

## **PART I**

### **INTRODUCTION AND BACKGROUND INFORMATION**

#### **Chapter 1 – Introduction**

#### **Chapter 2 – Forecasts and warnings of tropical cyclones, river floods and storm surges**

## CHAPTER 1

### INTRODUCTION

Tropical cyclones, hurricanes and typhoons are regional names for what is essentially one and the same phenomenon. Depressions in the tropics which develop into storms are called tropical cyclones in the south-west Indian Ocean, in the Bay of Bengal and Arabian Sea, in parts of the South Pacific and along the northern coasts of Australia; these storms are called typhoons in the North-west Pacific and are known as hurricanes in the Caribbean, in the south-east of the United States of America and in Central America.

The tropical cyclone is frequently described as the most devastating of all natural phenomena. In its combination of violence, duration and size of area affected, a tropical cyclone appears to be without equal for the sum total of the destruction it can cause. In the history of mankind there is a long catalogue of meteorological disasters and of all the lives that have been lost a high proportion has been attributed to tropical cyclones.

Probably the worst tropical cyclone ever experienced struck Bangladesh in November 1970 and resulted in more than 200000 deaths. The landfall of the tropical cyclone almost coincided with high tide. Winds of great violence funnelled water from the sea into the converging coastline and shallow waters at the head of the Bay of Bengal. The height of the storm surge varied from three to nine metres and, in sweeping over the offshore islands and low-lying coastal belt, it exacted a terrible death toll and caused enormous damage.

#### **Action to prevent or mitigate the effects of tropical cyclones**

In contemplating the disastrous effects that a tropical cyclone can have upon a country, the question must obviously arise as to whether the people and its government must passively accept that every so often a tropical cyclone will occur and hope that the effects will be small, or whether government and people can take well-planned measures which would prevent or at least reduce the losses of lives and the damage which may appear inseparable from tropical cyclones. The answer to such a question is emphatically that carefully planned measures functioning through an efficient organization are well worth the effort. Indeed, it can be asserted that if a nation prepares itself and takes all possible action for protection, a tropical cyclone would cause much less loss of life and much less damage to property than if no precautions had been taken. The purpose of these *Guidelines* is to describe and explain what can be done and to suggest ways of doing it.

The need for preparation and protection is of outstanding importance because some of the most populated areas of the world are affected by tropical cyclones and, as the Bangladesh disaster referred to above has shown, the potential for human disaster is enormous. Moreover, from the economic aspect, the damage caused to some countries by a tropical cyclone may amount to a significant percentage of the gross national product. In developing countries the damage may be on such a scale as to cancel out much of the progress made in improving the standard of living of their peoples.

#### **Action taken in different countries**

If a country is under strong pressure to take more extensive measures to combat the ravages of tropical cyclones, its government might well inquire what action has been taken by other vulnerable countries. In the various regions afflicted by tropical cyclones there are some forty or more nations, some at an advanced stage of development, others at an early or medium level of development. Tropical cyclones have been occurring over the centuries posing

threats which, from one period to another, differ in potential for disaster according to changes in the size and distribution of the population within a country and according to the progress that has been made in urban, industrial and other developments.

In some countries, notably Australia, Japan and the United States of America, highly developed systems already exist for disaster prevention and preparedness. Extensive long-term measures such as flood control, land-use control, zoning and building codes have been taken. For an impending or actual disaster situation, a well-tryed emergency organization can be brought into operation on receipt of a tropical cyclone warning, and every effort is made by disseminating information and by exercises to enlist the full co-operation of the general public. These countries have demonstrated that a programme for disaster prevention and preparedness, supported by the whole community and including an effective warning system, can substantially reduce the death toll from tropical cyclones. This point is illustrated in Figure 1 taken from a U.S.A. Government publication. These storms killed more than 10000 people in the 30-year period 1900-1929, but fewer than 2000 in the period of 30 years from 1945-1974. This reduction was achieved even though many more people were living in vulnerable areas during the latter period. By contrast, it was found in the United States that the average annual damage, after adjusting for the effects of inflation, was nine times as great in the decade 1965-1974 as in the decade 1915-1926. Of course, as economic development in a country goes on, the number of buildings and other installations increases so that the vulnerability is all the greater. This consideration emphasizes the importance of preventive measures.

Significantly it is in countries where sustained efforts are applied to disaster prevention and preparedness that there is a strong awareness that the time never comes when everything possible has been done. The protective arrangements, whether long-term or short-term, are under constant scrutiny to find ways of improving them and each tropical cyclone event is followed by a review of the functioning of the organization and of the public response. Other countries, conscious of what can be done and should be done, are making strenuous efforts to achieve greater development and the highest standards of efficiency in disaster prevention and preparedness. In still other countries such protective measures that exist are mostly in a rudimentary stage. It is the second and third groups of countries – those who have made a good start in the development of disaster prevention and preparedness and those still in the very early stages of pre-disaster planning – that these *Guidelines* are designed to help. In preparing the *Guidelines*, use has been made of the experience and expertise of those countries where many years of concerted effort have shown the way to progress.

### **International action and co-operation**

A single tropical cyclone may exist for several weeks and as it moves it may cause loss of life and damage in a number of countries. It is highly appropriate therefore that national efforts to combat the effects of tropical cyclones should be supported and supplemented by international action on both a global and a regional scale.

The validity and importance of international action are also justified by economic considerations. In the United Nations and among its Agencies and also among the voluntary organizations such as the League of Red Cross Societies (LRCS) it is appreciated that account should be taken not only of a country's need to safeguard life and property against the effects of tropical cyclones but also of that country's ability to provide the necessary protective measures. Action which would be considered practicable in advanced countries, with their resources of finance and technological skills, might well present developing countries with numerous problems which could not be surmounted without external aid

In 1964 the World Meteorological Organization (WMO) and the Economic and Social Commission for Asia and the Pacific (ESCAP) entered into discussions with interested countries on the feasibility of setting up a joint programme aimed at reducing the loss of human lives and the damage caused by tropical cyclones, referred to as typhoons, in the countries of South-east Asia and the Pacific. These discussions led to the establishment in 1968 of an inter-governmental Typhoon Committee charged with promoting and co-ordinating efforts to minimize typhoon damage in the ESCAP region.

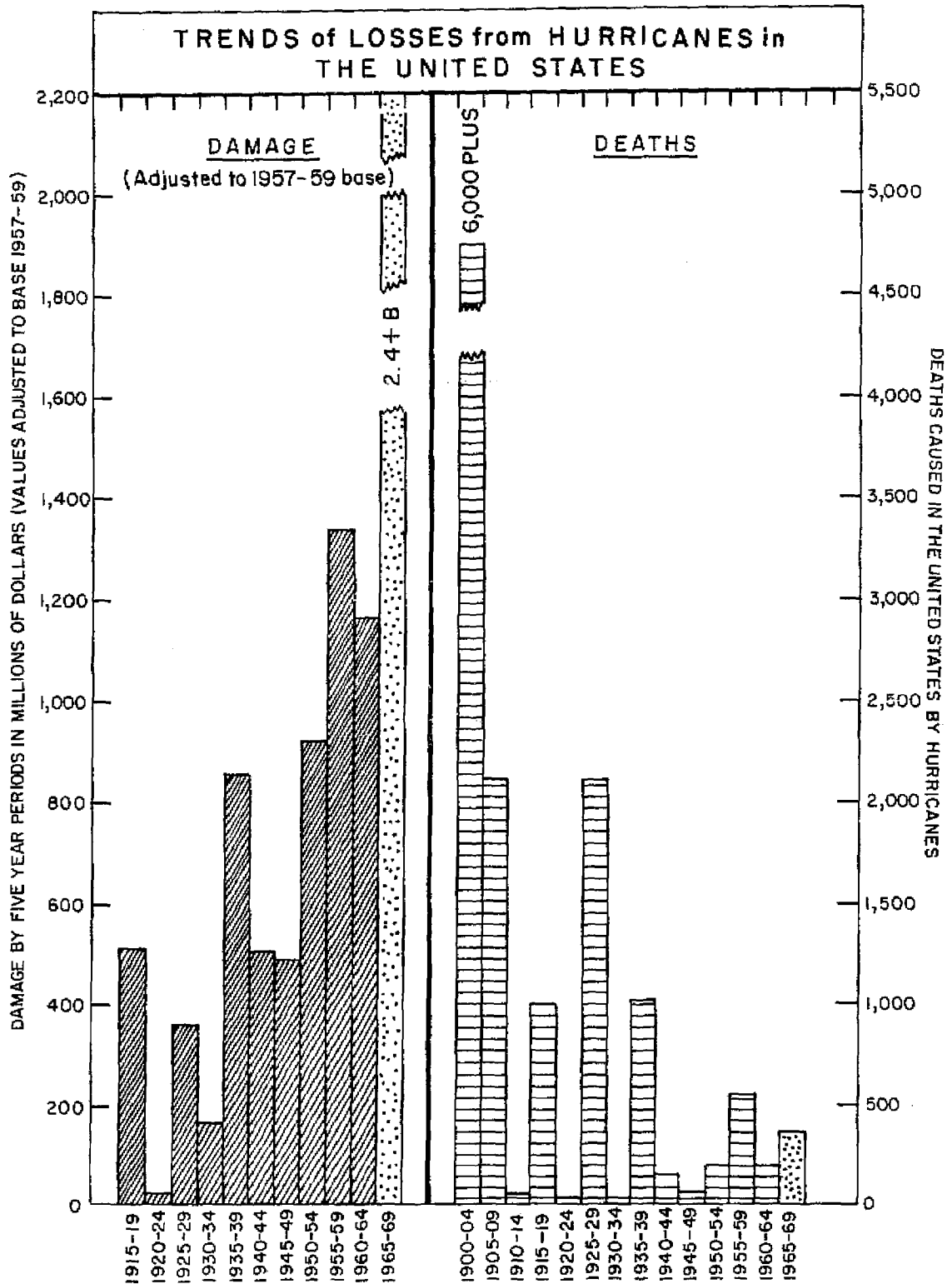


Figure 1 - Trends in losses from hurricanes in the United States summarized by five-year periods. Damage statistics have been adjusted to the 1957-59 Department of Commerce Composite Cost Index for Construction. The right side of diagram shows trend of decreasing deaths due to hurricanes. The decrease should be attributed to improvements in the hurricane warning service and community preparedness programme

The programme of the Typhoon Committee includes the provision of additional meteorological and hydrological facilities to improve the forecasting and warning of typhoons and to develop flood-forecasting systems in major rivers. In addition, efforts are devoted to the extension and further development of disaster prevention and preparedness, special attention being given to ensuring that the general public understands the dangers that accompany typhoons and is ready to co-operate with the emergency organization. Furthermore, training and research are important elements of the Committee's programme since it is essential that the latest techniques made available by science and technology should be utilized in the fight against tropical cyclones.

The tropical cyclone in the Bay of Bengal which brought such tragic consequences to Bangladesh in November 1970 became a starting point for a further focusing of international attention upon the need for combined efforts to counter the threats presented by tropical cyclones. Around this time a series of typhoons ravaged the Philippines causing heavy loss of life and damage on a massive scale. The Typhoon Committee appealed to the United Nations for international action. In response to this appeal General Assembly Resolution No. 2733 (XXV)D, expressing the belief that man's scientific and technological capabilities could help conquer the environmental scourge of tropical cyclones, called upon WMO with the help of other organizations and of Member States of UN to mobilize scientists and resources to discover ways of mitigating the harmful effects of these storms and of removing or minimizing their destructive potential. WMO accordingly set up a Tropical Cyclone Project which is the framework for a Plan of Action covering the detection and forecasting of tropical cyclones, the forecasting of floods and storm surges, the organization of early warning systems and certain other aspects of disaster prevention and preparedness.

A further General Assembly resolution, No. 2816 (XXVI), concerned specifically with the provision of assistance to countries in cases of natural disaster and other disaster situations, was adopted in 1971. This led in 1972 to the creation of the Office of the United Nations Disaster Relief Co-ordinator (UNDRO) with wide responsibilities covering international emergency relief co-ordination in cases of natural disasters and other disaster situations and also the promotion of disaster prevention and preparedness.

Other UN Agencies making substantial efforts in support of regional and national programmes to meet the dangers of tropical cyclones include the United Nations Development Programme (UNDP), the United Nations Environment Programme (UNEP) and regional bodies such as ESCAP, already mentioned with regard to the intergovernmental Typhoon Committee. In addition, among non-governmental organizations the League of Red Cross Societies (LRCS) plays a conspicuous part in all disaster-prone areas, including countries affected by tropical cyclones.

As an illustration of the international co-operation that is taking place in the field of tropical cyclones, it is worth mentioning that UNDRO and all the organizations mentioned in the preceding paragraph are participating in one or more of the sub-projects of the WMO Tropical Cyclone Project. It is also noteworthy that the activities of the ESCAP/WMO Typhoon Committee have evoked growing attention in other areas affected by tropical cyclones. A direct consequence has been the establishment of two other regional bodies, one for the countries around the Bay of Bengal and the Arabian Sea and the other for countries in the south-west Indian Ocean, with policies and programmes that are closely in line with those of the Typhoon Committee.

### **Scope of disaster prevention and preparedness**

Disaster prevention and preparedness consist of a wide range of measures, some long-term and others short-term, aimed at saving lives and limiting the amount of damage that might otherwise be caused. Prevention covers the long-term aspects and is concerned with policies and programmes to prevent or eliminate the occurrence of disasters. The corresponding measures are taken in such fields as physical and urban planning, public works and buildings. Short-term measures are designed to cover the action necessary during the approach of a possible disaster, during the existence of a disaster situation and in the ensuing period devoted to relief and rehabilitation.

An organization for disaster prevention and preparedness is inevitably complex. It involves a variety of different services and skills all of which must be blended together so that the whole organization can function smoothly

and meet its objectives. If one part of the system fails, other elements would be seriously handicapped. There is therefore a high degree of interdependence between the various components. Taking an overall view, it can be said that disaster prevention and preparedness form a system of enormous scope which involves official and voluntary organizations at national, regional and local levels, which involves the general public directly in a number of critical aspects and which includes activities on almost any time scale from a few minutes to several decades.

### **The vital role of the tropical cyclone warning system**

The warning system is a primary feature of the organization for disaster preparedness, the organization which has its origins in the short-term measures which are designed to minimize loss of life and damage and to facilitate timely and effective rescue, relief and rehabilitation. This organization must be in a state of full readiness in the tropical cyclone season and springs into action when warning of the approach of a tropical cyclone is issued. The centre or focal point of the warning system is the national Meteorological Service, which is responsible for detecting the existence of a tropical cyclone over the neighbouring seas and for predicting when and where it will strike the country and for assessing its expected characteristics in terms of wind strength, rainfall and storm surge. When a tropical cyclone warning is issued, the national Hydrological Service, using rainfall forecasts and basic data, will maintain a constant surveillance of flood risks with a view to issuing any necessary flood warnings.

In the past a lot of lives have been lost simply because a warning system either did not exist or was unable to carry out its responsibilities satisfactorily. The experience of countries where disaster preparedness is well developed and is constantly being improved confirms that an effective warning system makes a major contribution to the safety of human lives. A feature of the warning system, as of the short-term measures which result in disaster preparedness, is that the action which must follow the issue of a warning involves closely and personally the general public as well as all those who have specific responsibilities in the emergency organization.

### **Origins and objectives of the Guidelines**

As one of the activities of the Typhoon Committee, joint LRCS/WMO/ESCAP missions visited some of the member countries to study arrangements for disaster prevention and preparedness, to promote where necessary closer co-operation between the various national agencies concerned and to provide information and advice as required on any aspects of pre-disaster planning and organization. As a result of these visits, as already explained in the Foreword, the three organizations together with the Typhoon Committee accepted a recommendation that a manual should be prepared providing information and guidance on the development, organization and operation of systems for disaster prevention and preparedness. These bodies appointed an editorial board to compile the manual and, as soon as practicable, UNDRO was invited to participate and advise in all stages of the work.

The *Guidelines* are directed primarily at persons in governmental or non-governmental service whose responsibilities are concerned with disaster prevention and preparedness. It is intended that the *Guidelines* should serve as a source of information on what can be done to organize the best possible protective systems. The material in the manual is for the most part based upon the practices in such countries as Australia, Japan and the U.S.A., where the organization for disaster prevention and preparedness is extensive and constantly being improved. The needs and problems of developing countries have been borne in mind in the selection of practical examples but it must be emphasized that such examples are mainly for illustrative purposes aimed at helping each country to determine its own requirements for disaster prevention and preparedness. To assist further, the *Guidelines* include a bibliography listing publications and pamphlets on various aspects of the whole subject.

Although the *Guidelines* have been written within the context of tropical cyclones and associated floods and storm surges, many sections will be applicable to the requirements for meeting the potential hazards of other types of natural disaster. It is hoped that this consideration will enhance the usefulness of the *Guidelines* to those governmental and non-governmental agencies which bear the responsibility for disaster-related measures.

## The layout of the Guidelines

The *Guidelines* are arranged in four parts. Part I consists of the present introductory chapter followed by a chapter giving a general account of tropical cyclones and their characteristics and also of river floods and storm surges. Special attention is given to warning systems and to the immensely important subject of the dissemination of warnings to all concerned. This chapter is included because all who have responsibilities in the emergency organization should have a background knowledge of tropical cyclones and their main characteristics and of the types of forecast and warning that are issued so that these messages will be interpreted and acted upon in the most effective manner.

Part II is concerned with disaster prevention, the long-term measures which are taken with the objective of forestalling the disasters that could result from tropical cyclones. The subjects treated include disaster legislation, risk evaluation and such aspects as land-use control and building codes.

In Part III the planning and organization of disaster preparedness are described. Apart from the sections on legislation and planning, the topics dealt with in this part have a strong operational emphasis appropriate to the action that must be taken both before and during an emergency.

Finally, Part IV has as its subject matter the aftermath of disaster. A chapter on rehabilitation and resettlement discusses the short-, medium- and long-term actions that are required in the period following a disaster and points to the many social, economic and other questions that have to be examined. There follows a chapter on the important subject of making a detailed survey and assessing the damage experienced in each tropical cyclone event. The results of such an assessment are needed for a variety of purposes. One aim of special importance is to ensure that any deficiencies in the organization of disaster prevention and preparedness may be brought to light and appropriate action taken.