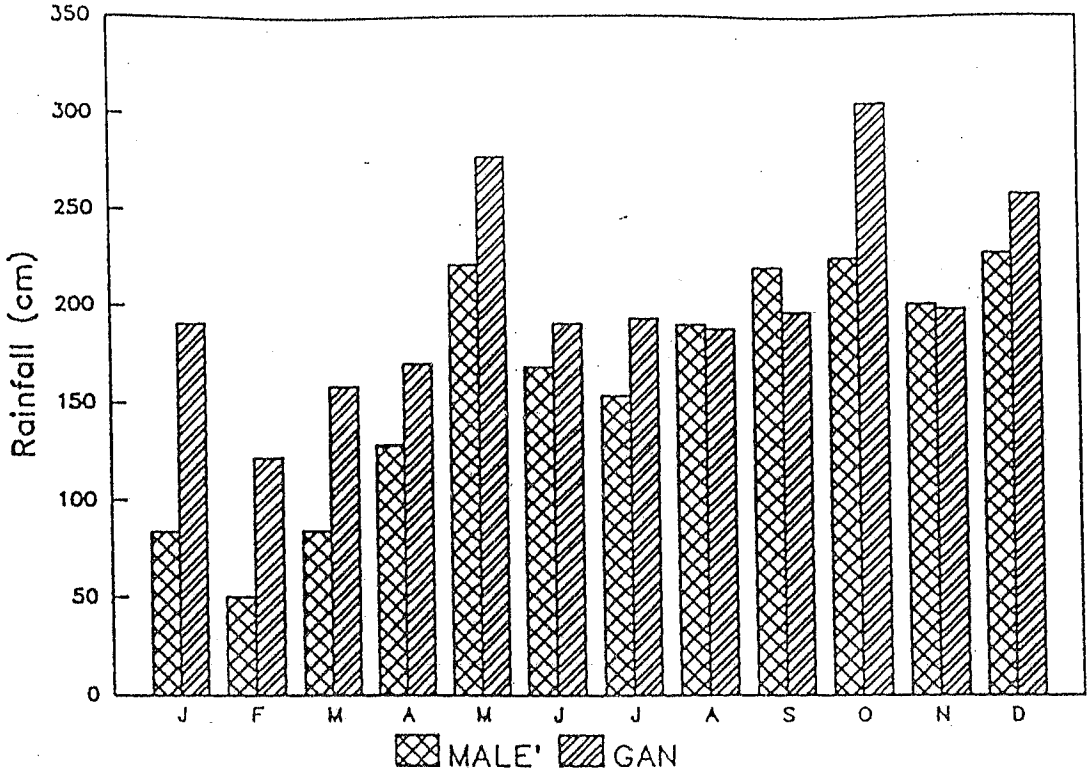

Figure 3a. Average monthly rainfall, Hulule' (1967-91) and Gan (1975-91) (Extracted from Department of Meteorology, n.d).

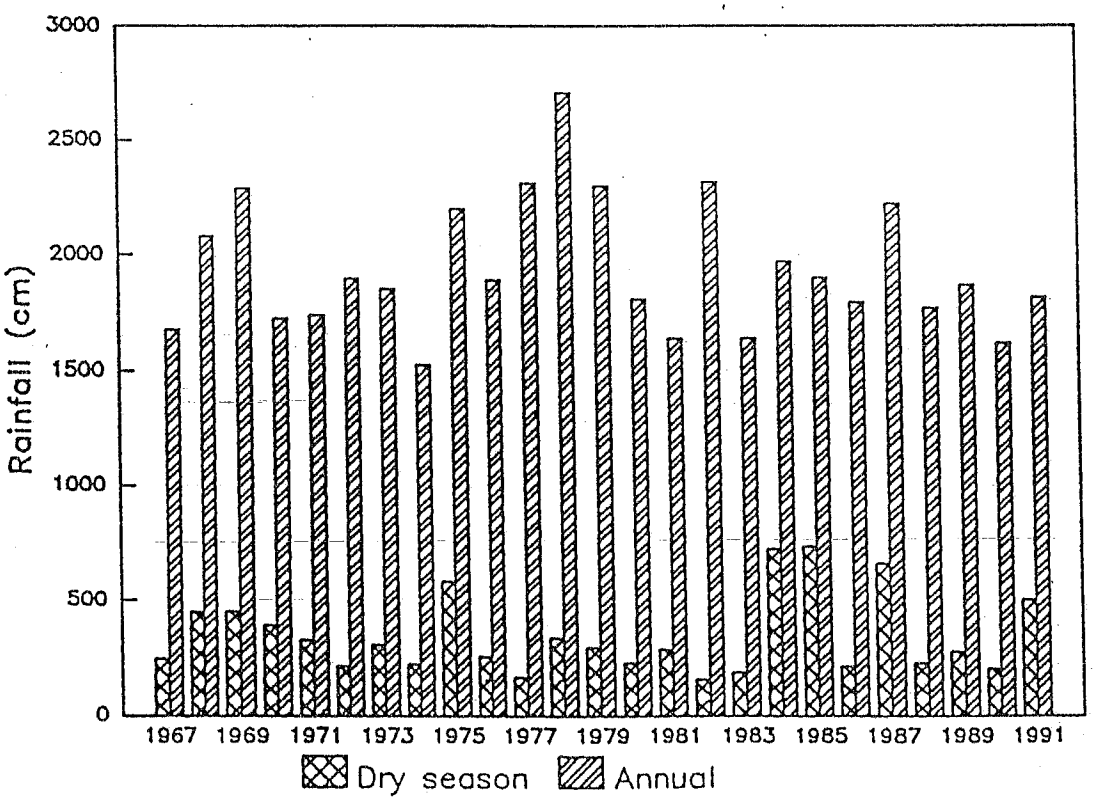

Figure 3b. Comparison of dry season (January-April) and annual rainfall, Hulule' (Extracted from Department of Meteorology, n.d)..

The periods of transition between the monsoons are often noted for their variability. Rainfall also appears to increase from north to south and although records of sufficient length do not exist for the northernmost atolls, it seems that these areas may be the most prone to prolonged rainless periods.

Generally, Maldives is too close to the equator to be badly affected by tropical cyclones although, especially in the north, some islands may be affected by gale and storm force winds associated with nearby cyclones moving into the Arabian Sea or Bay of Bengal. Data on tropical cyclones in these areas is summarized in Table 1. This shows that in the Arabian Sea tropical cyclones may occur in almost all months although they appear to be most likely in May and June and from October through December (South Asian Association for Regional Cooperation, 1992).

Table 1

Tropical cyclones in the north Indian Ocean

All cyclonic storms:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Bay of Bengal	5	1	4	19	39	35	38	26	32	62	68	363
Arabian Sea	2	0	0	5	16	15	3	2	5	20	25	98

Storms in which speeds exceeded 48 knots:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Bay of Bengal	1	1	2	8	26	4	7	1	10	26	33	133
Arabian Sea	0	0	0	4	13	10	0	0	1	7	19	55

Source: South Asian Association for Regional Cooperation (1992)

Waves generated by such events may cause coastal erosion or flooding in some areas. Also, storm waves propagated in the South Indian Ocean, thousands of kilometres from Maldives, may also reach the atoll shores. This was believed to be the cause of waves which wrought major damage in 1987 (Goda, 1988).

2.2 THE HISTORICAL RECORD OF DISASTER OCCURRENCE

The record of disaster occurrence in Maldives is not very complete. Two useful historical sources were used in this study (Bell, 1940, Maniku, 1990). In addition there are reports available regarding some of the more recent events. Storms clearly do affect Maldives from time to time, although it is difficult to assess their magnitude from the information available. There have also been periods of drought experienced in the past. In addition to these climatic hazards we may add disastrous fires, of which many have been recorded in Male' over the centuries, and epidemics. Appendix I lists the major events identified in the historical record.

From our understanding of the physical geography of Maldives and the patchy historical record of disaster occurrence it is possible to develop a list of disaster threats for the country. These include:

Storms may cause disasters in a number of ways. Their high winds may cause damage to crops, trees, buildings and other structures (e.g. communications antennae). They may also bring high intensity and/or prolonged rainfall which may cause flooding and water logging. The latter often reduces the stability of tree root systems and can contribute to wind damage of the tree. Finally, storms may cause a storm surge, a rising of the sea-level under the low atmospheric pressure conditions at the storm centre. Combined with heavy seas generated by the storm winds, storm surges may cause the inundation of coastal lands and accelerate the erosion of coastal areas. Thus storms may pose a danger to human life as well as to housing and agriculture, not to mention those whose livelihood is from the sea. The most recent storm to affect Maldives was in 1991 when 4081 houses in 13 atolls were damaged (South Asian Association for Regional Cooperation, 1992).[1] This represented approximately 13 per cent of all houses in the country (based on the 1990 census). One estimate of the total costs of damage was as high as US $30 million (Reuters News Service, 1991).

Droughts are very difficult to define, depending very much on the criteria being used. In most countries drought is significant in terms of its impacts upon agriculture. In Maldives water is even more critical, the fresh water resources of atoll islands being limited to a relatively small ground water lens and what can be obtained directly from rainfall. On the more densely populated islands ground water supplies have been severely impacted and are no

1. Cuny and Hill (1992) provide a figure of 3,407 homes damaged, with 23,849 people being forced to evacuate their homes, and a total of 36,000 altogether affected by storm damage to either dwellings or businesses.

longer drinkable. On Male' there is even resistance to the use of ground water for washing purposes, such is the state of ground water on the island. There is usually sufficient rain during the southwest monsoon, and many urban households and rural communities collect and store it. However, rainwater supplies are often quickly exhausted during the dry period from January through April, or even May. While on many outer islands ground water supplies are sufficient to sustain their populations, on the more heavily populated islands difficulties are experienced in maintaining a fresh water supply from ground water. On Male' very little groundwater is at all useful. This deficit is made up through water desalination. A major breakdown of one of the desalinization plants could have a serious impact upon the population of Male', especially if it occurred in the dry season.

High waves may be expected to occur from time to time, being generated in other parts of the Indian Ocean. There is often very little information available on weather conditions in the South Indian Ocean, and it is likely that Maldives will receive little warning when similar events occur in the future. High wave events were recorded in Maldives in 1987 and 1988.

The high waves of 10-12 April, 1987 were particularly serious, destroying the existing breakwaters "protecting" the southern part of Male'. Much of the reclaimed land in this area was washed away and elsewhere on the island there was damage to seawalls and breakwaters and to a number of buildings located near the coast. There was also serious damage on Hulule' and in other inhabited and resort islands in north and south Male' atolls. Edwards (1989) reports the total costs exceeded Rf 90 million.

In June and July of 1988 there was further wave damage and flooding in Maldives. A number of islands stretching from Haa Dhaalu atoll in the north to the island of Gan in the south were affected, especially in the western side of the country (Pernetta and Sestini, 1989). Edward's (1989) notes that one of the worst affected islands was Thulhaadhoo which received heavy flooding and lost several metres of beach. This small but densely populated island is reported to have suffered heavy erosion in historical storms (Edward's, 1989).

Epidemics have occurred on a number of occasions in the past and the most recent events to occur on Male' were in 1978 (cholera) and 1982 (shigella). Between 1965 and 1982 five epidemics were recorded (United Nations Conference on Trade and Development, 1983). However, since a comprehensive campaign of public education and an improved system of sewage disposal (in Male') were instituted, there have been no further outbreaks. However,

with the high population density, in Male' in particular, and the pressures upon sewage disposal and water supply another occurrence cannot be discounted.

Fires, causing widespread damage to housing, have been recorded frequently in the past. There may have been some reduction in the risk of fire with the reduction in the use of highly combustible building materials such as thatched roofing. However, in densely populated islands the fire threat remains a serious one. In Male' where there is considerable use of inflammable fuels the risk is heightened, and difficulties of access in many of the narrow lanes may also serve to hinder fire service response. Of further concern is the growth of multistory buildings in Male'. Most of these, to date, have few fire precautions incorporated into their design. At the same time, the fire section of the National Security Service does not have turn-table equipment such as that necessary for use in high rise buildings.

Earthquakes. An unusual element in the historical evaluation is the references to earthquake occurrence. Given the aseismic nature of the submarine ridge upon which Maldives is located (e.g. Edward's, 1989: 11) it may be anticipated that earthquake risk is low. However, the historical record does include some references to earthquake occurrence. It should be noted, that while the references to earthquakes do not describe much accompanying damage, there were two events in 1729 and 1730 which were described as *destructive* (Bell, 1940: 36). Certainly, construction methods in Maldives, with the use of coral blocks, lime based mortar and little use of reinforcing, would render much of the housing highly vulnerable to an earthquake if one were to occur. There is a need to clarify the probability of a serious earthquake occurring in Maldives.

"Technological disasters" not on the historical record. Maldives has not experienced a major technological disaster such as an oil spill or aviation accident. But, neither type of event can be ruled out.

A number of international shipping lanes pass either through or nearby Maldives. Some of the traffic includes ships carrying crude oil from the Gulf to other parts of Asia. Refined petroleum products are also off loaded at Male' and at Hulule'. A major spill of crude oil or any other toxic chemical could potentially cause considerable damage in Maldives. Environmental impacts would be most severe for the reef ecosystems which might be affected with implications for reef fisheries. In addition, any impacts upon coastal areas used in the tourist industry could have serious economic repercussions.

A major aircraft accident, especially on the runway at Hulule' airport, would also have very serious implications for Maldives. First, if there were large numbers of casualties in need of medical treatment, medical resources in Male' would be badly stretched. Second, with the runway closed, access to and from Maldives by air would be severely restricted. This would cause considerable disruption to the tourist industry in particular. Of equal, if not greater concern, would be the effect of such closure on the ability to bring in medical supplies and personnel that such an emergency would be likely to require.

The disaster history of Maldives indicates a relatively moderate exposure to the risk of disaster, but a real level of exposure nevertheless. Figure 4 summarizes the implications for the main sectors, of the various disaster types that might affect the country. As the Figure indicates, tourism, the country's main income earner may be adversely impacted by a number of disaster types, although in some cases the impact is an indirect one, resulting from negative images of Maldives that might arise as a result of disaster.

2.3 GLOBAL ENVIRONMENTAL CHANGE

An issue of considerable concern to the government and people of Maldives is that of sea-level rise in response to global warming. The Intergovernmental Panel on Climate Change provides a scenario of an average rate of sea level-rise of 6 cm per decade over the next century (Houghton et. al., 1990). There is however considerable uncertainty as to how coral growth might respond to such a rate of change (Woodroffe, 1989). Other factors such as increasing ocean temperatures may also be significant in determining the ability of coral to respond to sea level rise (Edward's, 1989). Even if coral reefs can grow apace with sea-level rise, the question remains as to how the processes of reef growth and island accumulation will affect inhabited islands, complete with settlements and other infrastructure.

Other scenarios of climatic change suggest increased climatic variability in such parameters as rainfall and the incidence of tropical cyclones. Changes in these characteristics could have very significant implications for disaster management in Maldives. If droughts and storms were, for example, to become more common, then the incidence of disasters may well increase. This would be exacerbated, were islands also suffering from erosion or inundation as a result of sea-level rise. It should also be noted that even if Maldives remains relatively free of the direct effects of tropical cyclones, if such events occurred with increased frequency and/or magnitude elsewhere in the Indian Ocean, Maldives may experience a greater incidence of high wave events.

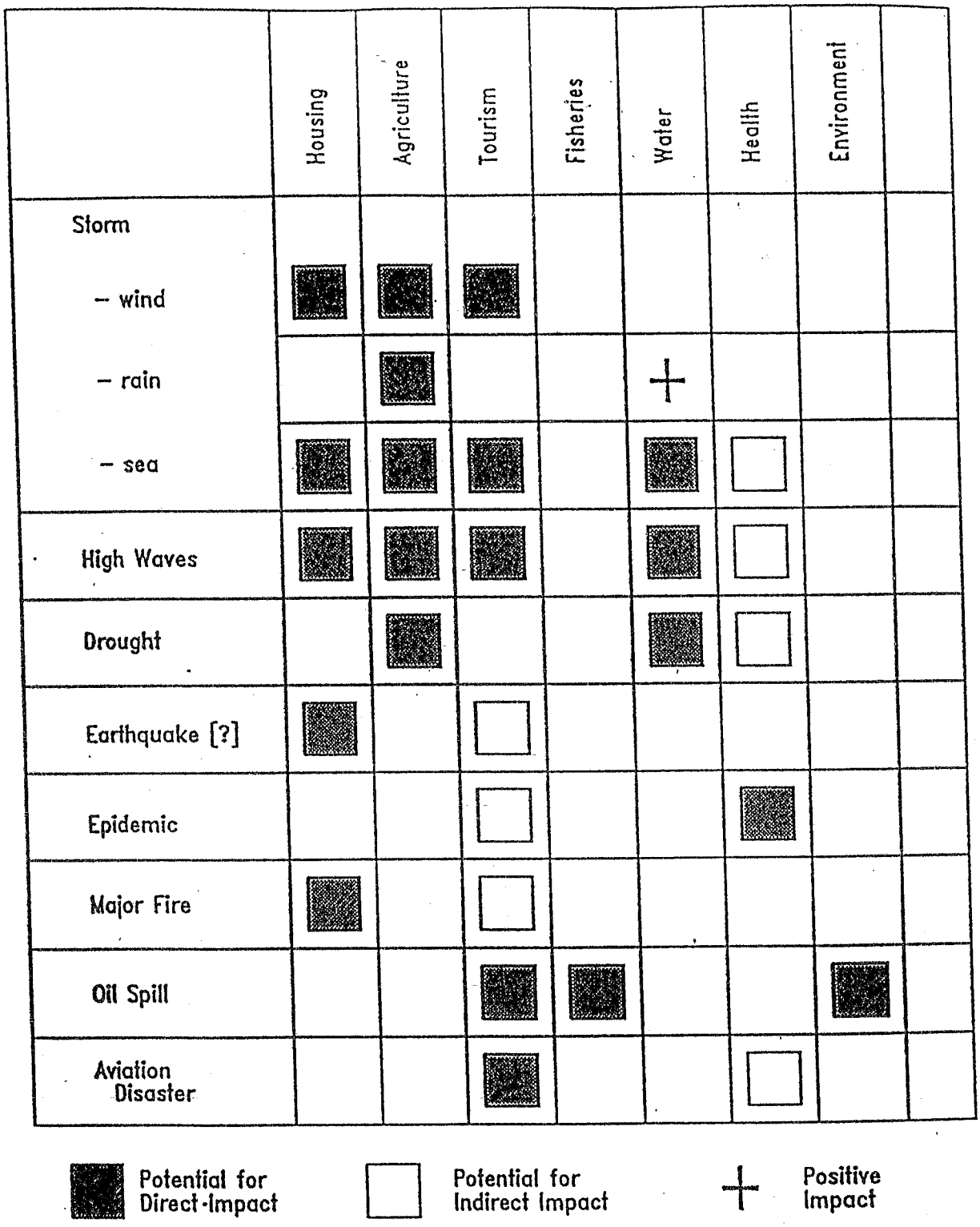

Figure 4: Matrix outlining listing potential disaster types and the sectors most likely to be adversely affected.

It is difficult to project with any certainty the effects of climate change upon the disaster vulnerability of Maldives. Nevertheless, a response which improves current disaster preparedness and mitigation, may be beneficial if disasters were to become more frequent in the future.

2.4 SOCIAL AND ECONOMIC CHANGE

Maldives has undergone considerable social and economic change in recent decades. For all this, the country still retains many of its traditional values, including religion and a strong sense of community interdependence, especially in the outer islands. These values are very important contributions to resilience in the face of hardship, and may be viewed as important disaster management resources.

Population Growth. One element of social change which does have serious implications for disaster management is population growth. The country as a whole has a rapid rate of population growth with an annual average increase rate of 3.43 per cent in the intercensal period from 1985 to 1990. Projections recently carried out on behalf of the Ministry of Planning and Environment indicate the population of Maldives could increase to as many as 433,000 to 563,000 persons by 2020 (Harvey, 1993). In Male' the rate of growth has been even faster than for the country as whole, at 3.74 per cent per annum. This rate, reflecting high rates of in migration to Male', represents a doubling in 20 years! In the outer islands the population growth rates are more variable. As a whole the atoll populations have a lower increase rate than Male', but some 77 islands recorded rates of increase in excess of 4 per cent per annum between 1985 and 1990, and of these, 44 islands have population growth rates that represent doubling periods of LESS than 16 years!

These growth rates are in some cases for islands that are already very densely populated. Male', an island of little more than 1.75 square kilometres today boasts a population well in excess of 60,000 and maybe as high as 70,000.[2] At the time of the 1990 census there were seven islands enumerated with population densities in excess of 100 persons per square kilometre. If the national intercensal growth rate was applied to all islands in Maldives, by 2010, that is in 20 years time, there would be some 27 islands with populations in excess of 100 persons per square kilometre. These population densities are very high, especially for atoll communities.[3]

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2. The Office of Physical Planning and Design (1993) has estimated that the present population of Male' may be as great as 75,000. This would represent a population density of 423.7 persons per hectare.
3. This data on size of islands and population density was kindly made available by Mr. Henning Hansen, of MPE, who generated the information using aerial photographs of the islands. He cautions that many of the islands have undergone changes since that time, but the 1969 survey is the only one to have been conducted thus far.

The existing high population densities (nationally, and in a large number of islands), and the increase in these, through high rates of population growth, have serious implications for the evaluation of disaster vulnerability in Maldives.

First, if disasters do happen, then there will be simply greater numbers of people to deal with. For example, there will be larger numbers of people to house if evacuation is necessary, to provide medical care to if there is an epidemic, or to provide with food relief in the event of a storm affecting crops. Moreover, because of the high birth rates currently being experienced in Maldives, at least in the foreseeable future, many of those who may need assistance during or following a disaster may be children.

The second set of implications of high and increasing population density is that pressure on resources may in fact increase the impact of a disaster, or even the possibility of a disaster occurring. Examples of such a process include:

- increased demand for coral mining to satisfy increasing building material requirements. Where coral mining occurs, there is less reef protection against wave attack and coastal inundation and erosion is more likely in such circumstances,

- increased density of settlement may increase the numbers of houses built on marginal lands such as adjacent to the sea or on reclaimed land,

- increased demand upon fresh water resources will increase the likelihood of supplies (stored rain water, or ground water) becoming insufficient. If a prolonged dry period occurs, the impacts would occur much more rapidly and would be much greater than if population was lower,

- increased density of settlement may also increase the risk of fire and the spread of epidemic diseases. This latter problem may also be exacerbated through the depletion of fresh water resources and increased demand upon sewage disposal facilities.

Population growth is likely to play a very significant role, at least in the immediate future, in bringing about a higher level of disaster vulnerability in Maldives, than presently exists.

Tourism. One development that may have implications for disaster vulnerability is the growth of tourism on "uninhabited islands." In areas prone to tropical cyclones vulnerability of the

tourist sector is an important concern. Fortunately for Maldives, such events are infrequent. Although the northernmost atolls are most likely to be affected by tropical storms which may originate or pass very close to the north of the country the great majority of tourist resorts are located in the central Maldives, near to Male'. Tourism facilities may however be impacted by high wave events.

Tourism has begun to dominate the economy of Maldives. Any disaster that affects tourism, even indirectly, may therefore have an undue impact on the national economy. Disasters in this category include a major aviation disaster at Hulule' Airport for example, which may force the airport to be closed for some time, an outbreak of disease in Maldives, even if not in tourist islands, an oil spill which affects tourist beaches, or indeed any other event which results in adverse publicity in Maldives' tourist markets. In this context, even if a disaster did occur but was seen to be managed effectively by Maldivian authorities, the impact may be minimal. But where the disaster response is perceived (by international media) as having been less than well managed the implications for tourism may be significant.

3.0 DISASTER RESPONSE IN REPUBLIC OF MALDIVES

Given the historical record, which indicates occasional occurrences of various types of disaster in Maldives, it may be expected that the communities which make up the country have developed a variety of approaches to environmental variability over the years. Community resilience is undoubtedly still an important asset in Maldives (Cuny and Hill, 1992). However, the levels of hardship and suffering that may have been experienced in previous generations are not necessarily acceptable today. Furthermore, as noted above (in section 2.4), there have been important social and economic changes which have influenced the ability of communities to cope. In this light, some level of involvement and assistance in disaster response is an important component of services provided by the Government that the community at large may feel entitled to expect.

3.1 A NOTE ON TYPES OF DISASTER RESPONSE

It is useful to distinguish between the broad types of disaster response or disaster management practices. In essence four types of disaster response can be identified. The two most important are mitigation and preparedness. **Mitigation** measures are those in which the intention is to reduce the initial impact of the disaster and thereby lower the level of disruption and losses. This may be achieved through measures that seek to modify the impact of the physical event such as the building of seawalls or breakwaters or through measures that modify human activities such as land use zoning which restricts building close to the shore. The second type of response is **preparedness** which includes measures that do not seek to minimize the initial impact of disaster but to lessen that impact through measures that minimize the disruption and losses once the impact occurs. These measures include provision of warnings, emergency management, search and rescue and the like. Other types of disaster reduction measure include **prevention** in which it is sought to stop the disaster from occurring in the first place. Such measures are few, often unsuccessful, and are not considered any further in this report. Finally, there is a need to include a category that involves **dealing with the losses**. This includes measures to assist people such as in the provision of relief, as well as insurance which people may take out to protect themselves against losses. An important component in this respect is community assistance where losses are shared and help is given to those most badly affected. In disaster management, the main aims are to reduce the need for loss coping measures by improving mitigation and preparedness capability.

3.2 RESPONSE TO RECENT EVENTS

In recent events where the disruption and/or losses have been very significant an important response has been the declaration of emergency by the President, and the appointment, by him, of an emergency committee which oversees the emergency response. This approach was used in 1978 and 1982 in response to epidemics in Male', following the severe wave event in 1987, and in response to the 1991 storm.

The response to the events reveals a relatively satisfactory process. For example, Cuny and Hill (1992) provide a positive review of the response to the 1991 storm. However, it does appear that there are only a few instances where specific disaster or emergency plans have been developed. These relate to the International Airport and marine pollution events. No government departments have their own emergency or disaster plans, and response, even at the national level has been carried out on an *ad hoc* basis.

While this *ad hoc* approach has been successful to date it is considered that some simple measures would help ensure continued effectiveness of response to future events. These include establishing a national organizational structure for disaster response (based on existing departments and agencies) and a national disaster plan outlining roles and procedures for departments, agencies, the private sector and the general public.

3.3 EXISTING ARRANGEMENTS

There are however, a number of arrangements, some which have been formalized, which contribute to disaster preparedness.

Article 35. Under Article 35 of the Constitution of the Republic of Maldives, the President may, in the event of a national emergency, issue temporary orders to enable problems to be dealt with as appropriate.

National disaster committee. Republic of Maldives has had a "Committee on Natural Disasters" since at least the mid-1980s. However, it only met irregularly, usually being convened following disaster events. This Committee was subsequently incorporated into the National Commission for the Protection of the Environment (NCPE). The decision reflected a high level of common membership in the two committees and perhaps a reduction in the priority given to disaster management.

Given that the NCPE meets relatively regularly and is made up of high level officials it is considered that the incorporation of the disaster committee into it is a positive outcome. The alternative would be to have a distinct body with a clear purpose, but one which was not likely to function regularly.

Communications. The present telecommunications network in Maldives is illustrated in Figure 5. A microwave 2Mb/s radio transmission system extends from Male' to Thaa atoll in the south. Single/multichannel vhf/uhf radios are used to connect subscribers to the transmission network. To the north a 4 channel FDM radio system provides telephones to Felivaru, Lhaviyani and Baa Atoll (one telephone each). A troppo-scatter link connects Male' and Alif Atoll.

A large portion of the country thus remains without any telephone service. Each atoll office in the country, including those with telephone services, has a high frequency (HF) link with the Ministry of Atolls Administration in Male' and the National Security Service maintains a 24 hour HF radio watch. Within atolls, islands can communicate with each other, and their atoll capital, with citizen band (CB) (27 MHz) transceivers, installed by the Ministry of Atolls Administration.

REPUBLIC OF MALDIVES

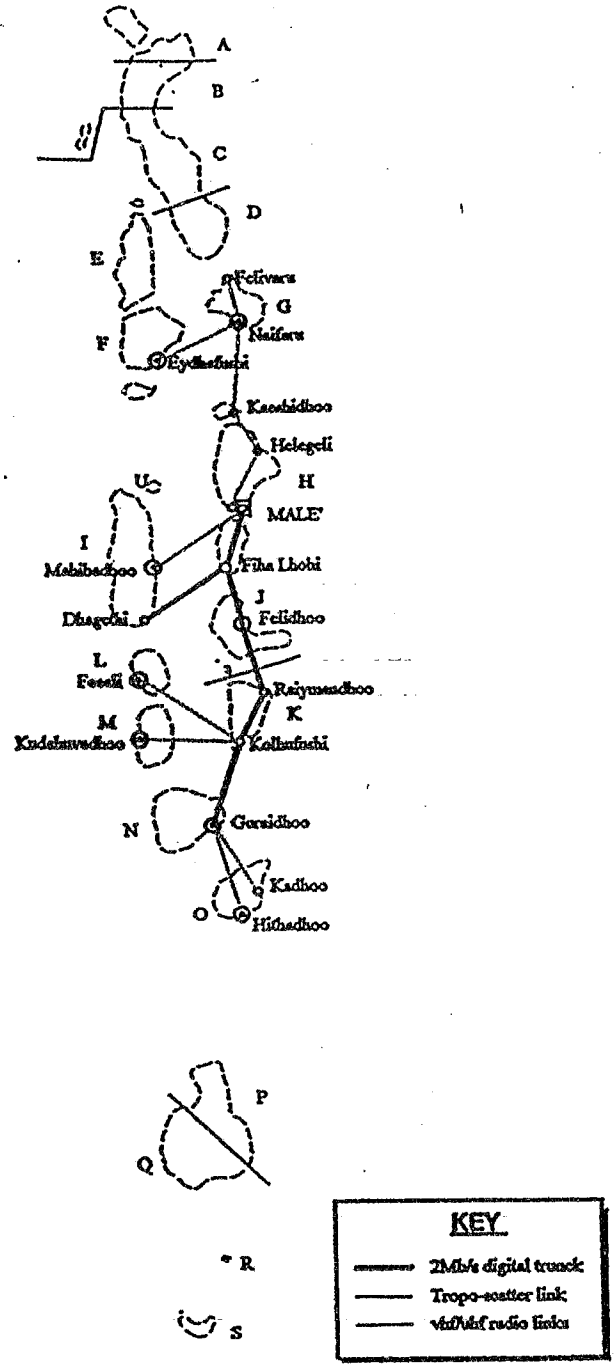

Figure 5. The telecommunications network. Source: Dhiraagu. (see Appendix VI).

It is considered that the telecommunications system is prone to high wind events through the exposure of the various forms of antennae used. There is particular concern for the microwave link which could not be restored without the availability of trained technicians.

Warnings. There is no formalized system for the provision of disaster warnings although an informal arrangement does exist between the Meteorology Department and the broadcast media in Maldives: the Voice of Maldives radio station and Television Maldives (TVM).

The usual procedure is for a forecaster to inform the Director of Meteorology when adverse weather conditions are anticipated. The Director then authorizes the forecaster to pass the information onto the media. Normally, in the case of a severe weather warning the forecaster will go on the air to describe the event and its implications.

Draft building code. A draft building code has been formulated for Maldives. This code, which is awaiting normalization, includes a number of requirements for multistory buildings including a number of fire safety features.

The draft building code does not, however, include provisions restricting building in hazardous zones, such as adjacent to the coastline, nor does it include provisions to ensure adequate strength of buildings in the event of a natural disaster.

3.4. KEY DEPARTMENTS AND OTHER RESOURCES

Numerous government departments, non-governmental organizations and the general public have a role to play in disaster preparedness and mitigation. Appendix II outlines some of the resources to be found for disaster response in Maldives, and lists responsibilities that may be given to the various departments and other sectors of the community.

A very important consideration when evaluating the resources of government departments is that, in common with small island nations, the departments are relatively small. While most departments have many useful human skill based, logistic and material resources, these resources are naturally focused towards day to day or current needs. Any program of disaster preparedness involving a wide range of departments must realistically take account of this constraint. It will be extremely difficult to gain widespread input into a comprehensive and exhaustive program of disaster preparedness, when pressing and immediate priorities will be

perceived as more important than the possibility that some time in the future there will be a disaster.

The approach advocated in this report is to stress to all ministries that their input need not be onerous, and that once roles and responsibilities have been determined, an annual review would be adequate to ensure a minimal level of preparedness is attained.

4.0 FUTURE DISASTERS AND RESPONSE CAPABILITY

4.1 PREDICTING FUTURE LEVELS OF VULNERABILITY

It may be anticipated that the vulnerability of Maldives will increase in the foreseeable future for a variety of reasons:

- population growth, especially in the capital, Male',
- growing dependence on a single sector of the economy, namely tourism, that may be prone to disasters, not only directly, but also indirectly,
- the increasing probability of a technological mishap, if only because of increasing shipping and aviation traffic,
- the possibility of sea-level rise and other climatic changes resulting from the enhanced greenhouse effect.

4.2 FUTURE DISASTER RESPONSES

If the current system of disaster response was to remain unchanged it is possible that problems may arise in future simply through increased loads on the system. In particular, if a very devastating event was to occur, the current *ad hoc* system may prove to be inadequate. This is likely to be the case in terms of departmental roles and responsibilities which are presently not formally laid down. This provides the possibility for confusion in the event of a major disaster.

By developing a formal disaster response structure, based on existing departmental resources and roles, together with a national disaster plan which outlines responsibilities and roles of government departments, and where appropriate the non-governmental sector and the general public, some of these potential problems may be avoided. This can be achieved with relatively little additional use of scarce resources (time and personnel) in the first instance and should require only a brief annual review to ensure all responsibilities can be met, thereafter.

It is considered that a more complex approach would be unrealistic in Maldives. The human resources are not available, and given the relatively moderate (albeit increasing) disaster vulnerability, it would be very difficult to maintain support during long periods when disasters do not occur.

4.3 COMPATIBILITY WITH NATIONAL POLICIES

The main development objectives for the Republic of Maldives are set out in the *National Development Plan 1991-1993*. These objectives are to:

- secure improvements in the living standards and quality of life of all Maldives,
- ensure that the benefits of development are shared more equitably among the population, and
- achieve greater self reliance, which is essential for future growth. (Ministry of Planning and Environment, 1991: 25)

The first and third of these objectives, in particular, are of relevance to disaster management in Maldives. By improving disaster preparedness and mitigation the reductions in living standards that disasters cause from time to time will be reduced. In addition, by reducing the impacts of disasters, either through mitigation or preparedness, the likelihood of future dependency on overseas assistance in the wake of disaster can be reduced.

The recommendations which follow outline a range of needs for improved disaster management in Maldives. The recommendations take into account the restraints of smallness and availability of human resources for disaster management, as well as the relatively low incidence of disaster occurrence. If adopted it is considered the national development objectives of Maldives would be enhanced.

5.0 RECOMMENDATIONS

Recommendation 1.

In general, it is recommended that a relatively minimal approach to disaster management be established, reflecting the relative infrequency of major disasters and limited resources in the Republic of Maldives. However, if resources permit the range of activities should be expanded. While disasters do not occur as frequently in Maldives as in many other island nations, they do occur, and will continue to occur in the future.

Recommendation 2.

A national disaster response structure or organization should be established. It is important to identify existing resources and strengthen them rather than to seek to develop new ones in their place. Appendix III provides an outline of a proposed national structure for disaster response, taking these considerations into account.

Recommendation 3.

It is recommended that the present situation where the National Disaster Committee has been incorporated into the National Commission for the Protection of the Environment (NCPE) be continued. This is for practical reasons. First, the membership of the two committees is the same. Second, the NCPE, while having only an advisory status is comprised of high ranking officials. Third, it is probable that if the two committees were separated, the disaster committee may cease to function. In this light, if disaster matters, at least on an annual or twice-yearly basis, were placed on the agenda they would receive regular attention.

Recommendation 4.

It is recommended that the National Commission for the Protection of the Environment should meet as soon as possible to develop a program for enhanced disaster preparedness and mitigation in Republic of Maldives. This program should include the development of a National Disaster Plan and the establishment of a National Emergency Operations Centre.

Recommendation 5.

It is recommended that a National Disaster Plan be established for Republic of Maldives, outlining the roles and responsibilities of government departments in the event of disaster, an appropriate warning system, and a structure for disaster response. This plan, should as much as is possible, reflect existing arrangements in government and in emergency response. It is not anticipated that an elaborate plan is either necessary or desirable for Republic of Maldives.

Recommendation 6.

It is recommended that a National Emergency Operations Centre be established. This does not need to be a new site, but an existing room, which is secure, which can be provided with communications facilities, and in which maps, censuses and other data can be safely stored. The room chosen need not be set aside solely for this purpose but may be used for normal activities during non-disaster periods.

Recommendation 7.

It is recommended that an officer within Ministry of Planning and Environment be assigned the role of National Disaster Response Coordinator as part of his or her responsibilities. This officer will liaise with other departments in coordinating disaster response in Maldives.

Recommendation 8.

It is recommended that this officer assigned responsibility for disaster coordination should be given training in disaster management as soon as possible. A six week course, held regularly at the Asian Disaster Preparedness Centre, Asian Institute of Technology, is recommended.

Recommendation 9.

It is recommended that a hazards register for Republic of Maldives be established. This would most usefully be in the form of a data base in which standardized information on damages, by island, could be maintained. This information should be supported by data from other sources such as meteorological data from the Meteorology Department, or wave height data from MPWL. As MPE is in the process of developing an environmental database it is suggested that MPE be the focal point for the hazards data base.

Recommendation 10.

It is recommended that the forecasting and data collection capabilities of the Meteorology Department be enhanced. In particular basic equipment for existing stations should be maintained and new equipment be made available for the new stations about to be established at the two new airports. See Appendix IV for an evaluation of equipment needs and recommendations for new equipment for the Meteorology Department.

Recommendation 11.

It is recommended that the scientific debate on global warming and sea-level rise be closely monitored. Ministry of Public Works and Labor should as soon as is possible resume wave, tide and current monitoring. Training of staff to carry out such work should be given priority.

Recommendation 12.

It is recommended that the reports and activities of the Coastal Zone Management Subgroup of the Intergovernmental Panel on Climate Change be monitored for information on adaptation to the coastal effects of climate change, especially in relation to mitigating the effects of coastal hazards.

Recommendation 13.

That the training of personnel in fields related to coastal erosion and engineering be encouraged.

Recommendation 14.

It is recommended that the Government of Maldives investigates the possibility of funding from the Global Environmental Facility (administered by the World Bank) to support activities relating to coastal hazards, given the link between coastal hazards and the potential effects of sea level rise.

Recommendation 15.

It is recommended that tourist resorts be required to establish emergency procedures, including procedures for guest evacuation. These should be annually reviewed.

Recommendation 16.

It is recommended that Maldives establish links, where appropriate, with Pacific Island Countries and Pacific regional organizations involved in disaster management activities. The island nature of these countries and the body of experience developed within them for dealing with disasters may provide useful ideas for the development of improved disaster management in Maldives.

Recommendation 17.

That current family spacing programs in Maldives be substantially enhanced. Demographic data indicate little let up in population growth and it is likely that if this trend is not slowed down, or halted, a considerable increase in disaster vulnerability, and environmental degradation, may be expected.

6.0 PRIORITIES FOR IMMEDIATE ACTION

It is considered that all of the activities outlined in the recommendations above are important. Moreover, they all, if carried out, would contribute to an integrated disaster reduction package for Maldives. However, given the constraints listed elsewhere in this paper it is necessary to establish some priorities. It is stressed however, that in establishing the priorities, the importance of other recommendations is not downplayed.

The first priority should be for the National Commission for the Protection of the Environment to meet and consider a program of activities for improved disaster management. To facilitate this it will be necessary to identify an individual who will be responsible for coordinating disaster management in Maldives. This person would in turn be responsible for formalizing the national disaster response structure, developing the national disaster plan (based largely on existing resources and responsibilities) and establishing a national emergency operations centre.

It is also important that the forecasting and monitoring capacity of the Meteorology Department be enhanced and maintained.

Other activities, for which only a long term response may be expected, should also be initiated as soon as possible, as is the case with increased promotion of family spacing.

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APPENDICES

APPENDIX I

Historical list of disasters in Maldives

Storms (and similar events)

Oct 1733: "A cyclone visited the Maldives in October . . . devastating and laying under water many islands (particularly among the northern atolls), with great loss of life and property." Bell (1940: 37) A footnote to this statement is as follows: "Sultan's missive of May 9, 1734 (in Portuguese) to the Dutch Governor of Ceylon gives particulars. The disaster was accepted with . . . resignation . . . Unaccountably the *tarikh* is silent regarding this cyclone."

1742: "On 16th Rabi-ul-Aakhir, A.H. 1155 (A.C. 1742) a Tornado struck Male from the West, and more than 110 coconut trees were laid low . . ." (Bell, 1940: 37)

7 Jun 1752: Male (4° 10' North) affected by a severe storm which blew from the south-west. No record of other islands being affected.

7 May 1812: Storm devastated a number of islands in northern Maldives. Reached as fas south as Kuredhdhoo (5° 33' North)

9 Oct 1819: Male (4° 10' North) affected by a storm which blew from the west. No record of other islands being affected.

1819: "A great storm burst upon Male from the West on 21 Zul Hajji. Many trees were blown down; and in the Palace Enclosure (*M. Etere-kolu*) twelve buildings fell." (Bell, 1940: 43)

29 Dec 1819: Storm affected islands from South Maalhosmadulu (5° 01' North)

1820: "On 13th Rabi-ul-Awwal, A.H. 1235 (A.C. 1820), a tornado struck the Maldives. Many islands of Tiladummati, Miladummadulu Atols, and one or two in Malosmadulu were devastated, and more than 30 *odifahuru* wrecked, a large number of persons being drowned.

The islands made temporarily derelict (M. *falu*) by this storm were: Hiri Maradu, Hirinaidu, Kelakunu, Kumburudu, Kuribi, Kuda Muraidu, Muiri, Nagori, Navaidu, Naridu, Nekurendu,

Nelivaran, Vaikara, Muraidu, Vaikaradu in Tiladummati Atol; Fokaidu, Goidu, Hiribadu, Kakal Eriyadu, Kaditimu, Madidu, Magudu, Ma Kadudu, Kofa Kamandu, Milandu, Nalandu, Nelu, Numara, Ribudu in Miladummudulu Atol North; and Kuluduffuri, Kurendu, Tiladu in Malasmadulu Ato, [sic?], North and South.

8 Dec 1821: Storm laid waste many islands from the southern point of Miladhummadulu (5° 39' North)

1898: Thulhaadhoo (5° 02' North) affected by a storm in the south-west monsoon of 1898.

25 Dec 1923: The well known "Bodu Vissara" struck Male (4° 10' North). During this storm strong winds were experienced from the previous night from a south-westerly direction. Heavy rains started in the morning and the winds became less violent by about 9 in the morning. But winds became more furious with another storm from the northwest at about 10 in the morning. . . . several houses and trees fell and large areas of Male were flooded. By about 2 in the afternoon the winds subsided . . . four vessels in Male harbor were lost.

9 Jan 1955: Storm laid waste many islands from the southern point of Miladhummadulu (5° 39' North)

23 Jun 1987: A large number of islands affected by what Maniku (1990) refers to as freak storms:

4 islands in Faaf Atoll
5 islands in Dhaal Atoll
8 islands in Gaaf-Alif Atoll
7 islands in Gaaf-Dhaal Atoll

25 Jun 1987: The following were added to the above list:

2 islands in Haa-Dhaal Atoll
1 island in Alif Atoll
2 islands in Vaavu Atoll
2 islands in Faaf Atoll
2 islands in Dhaal Atoll
5 islands in Laamu Atoll

8 islands in Gaaf-Dhaal Atoll
1 (and only) island in Gnaviyani Atoll
6 islands in Seenu Atoll

1991: Storm causes damage throughout Maldives including damage to over 4,000 houses.

Other types of events

late 16th Century: " . . . epidemics of something like smallpox, from which many people died, occurred every 10 years." (United Nations Conference on Trade and Development, 1983: Annex 8)

1704: Smallpox (United Nations Conference on Trade and Development)

1704-1721: "During this reign [of S. Muzaffar Muhammad 'Imad-ud-din II] several disastrous fires destroyed important residences at Male." (Bell, 1940: 36)

1729: ". . . much of Henvaru *Avaru* (Ward) of Male was destroyed by fire . . ." (Bell, 1940: 36)

August 1 1729: Destructive earthquake occurred in the East (Bell, 1940: 36)

March 12 1730: Destructive earthquake occurred in the East (Bell, 1940: 36)

Sept 21 1730: Earthquake (Bell, 1940: 36)
Sept 29 1730: Earthquake (Bell, 1940: 36)
Oct 1730: Earthquake (Bell, 1940: 36)

Bell (1940: 36) makes the following statement: "In [A.H. 1142 (A.C. 1729)], on Sha'ban night, much of Henvareu *Avaru* (Ward) of Male was destroyed by fire; and an earthquake was felt throughout the islands."

A footnote to this statement is as follows: "During A.H. 1142 (July, 16 1729 - July 6, 1730), two destructive Earthquakes occurred in the East - on August 1, 1729, and March 12, 1730. The Earthquakes of September 21, 29 and October are not mentioned in the *Tarikh*."

1735: "On the night of 25th Rabi-ul-Akhir, A.H. 1148 (A.C. 1735) another serious fire occurred; this time at Kuda Kiba the apartments of the Queens." (Bell, 1940: 37)

1737: "That year [A.H. 1152 (A.C. 1739)] a famine occurred at Male. One *kotte* (28 lbs) of cowries would hardly purchase 12 seers of rice. People were reduced to eating leaves and even weeds." (Bell, 1940: 37).

In a footnote the following is stated: "If 2 1/2 Rix Dollars, the price of cowries per *kotte* at the period, and Rs. 2.50, the present day rate, can be treated as equal values, one seer (M.*nali*) of rice would have cost the equivalent in Dutch stuivers of 20/5/6 cents modern Ceylon currency. In 1920 the price of a *nali* of rice touched 50 cents (Maldive *Kuda lari*), or two seers to the rupee.

1742: The tornado on 16th Rabi-ul-Aakhir, A.H. 1155 (A.C. 1742) " . . . was followed a fortnight later by a great fire in Henvaru *Avaru*, in which many buildings were burnt down including the *Attarafanin Miskit* (Mosque)." (Bell, 1940: 37)

1759: "Male suffered a double visitation . . . [in A.H. 1173 (A.C. 1759)] . . . A great conflagration in Henveru *Avaru* destroyed *Danna Muhammad Miskit* and another Mosque, besides the whole of the bazars. This disaster was preceded by an earthquake. (Bell, 1940: 39)

1772: "All houses except one in Himiti Island (N. Nilande Atol) were burnt down the next year [1772]." (Bell, 1940: 40)

1818-1819: "A great Famine occurred at the Islands in A.H. 1234 (A.C. 1818-19) which reduced people to eating grass. (Bell, 1940: 43)

3 Feb 1887: On Male' there was a major fire in which "all merchant shops and some of the Maldivians' houses and other shops burnt down, also shops and houses belonging to the Government." (United Nations Conference on Trade and Development, 1983: Annex 8)

1920: " . . . the inhabitants of two Islands (Huvarafuri in Ihavandifulu Atol, and Kuludufuri in Tiladummati Atol) were driven to the same straits [of eating grass, as in the "great Famine" of 1818-19] (*Ceylon Sessional Paper XV, 1921, p48*)." (Bell, 1940: 43)

Oct/Nov 1922: " . . . no less than three hundred (300) victims, Noble and plebian alike, perished from this scourge at Male." . . . "the dread 'Maldive gift-fever' (a type of deadly "Influenza" notorious for centuries past) . . ." (Bell, 1940: 6)

1965: Gastro-enteritis epidemic. (United Nations Conference on Trade and Development, 1983)

1966: Typhoid epidemic. (United Nations Conference on Trade and Development, 1983)

1968: Diarrhea epidemic. (United Nations Conference on Trade and Development, 1983)

1978-1979: Major outbreak of cholera occurred on Male'. 11,258 people were affected representing 7.5 per cent of population. Cases were reported on over 50 islands. Fatalities totaled 219 (in 1978). (United Nations Conference on Trade and Development, 1983).

1982: Major outbreak of shigella occurred on Male' [interview notes]

1987: High wave event causes damage on a number of islands including major flooding in Male.

1988: High wave event causes coastal damage on some islands in the south.

APPENDIX II

Draft list of possible roles and responsibilities for government departments. This list is largely based on existing departmental capabilities and resources. However, it is important in the disaster planning process that these resources are formally identified and responsibilities of each department agreed upon.

Department of Information and Broadcasting

Resources: Voice of Maldives, radio Television Maldives

Responsible for broadcasting warnings.
To remain on the air on a 24 hour basis as required by National Emergency Operations Centre - (NEOC).

Maldives Airport Authority

Resources: Emergency planning experience
Aviation emergency plan
Communications facilities
Fire fighting equipment

Responsibilities:
Assist where possible in facilitating aircraft availability for disaster operations.
Make available communications facilities in times of disaster (as far as is possible).
Contribute to the disaster planning process.

Meteorology Department

Resources: Forecasting capability
Specialist knowledge on weather behavior

Responsible for issuing initial notification of potential weather related disasters.
Provides information for public awareness programs.
Liaises with Ministry of Information and Broadcasting on the broadcast of disaster warnings.

Ministry of Atolls Administration

Resources: Network of atoll and island chiefs
Communications with atolls

Responsibilities:
Pass information on disaster occurrence to NEOC
Assist in the distribution of relief supplies

Ministry of Fisheries and Agriculture

Resources:

Responsibilities:
Assists in the assessment of damage and impact of disasters upon food supplies

Ministry of Foreign Affairs

Resources: Diplomatic relationships

Responsibilities:
Liaise with foreign governments and international organizations regarding needs for assistance.

Ministry of Health and Welfare

Resources: Medical facilities
Medical staff

Responsibilities:
Provision of emergency medical care of disaster victims
Inform NEOC of number of beds, staff, and medical supplies available as requested
Takes measures to avoid the spread of disease
Maintenance of sanitary conditions in areas impacted by the disaster

National Commission for the Protection of the Environment

Responsibilities:
Advises government on disaster management affairs and recommends appropriate actions where necessary.
Carries out a review of disaster events and advises government on measures that may improve future performance.

National Security Service

Resources: Communications
Command structure
Naval section
Air wing

Responsibilities:
Maintenance of law and order during disaster.
Control of peoples movements in disaster areas.
Search and rescue. Maintenance of 24 hour radio watch.
Provision of fire services.

APPENDIX III

Proposed structure for disaster management.

It is suggested that the present system of disaster management be formalized so that those departments, ministries and other organizations involved in disaster management are made aware of their roles and responsibilities.

Figures 6 and 7 show a structure in which disaster management, or disaster reduction, is subdivided into two overlapping sets of activities, namely mitigation and preparedness. Coordination of the overall program is carried out by MPE, under the advice of the NCPE.

At the head of the structure is His Excellency the President of the Republic of Maldives. This reflects his importance in disaster response activities. The proposed structure also reflects recent practice with an emergency committee being appointed as needed by the President. This committee would provide leadership to all the government departments involved in the emergency response.

However, in times when there is no emergency, the departments periodically review their resources and responsibilities for disaster management, and inform the National Disaster Coordinator.

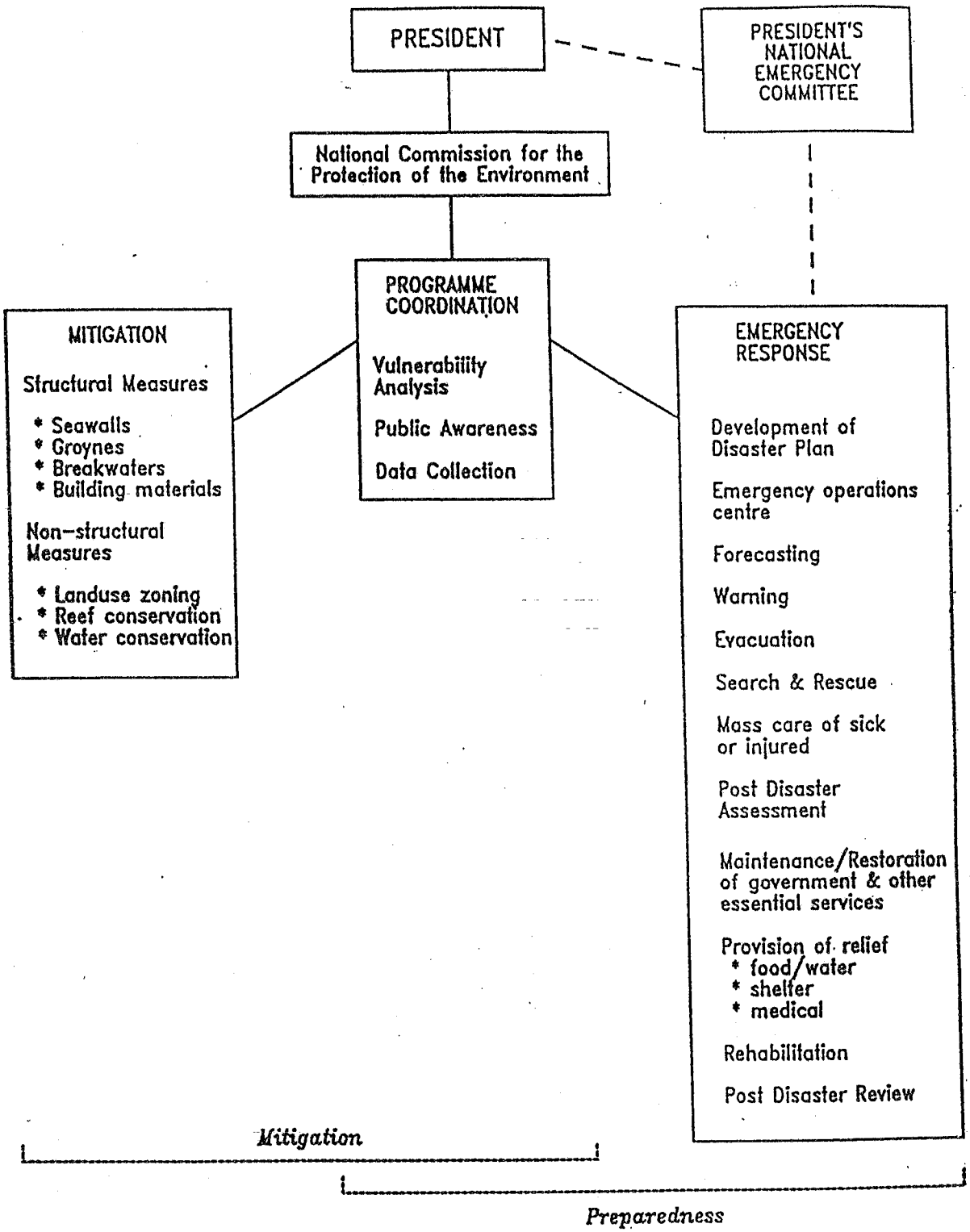


Figure 6. A possible structure for disaster management in Maldives, outlining the range of activities and responsibilities involved.

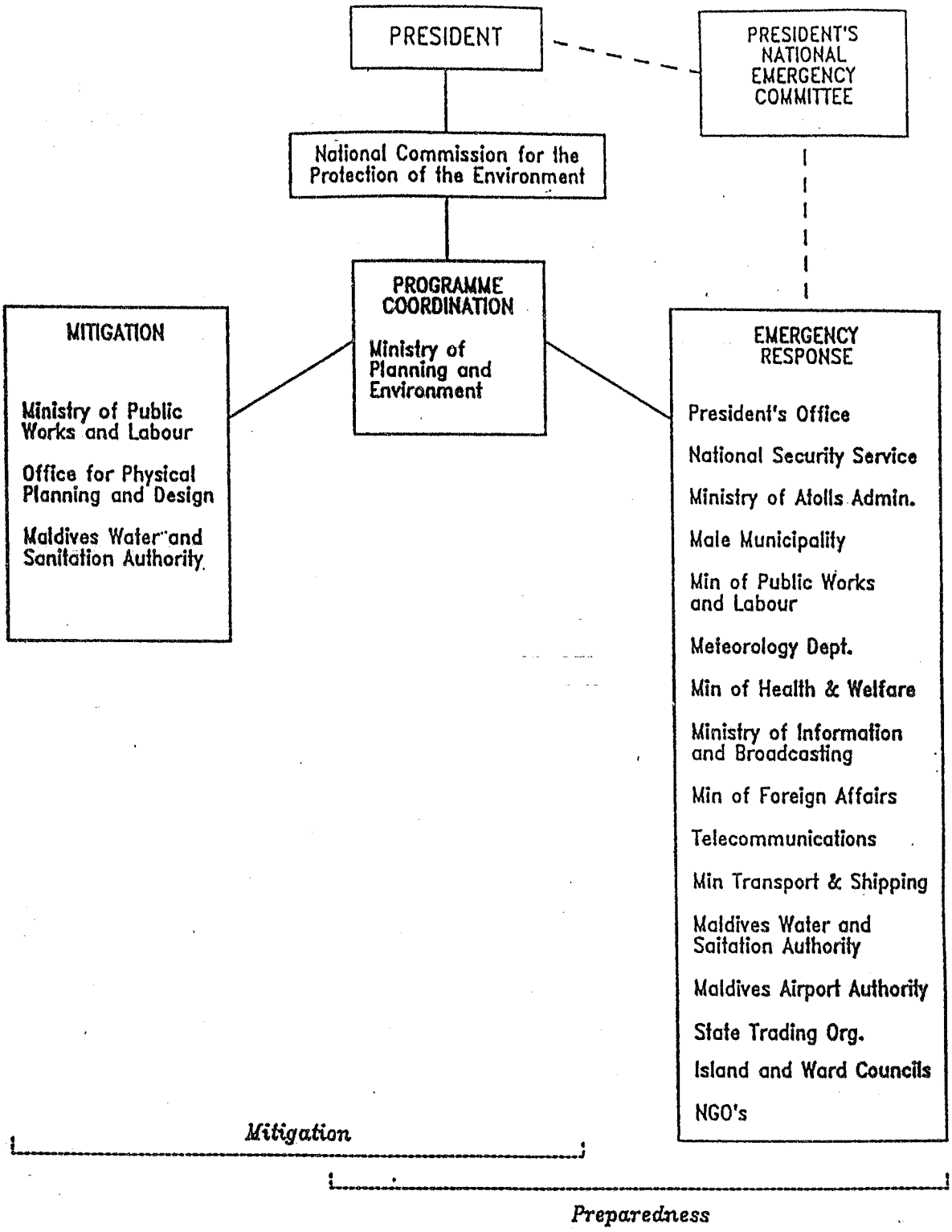


Figure 7. A possible structure for disaster management in Maldives, indicating the government departments and other agencies involved.

APPENDIX IV

Evaluation of Equipment Needs for Republic of Maldives

Existing communications capability

The Republic of Maldives has an adequate communication system both for normal usage and for application in disaster response. Essentially, atoll offices may contact the National Security Service on a 24 hour basis. Many atolls are connected by telephone service, and all have HF radio as well. All islands, in turn, have contact with their atoll office through CB radio, as well as with other islands in their atoll. The atoll offices also have regular daily contact with the Ministry of Atoll Administration in Male.

Given the relative infrequency of major extremes it is considered that further improvement in the existing system, for express purpose of building disaster preparedness, would be unnecessary.

A detailed description of telecommunications in Maldives, kindly prepared by Dhiraagu, is presented in Appendix VI.

Equipment needs for disaster warnings

A key consideration in the communication of disaster information relates to the ability to provide warnings. This is currently the responsibility of the Meteorological Department. Forecasts are based on information received from overseas sources together with local data from the four meteorological stations based at each of the four airports in the country. A further airport is under construction and another under consideration.

The Meteorology Department currently has some problems in maintaining basic data collection at these sites. Moreover, there will be a need to equip the new airport meteorological stations once the airports become operational. Filling these equipment needs should be considered as a priority.

This would be beneficial from the perspective of forecasting and the provision of warnings. It would also be beneficial in helping to build a record of meteorological data which can be used

to more accurately determine the exposure of Maldives to extreme weather events. Currently the only long term record is for Male, and that only runs continuously since 1966.

A MINIMUM list of meteorological equipment needs, as furnished by the Meteorology Department is attached below. It is suggested that this list be expanded to include at least 4 anemometers with cables and printers.

Copy of list supplied by Department of Meteorology

ITEM	QTY	CAT.	DESCRIPTION	SUPPLIER
01	10	W3310	Ordinary Thermometers	{Casella London
02		W3318	BSI Test Certificate for W3310	{Cable: ESCUTCHEON, {London, N. 1 {TELEX: 26 1641
03	10	W3160	Minimum Thermometers	{Tel: 01-253-8581
04		W3160	BSI Test Certificate for W3160	{ {
05	10	W3012	Maximum Thermometers	{
06		W3018	BSI Test Certificate for W3012	{ {
07	02	W1300	Cup Generator Anemometer	{
✓ 08	02	W1212	200 Meters Core Cable for W1300 Anemometer	{ {
09	02		Okitex Telex Terminal with printer	Okitex, Japan
10	01		NEC P6300 Printer	
11	01		Drive for AFDOS Printer for use with NEC P6300	NEC, Japan

22 May 1993

APPENDIX V

Schedule of interviews:

Department of Information and Broadcasting

Mr. Abdullah Rasheed
Director General

Department of Posts and Telecommunications

Mr. Mohamed Amir
Engineer

Ms. Zuleykha Ibrahim
Computer Programmer

Maldives Airport Authority

Mr. Mohamed Ibrahim
Director General,

Mr. Ahmed Shihab
Director

Maldives Association of Tourism Industry

Mr. Mohamed Hameed
Secretary General

Meteorology Department

Mr. Abdullahi Majeed
Director of Meteorology

Ministry of Defense and National Security

Colonel Shaukath Ibrahim

Ministry of Health and Welfare

Mr. Moosa Anwar
Director, Organizational Support

Ministry of Planning and Environment

Mr. Hussein Shihab
Director of Environmental Affairs

Ministry of Public Works and Labor

Mr. Abdulla Kamaaludhdheen
Minister of Public Works and Labor

Mr. Ismail Ibrahim
Civil Engineer

Ms. Fathin Hameed
Hydrographic Surveyor

Ministry of Tourism

Mr. Ibrahim Ahmed Manik
Assistant Director
Ministry of Tourism

Ministry of Transport and Shipping

Mr. Ali Ahmed
Assistant Director

Office of Physical Planning and Design

Mr. Mohamed Shafeeq
Director

Mr. Ibrahim Rafeeq
Deputy Director

Mr. Ali Haidar
Senior Planner

Mr. Mohamed Asim
Architect

Ms. Maryam Zulfa
Planning Officer

Interviews conducted during visit to Haa Dhaalu Atoll

Mr. Ahmed Sameer
Atoll Chief
Kulhuduffushi Island

Mr. Gasim Adam
Island Chief
Hodaidhoo Island

Mr. Mohamed Ibrahim
Island Chief
Nolhivaramu Island

Mr. Ahmed Ali
Island Chief
Finey Island

Mr. Mohamed Moosa
Island Chief
Nolhivaranfaru Island

Mr. Gasim Faheem
Island Chief
Hanimadhoo Island

APPENDIX VI

(Prepared by Dhiraagu)

WHAT TELECOMMUNICATIONS CAN OFFER IN CASE OF A DISASTER

1. INTRODUCTION

Maldives is an island nation comprising of 1200 islands out of which 200 island is inhabitat. The geographical structure, the distribution of population into tiny communities throughout the nation, created great difficulties for any type of communication means to be penetrated to reach these communities. Telecommunications not only plays a vital role in the development of a community, but in the times of disaster that could be the only mean of survival, specially, when isolated from the rest of the world.

This paper will look at the current situation of the telecommunications in the Maldives. It will also look at the possibility of utilizing the present links in the case of a disaster.

2. CURRENT TELECOM NETWORK INFRASTRUCTURE

The current telecommunications network of the Maldives consists of a digital exchange, Male' Cable network, microwave trunk network to the southern atolls, a troposcatter link, and vhf/uhf single/multichannel subscriber radio links. Figure 1.1 shows the existing telecommunications network.

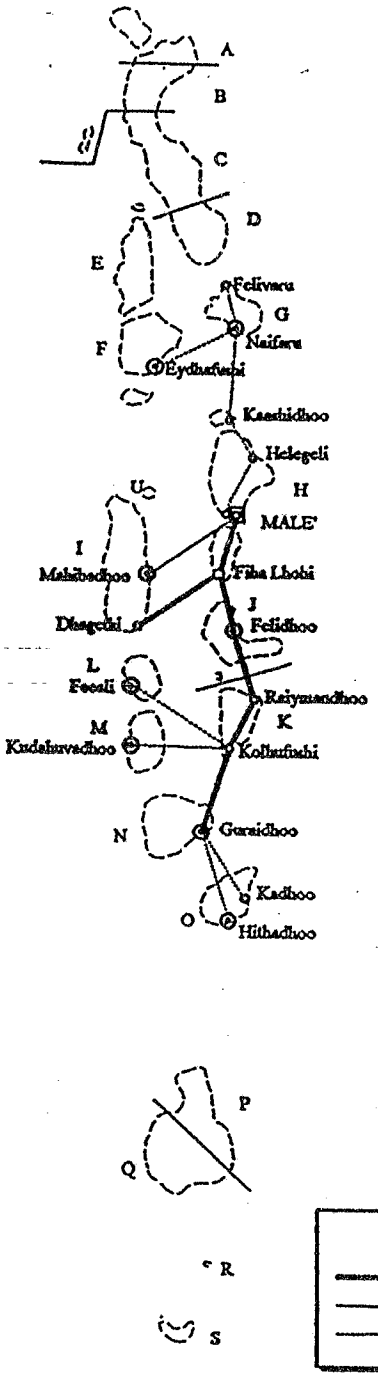
The backbone transmission network(Fig.1.2) is a microwave 2Mb/s radio transmission system extending to Thaa Atoll (N) in the South. Single/multichannel vhf/uhf radios are used to connect the subscribers to the transmission network.

The northern part of the network originating from Villingili is 4 channel FDM uhf radio system to provide telephones to Felivaru (the Maldives only tuna cannery), Lhaviyani and Baa (F) Atoll (one telephone each).

The troppo-scatter link (Fig1.1.) from Male' to the Alif Atoll (I) is analog. The subscribers end uses a multi-access scheme where by 8 subscribers will share 4 radio channels.

The rest of the country does not have any telephone service. They rely on HF radios for their communication needs.

REPUBLIC OF MALDIVES



TELECOMMUNICATIONS TRANSMISSION INFRA STRUCTURE

Figure 1.1

EXISTING DIGITAL TRANSMISSTION NETWORK

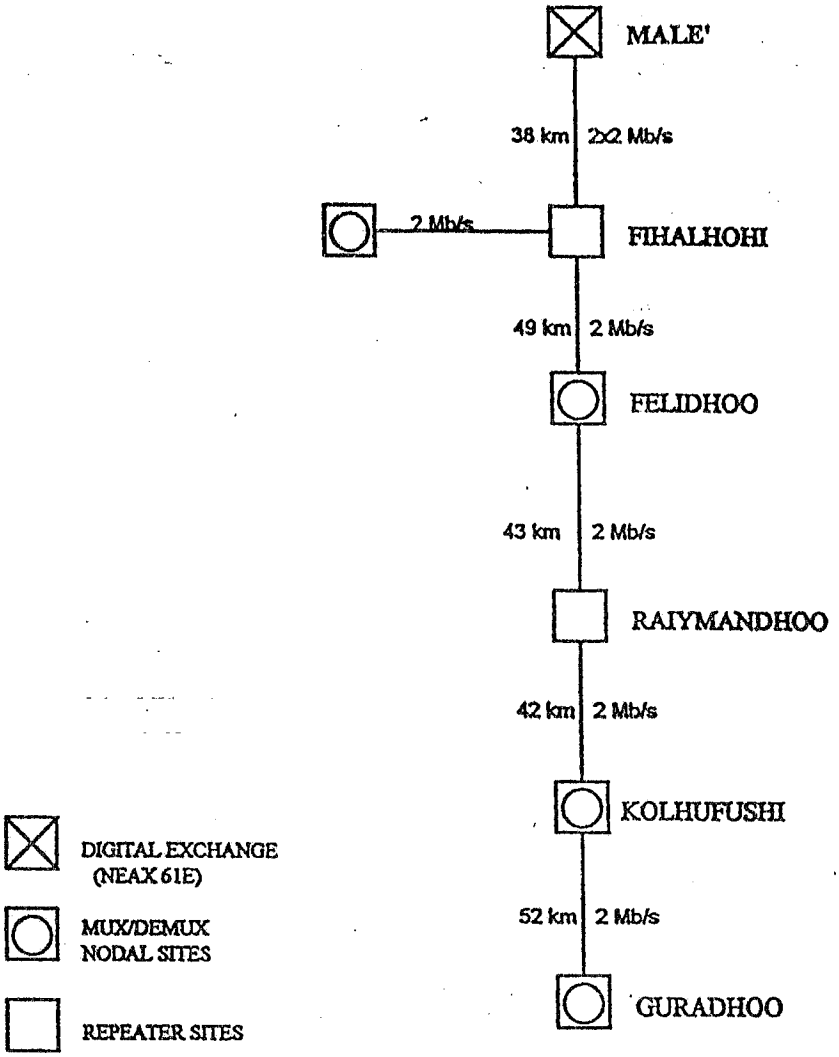


Figure 1.2

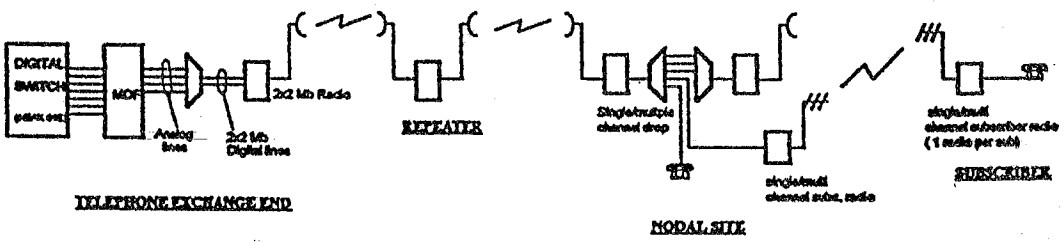
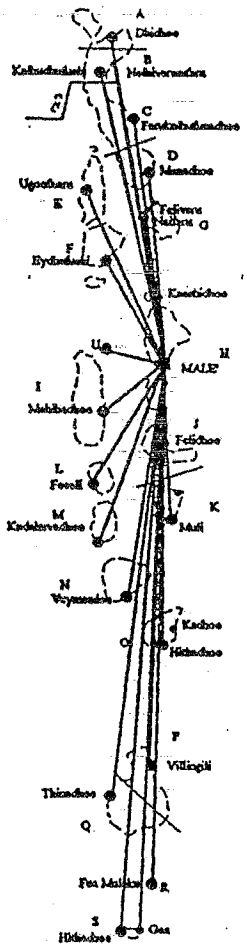


Figure 1.3

The current network provides telephone, fax and telex facilities to the residents in Male' and nearby islands including the tourist resorts in Male' and Alif(I,U) Atolls. Still a large part of the country has to rely on High Frequency (HF) communication using HF transceivers.

The HF network serves to all Atoll Capitals including the atolls where telephones are provided (Fig. 1.4). Toll Call service to these atolls are provided through Atoll Communications Center of Dhiraagu Pvt. Ltd. For special government communication needs some of the Government authorities including National Security Service, Min. of Atolls Administration, Min. of Health and Welfare have installed HF transceivers at their premises, to communicate to the Atolls.

Communication within atoll is via Citizen Band (27 MHz) transceivers. These CB transceivers are installed in all the inhabitat islands by Min. of Atolls Administration.



HF NETWORK

Figure 1.4

3. EMERGENCIES

After the terrorist attack to the Capital on the 3rd Novem 19
were informed to keep watch 24 hrs on HF radio.
operates between 7.30am to 7.30pm. Rest of
designated HF frequency for emergency p

In case of an emergency any
transceiver. Atoll Capitals ca
Male' Coastal Radio Station or

4. DISASTERS WARNINGS

Only two methods are identifiable to send w
national radio broadcast and the telecomm
network. The most effective from the two w
broadcast is the best mean to inform the pu
Unfortunately this service is limited to the period in w
operates.

5. AFTER DISASTER STRIKES

Since the telecommunication network is based on radio technology
towers are constructed through out the country. Microwave dish an
and yagi antennae used on these towers are susceptible strong winds. A
could damage the antenna system, breaking down the telecommunication
problem will be worse for the microwave link, whereby only trained technicia
restore the service. In the HF network however it will be quicker to restore the se
This is because the antenna system used in the HF stations are easy and simple
install.

Other possibilities in the future could be the use of Inmarsat satellite terminals. Comparing the cost of such equipment, it may not be a very useful alternative to the existing HF network.

6. CONCLUSION

In conclusion it is felt that the
telecommunications in the ca
more coordination will be r
Authorities in Male' for
contact points, and to
disaster warning.

felt that the existing Hr
as in the case of a disaster. But to ma
on will be required by Atoll Offices, Island Offices,
Male' for disaster surveillance to chose the emergency Req
s, and to decide on procedures to follow in case of an emergency or on a
ning.