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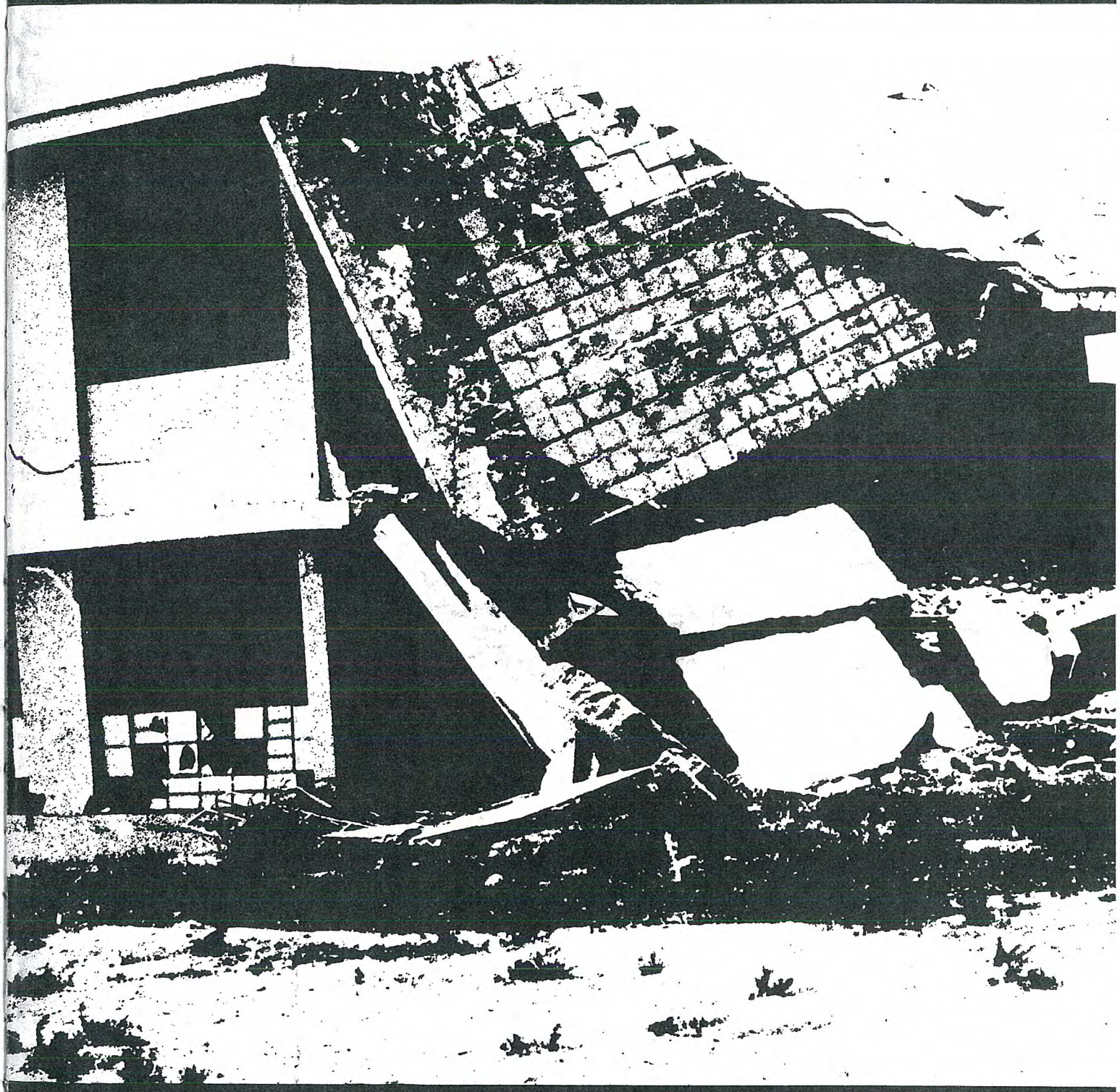


PLANNING FOR HUMAN SETTLEMENTS IN DISASTER — PRONE AREAS

Planning for human settlements in disaster-prone areas

UNITED NATIONS CENTRE FOR HUMAN SETTLEMENTS (HABITAT)
NAIROBI, 1983

Foreword

Every year, natural disasters cause great losses in human lives, property and productive capacity. Those losses are most dramatic in developing countries, whose economies are not sufficiently developed to absorb the consequences of natural disasters, and real economic growth in many of those countries has been seriously set back by disaster losses. It is imperative, therefore, that we apply ourselves to controlling the effects of natural disasters through human settlements planning. The task is growing more difficult with time, as population increases, as urbanization expands and as economic activities concentrate in urban areas, many of which are quite vulnerable to natural disasters.

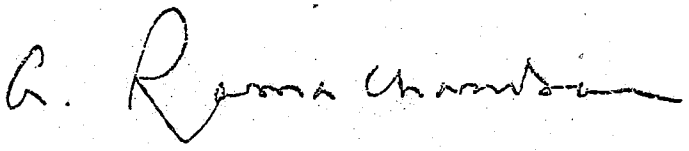
Although it is not possible in most cases to stop development altogether in areas that are prone to natural disasters, it is possible with appropriate planning measures to steer development away from those areas into safer areas. It is also possible to reduce the destructive effects of natural disasters by decreasing the vulnerability of human settlements to natural disasters and increasing their resistance to damage caused by disasters, through implementation of appropriate land-use planning and use of appropriate building materials and technologies.

This publication is based on a report submitted to the Commission on Human Settlements at its fifth session, held at

1325 / Direct / DOC

Nairobi from 26 April to 7 May 1982. The main conclusions and recommendations resulting from the Commission's deliberations and the action taken by the United Nations Centre for Human Settlements (Habitat) to implement those decisions are reflected in the introductory chapter.

I commend this publication not only to political leaders, policy makers and senior government officials but also to other organizations and individuals concerned with the improvement of living conditions in urban slums and squatter areas.



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Nairobi, December 1982

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Introduction

While natural hazards are integral features of the environment, the extent of the damage that results from them is to a significant degree a function of decisions made or not made in the process of human settlements development. While, in recent years, there has been some improvement in the sensitivity of human settlements decisions to natural disasters in some countries, costly but avoidable destruction remains commonplace. Until now, the response of the international community to natural disasters has been to focus primarily on post-disaster activities. In most disaster-prone developing countries, little attention has been given to natural disasters as a component of national or subnational social, economic and spatial planning. Rapid population growth and accelerated urbanization in the regions exposed to violent natural disasters suggest that ad hoc responses, relief measures and post-disaster action alone are insufficient.

Member States represented in the Economic and Social Council and in the Commission on Human Settlements have expressed concern over the severe damage, loss of life and loss of capital investments caused by natural disasters in developing countries. Also, the Commission on Human Settlements, at its fourth session, instructed the United Nations Centre for Human Settlements (Habitat) to prepare a report on the subject of human settlements planning in disaster-prone areas for the fifth session of the Commission.

This report identifies current and potential efforts to incorporate natural-disaster considerations into human settlements development planning, analyzes the obstacles that prevent the application of measures to mitigate disasters, examines methods to overcome them and proposes a conceptual and operational framework for the integration of disaster mitigation into national development plans. It includes a recommended course of action for national Governments and

international organizations, particularly UNCHS (Habitat), for considerations at the fifth session of the Commission on Human Settlements.

Chapter I of the report discusses the social, physical and economic implications of the impact of natural disasters. Chapter II examines the relationship between natural disasters and settlements development planning and analyzes the costs and benefits of disaster mitigation planning. Chapter III identifies natural-hazard characteristics and stages and considers their relevance for development planning. Chapter IV interprets the concepts of vulnerability, risk and disaster mitigation. Chapter V offers a conceptual and operational framework for disaster mitigation planning. Chapter VI recommends a course of action for UNCHS (Habitat), national Governments and other international organizations.

ROLE OF THE UNITED NATIONS IN PLANNING FOR HUMAN SETTLEMENTS IN DISASTER-PRONE AREAS

Several United Nations agencies have concentrated on disaster related problems. The Office of the United Nations Disaster Relief Co-ordinator (UNDRO) co-ordinates post-disaster international relief actions and during the past years has initiated a programme of pre-disaster preparedness studies. It also collaborates with other United Nations agencies in undertaking projects of risk reduction and post-disaster reconstruction. Examples are the UNCHS (Habitat) physical planning project at Montenegro, Yugoslavia, and the UNCHS project of assistance for the re-construction of the flood stricken villages in upper Egypt, in which UNDRO has been the co-operating agency in earthquake vulnerability assessment and flood prevention. The United Nations Development Programme (UNDP) provides technical assistance to settlements destroyed by natural disasters. The United Nations Educational, Scientific and Cultural Organization (UNESCO) stimulates the develop-ment of research in earth sciences and has undertaken projects in that field, such as the UNESCO project for seismic risk reduction in the Balkan region, in association with UNDRO. Other United Nations agencies that have conducted work in disaster-related problems are the United Nations Environment Programme (UNEP), the Food and Agriculture Organization of the United Nations (FAO), the World Health Organization (WHO), the World Meteorological Organization (WMO), the United Nations Children's Fund (UNICEF) and the World Food Programme (WFP).

Although the aforementioned agencies have carried out valuable projects and research programmes concerning natural catastrophes, the importance of integrating disaster-mitigation strategy into development planning has until now received very little attention. Habitat: United Nations Conference on Human Settlements, held in Vancouver in 1976, recognized the serious threat of natural disasters and emphasized the need to mitigate their effects. 1/ However, certain problems still have to be addressed in disaster-prone countries, especially the developing countries, and these problems include the following:

Inadequate understanding of the relationship between social, economic and spatial activities in the context of human settlements and natural disasters; in order to understand these relationships it is essential to identify and assess hazards and to estimate both vulnerability functions and risk;

Lack of consideration of development options that would allow optimal utilization of resources for preventing and mitigating the disruptive impact of natural disasters and thereby promote socio-economic efficiency;

Lack of appreciation of the need to account for disaster vulnerability in the human settlements development process from the earliest stages of planning up to the continuing management, administrative and operational functions;

Lack of institutionalized mechanisms for assembling and processing necessary information for assessing risks and trade-offs, for developing co-ordinated policy, for incorporating policy into settlements development planning and for selecting, designing and employing implementation measures.

1/ Report of Habitat: United Nations Conference on Human Settlements, Vancouver, 31 May - 11 June 1976 (United Nations publication, Sales No. E.76.IV.7 and corrigendum), chap. II, recommendation B.14.

Impact of natural disasters

SOCIAL, PHYSICAL AND ECONOMIC IMPLICATIONS

Large portions of the world that are underdeveloped, particularly the portion that stretches across the tropical and subtropical areas of Africa, Asia, Latin America and the Caribbean, are prone to disasters. Severe earthquakes, volcanic eruptions, droughts, floods and hurricanes cause heavy destruction and inhibit economic growth and development through their direct, indirect and cumulative effects. It has been estimated that the total toll of natural disasters in the period between 1900 and 1976 amounted to approximately 4.6 million persons killed and over 230 million left homeless. It can be calculated that no less than 45 million dwellings have been damaged, and this represents 6-7 per cent of the total existing housing stock of the world or three years of all the world's housing development programmes at the present rate of implementation. 2/ The United Nations Economic Commission for Latin America (ECLA) has estimated that, for example, the damage caused by natural disasters in the five countries of the Central American Common Market reduced the average annual growth rate of gross domestic product (GDP) by approximately 2.3 per cent over the 15-year period between 1960 and 1974. 3/ Even this alarming figure, however, does not take into account the indirect effects of disasters such as the resultant higher incidence of disease or the cumulative effects

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2/ A. Ciborowski, "Physical development planning for human settlements in disaster-prone areas", report prepared for UNCHS (Habitat).

3/ Office of the United Nations Disaster Relief Co-ordinator, Disaster Prevention and Mitigation: A Compendium of Current Knowledge, vol. 7 (New York, 1979), page 1.

of many small events such as limited floods which, in the aggregate, have very serious effects. Some countries have suffered damage from hurricanes equivalent to 15 per cent of their annual gross national product (GNP), e.g. the Dominican Republic in 1979 and Haiti, Saint Lucia and Saint Vincent in 1980. In Huaraz, Peru, the 1970 earthquake damaged 95 per cent of the downtown area. In the Bangladesh tropical cyclone of 1970, 250,000 people lost their lives, and in the 1976 earthquake in Tangshan, China, over 240,000 people died. In 1972, the earthquake in Managua completely destroyed the capital of Nicaragua, and the 1976 earthquake in Guatemala left approximately 1 million persons homeless - over 15 per cent of the national population. Almost one quarter of Fiji's population was rendered homeless by one hurricane in 1976.

RELATIONSHIPS BETWEEN THE IMPACT OF DISASTERS AND AREA CHARACTERISTICS

An important issue is the impact of disasters relative to size of country, population and level of economic development. The poorest and the smallest disaster-prone countries suffer the severest losses. For example, the 1979 hurricane in Dominica destroyed 80 per cent of all housing in the country.

Countries that have a high level of economic development usually suffer high capital losses, while countries with a lower level of development suffer higher social losses. When urban concentrations are affected by disaster, damage and destruction are concentrated and highly visible. Very often, however, urban residents represent only a proportion of those affected by disaster, e.g. in the Guatemala earthquake of 1976, the Sri Lanka cyclone of 1977 and the Algeria earthquake of 1980.

Disaster brings about more than physical damage, since damage can also take less tangible forms, including social deprivation, unemployment, decreased production, dependency, displacement of populations, migration and political instability. Moreover, there is no reliable way of calculating the loss of development momentum and of benefits from economic activity not realized owing to destruction by natural disasters.

Analysis of specific disasters indicates that, although there are some general conclusions to be drawn, there are many differences between disasters of the same type in different contexts. The differences and similarities between disasters are as much

a function of local, regional, social and economic characteristics as of the physical characteristics of the disaster. There is a need for systematic field analyses of disasters and disaster-prone areas to learn more about their differences and similarities and to plan strategies for disaster mitigation adapted to subnational and national characteristics.

Relationships between natural disasters and settlements development planning

THE PURPOSE OF DEVELOPMENT PLANNING FOR HUMAN SETTLEMENTS

Development planning entails the balancing of social, physical, environmental and economic factors in a process designed to identify and evaluate options for achieving development goals, to select preferred options from among feasible alternatives and to plan the steps necessary to carry out the chosen courses of action and manage the results. It can be undertaken at the subnational or national level, it can address a single sector or several sectors and it can be short-term or long-term. Ideally, it constitutes a vehicle for the integration of decision-making across space, sectors and time. It is essentially a dynamic and incremental process. If it is ignored or done poorly, the result is inefficiency and, usually, inequity.

DEVELOPMENT PLANNING AND HAZARD MITIGATION

Seldom does development planning account directly and integrally for natural hazards, a fact that is striking, since many of the objects of development planning are precisely the same as those of disaster-mitigation planning for a given area. Favourable consequences of otherwise good planning can be and have been wiped out in minutes through a failure to account for the disaster potential of natural hazards. There is a tendency to view such misfortunes as unavoidable tragedies, whereas in fact they are, to a substantial degree, testimony to poor planning that has ignored vulnerability to disasters.

The disaster vulnerability of a given region or settlement refers to the likelihood of human, physical and economic loss attributable to natural hazards. The disaster vulnerability of an area may be thought of as a function of a set of characteristics pertaining to its natural environment and a set of characteristics pertaining to its human

settlements. The former are facts that can, to a significant extent, be determined technically. The latter are the consequence of spontaneous or calculated decisions and actions and are in principle amenable to planning and management. 4/

COSTS AND BENEFITS OF DISASTER MITIGATION PLANNING

Human settlements development planning undertaken without due regard for environmental hazards and natural disasters not only ignores the potential destruction of its own structures, products and purposes but also risks the exacerbation of the impact of disasters by multiplying natural dangers. Development planning influences where people and structures are located, what materials and methods are used in construction, how topography is altered, what emergency systems are supported, what resource reserves are maintained, what economic dependencies are fostered, what communication and transportation systems are available and what public buildings and other infrastructure are in place. These and other factors not only directly affect disaster vulnerability but also may have indirect consequences that are no less significant.

For example, the decision to locate a factory in the path of hurricanes or tropical storms is an obvious gamble with economic development in general and the lives and livelihoods of the workers in particular. If the factory is destroyed, the true measure of the disaster is not merely the value of assets lost or of potential revenues lost; the real measure of the disaster, in development terms, also includes the income, additional investments and development benefits which would have accrued from the indirect and induced multiplier effects of an alternative prospering enterprise that would have represented a more efficient use of development resources. Even more subtle might be the effects of the disaster on economic linkages associated with the production undertaken in the factory. Cases are now common of hillsides being deforested to provide raw materials for production, resulting in mudslides and increased flooding in areas previously thought to be safe. The factory may have been a victim of the very "development" processes it generated.

4/ In Japan, the extent of damage and loss attributable to disasters decreased considerably after 1966 owing to a significant increase in GNP and to a widespread effort in respect of disaster prevention and preparedness.

Natural hazards

CHARACTERISTICS OF NATURAL HAZARDS

In this chapter, the general characteristics of natural hazards are identified and attention is given to their secondary physical effects. Only sudden-onset hazard phenomena are considered in the scope of this report. Their secondary or tertiary effects on socio-economic structures are discussed below.

For the scientific description and technical aspects of each phenomenon in itself and in combination with others, reference should be made to UNDRO works on the matter. 6/ However, for general purposes, natural hazards can be grouped into three categories:

Extreme ground motions, including earthquakes, avalanches, volcanic eruptions and landslides;

Extreme water motions, including floods and tsunamis;

Extreme air motions, including cyclones, hurricanes, typhoons, volcanic eruptions and tornadoes.

EARTHQUAKES

An earthquake is a sudden release of accumulated strain energy within the crust and upper mantle of the earth, triggering seismic waves of different amplitudes, frequencies and duration which are transmitted in all directions. The resulting oscillatory movement of the earth's surface is often associated with widespread permanent deformations which may include tilting of segments of the earth's crust and offsets along faults. Secondary physical effects may occur, including compaction of loose soil materials, liquefaction of soils, landslides, avalanches, tsunamis, floods caused by the rupture of hydraulic structures and

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6/ Office of the United Nations Disaster Relief Co-ordinator, Disaster Prevention and Mitigation: A Compendium of Current Knowledge, 9 volumes, (New York, 1977).

fires. Under certain special conditions, large man-built reservoirs may induce a certain increase in seismicity.

VOLCANIC ERUPTIONS

A volcanic eruption is a release of gases, lava, rock blocks, ashes or a combination of these which spreads over the flanks of a mountain and sometimes into adjacent valleys. Secondary physical effects may include floods, earthquakes, fires, tsunamis and mud flows.

LANDSLIDES

Landslides include all gravitational phenomena of various velocities leading to the displacement of soil or rock masses. They can be described more specifically according to the type of material which is transported, for example soil landslides, rock falls or mud flows. Secondary physical effects include floods, when a landslide cutting a valley river forms a lake which may suddenly burst or when a landslide falls into an existing reservoir. In many cases, landslides are caused or triggered by human activities.

FLOODS

Floods can occur on seashores and in riverbed areas or adjacent plains where no defined channel exists or when the channel does not offer sufficient discharge capacity and heavy rainfall occurs in the catchment area. Floods can also occur as the result of structural failures of containing embankments and the irruption of landslides into reservoirs. Very heavy rainfall can cause a flood of sudden onset (flash flood) with little warning. Flood magnitude will be increased by any extensive deforestation in the catchment area, and secondary effects include erosion, mud-flows and pollution.

AVALANCHES

Avalanches occur in well-defined areas when accumulations of snow caused by heavy snowfall and prevailing winds suddenly slide or drop down steep slopes as a result of particular temperature conditions in the snow mass and in the air. Two distinct phenomena can be observed depending on the time of the year: avalanches due to the accumulation of blown or recent snow, which occur in winter and are very fast, and avalanches due to sun and snowmelt, which occur in spring and are much slower. Avalanches may sometimes be associated with landslides or rockfalls.

TORNADOES

Tornadoes and, in general, thunderstorms accompanied by lightning and hail are categorized as "severe local storms" which cover limited geographical areas or which move along narrow paths. Tornadoes, the most destructive phenomena, are found where wind, temperature and humidity conditions are such that they generate a vortex forming the funnel-shaped cloud characteristic of a tornado.

Where this cloud dips to the ground, destruction occurs through the combined action of strong rotary winds and the partial vacuum in its centre. Thunderstorms, usually accompanied by large hailstones and/or strong gusting winds, can cause considerable destruction and are sometimes associated with tornadoes. Lightning occurs commonly with thunderstorms, though less frequently with tornadoes, and can generate fires.

TSUNAMIS

Tsunamis are sea waves generated by sudden displacement of the sea floor caused by earthquakes, landslides, collapses or volcanic eruptions. These waves propogate over large distances and increase in amplitude along shores where the slope of the sea floor rises gently and uniformly.

TROPICAL CYCLONES

Tropical cyclones are weather systems in which the atmospheric pressure decreases to a minimum value at the centre, with winds blowing in a spiral. Damage to human settlements is cuased by the direct effects of violent wind and associated excessive rainfall and by the secondary effects of river flooding, storm surge and landslides.

OTHER NATURAL HAZARDS

In special situations or conditions, other natural hazards may occur, generally in mountain areas. For instance, icefall from the edge of a glacier may reach human settlements. Huaicos, which are a combination of avalanche, landslide mud flow and flood, occur frequently in Peru.

Obviously, physical effects can have numerous direct or immediate socio-economic expressions such as loss of life and health, destruction/damage of housing, interruption of social services, destruction/damage of production facilities, interruption of economic activity, loss of income, loss of employment, interruption/destruction of utilities, interruption of transportation and communications, increases in prices, food shortages and unsanitary conditions.

In general, the direct and immediate effects can be characterized as a severe disruption of the socio-economic order. The developmental implications of this disruption may be felt for many years after the socio-economic order has returned to its pre-disaster situation and may well have overall depressive effects that far exceed those of the socio-economic disruption. It is for this reason that preparations for immediate response and relief alone, as is usually seen in disaster-prone countries, are inefficient and inadequate.

There is a tendency on the part of both Governments and populations to resist discussion of the prospect of natural disasters or to allocate no more than token resources to disaster prevention and preparedness during a pre-disaster "normal" period. In certain situations, the relative infrequency of disasters provides convenient grounds for procrastination in disaster planning, except, perhaps, with regard to the allocation of emergency supplies for immediate relief. Economic development priorities may also be perceived as competing with the need for disaster prevention, mitigation and preparedness programmes and activities. Planning and management for the latter are commonly dissociated from planning and management for development and considered a luxury not permitted as a result of resource scarcity, especially in developing countries. Investment in disaster prevention and mitigation tends to be viewed as a low-priority part of development programmes rather than as an integral component of sound development planning practice. This substantially increases the vulnerability of developing countries in disaster-prone areas, jeopardizing development objectives and the investments made to achieve them. National development policies that increase regional imbalances by promoting a high concentration of industry, commerce, amenities and housing in disaster-prone areas, for example, contribute to increased disaster vulnerability in those areas.

Forecasting and warning require data which may be difficult to collect and which are of uncertain accuracy. The prediction and detection of tornadoes and destructive winds are still uncertain, tsunami prediction is limited by lack of knowledge of the hazard, avalanche prediction is only partly developed, hurricane forecasting is possible and earthquake prediction is still at an embryonic stage. In addition, in developing countries the problem is complicated by the lack of adequate systems for monitoring and data collection, shortages of trained personnel to operate and maintain existing systems and lack of adequate provisions for the dissemination of warnings. 7/ This

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7/ In the 1970 cyclone in Bangladesh, the disaster was forecast, but the mechanisms for warning, dissemination of information and response (evacuation) were not available, resulting in one of the greatest disasters in this century.

tends to reinforce fatalistic attitudes and the notion that efforts to assemble and utilize natural-hazard information for prevention and mitigation planning will be of little ultimate avail.

The assessment of damage and needs requires the use of pre-disaster information as a complement to post-disaster data. The process of damage and needs assessment is in most cases decentralized, and central government and local disaster-related agencies tend to make their own independent assessments following a disaster. Most, however, cannot collect technical information and have to rely on traditional sources such as the news media as information sources. In most post-disaster situations this ineffective assessment results in a duplication of efforts, waste of resources and inadequate response.

As a result of the impact of a disaster, undesirable human settlement conditions can be substantially aggravated. Damage to the housing sector, to infrastructure (especially roads and bridges), to the energy sector (generating facilities and transmission and distribution networks) and to the communications, commercial and industrial sectors can be extensive. In addition, local economies can be severely affected by the destruction of crops and livestock, the interruption of services and the impairement of production facilities. Efforts by domestic and international disaster-related agencies to provide relief and to rehabilitate the stricken community are compressed in terms of time and capital investment. Massive, uncoordinated responses by a variety of agencies, each with a different degree of experience and its own priorities and peculiarities, may be at cross-purposes and may ultimately even disadvantage the victims they are intended to help. Furthermore, disaster-relief agencies tend to overlook the interconnections between short-term response and long-term development-oriented recovery or to confuse priorities. In most cases, reconstruction strategies follow a palliative rather than a preventive approach. 8/

8/ Two instances of the palliative approach concern the low-income housing reconstruction which took place in Dominica and the Dominican Republic after the 1979 hurricanes and which in most cases ignored available low-cost wind-resistant techniques, and the food distribution programmes which took place after the 1976 earthquake in Guatemala and the 1977 cyclone in Tonga and which ignored the long-term effects of the disaster on agricultural production and acted as disincentives for agricultural rehabilitation.

Relevant definitions for development planning in disaster-prone areas

New working definitions of hazards, vulnerability and risk were adopted at the Expert Group Meeting on Natural Disasters and Vulnerability Analysis, held at UNDRO in July 1979. 9/ They are used by the United Nations agencies concerned.

NATURAL HAZARD AND DISASTER

Hazard is the probability of the occurrence, within a specific period of time in a given area, of a potentially damaging natural phenomenon. Natural disasters are extreme phenomena inducing ground, water or air motions which affect a certain area. The magnitude of the phenomenon, the probability of its occurrence and the extent of its impact may vary and can be determined in certain cases.

Disaster is the manifestation of the natural hazard and the total damage resulting from its direct and indirect effects. It includes physical damage to buildings and infrastructure, as well as damage to socio-economic and human-enviornment conditions.

VULNERABILITY AND VULNERABILITY DYNAMIC ANALYSIS

The vulnerability of any physical or socio-economic structural element exposed to a natural hazard is its liability to be destroyed, damaged or lost.

RISK AND RISK ASSESSMENT

The notion of risk can be directly related to the concept of disaster, as it includes the total loss and damage that might be suffered

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9/ See Office of the United Nations Disaster Relief Co-ordinator (UNDRO), Natural Disasters and Vulnerability Analysis, Report of an Expert Group Meeting, 9 - 12 July 1979 (Geneva, 1980).

A conceptual framework for disaster-mitigation planning

DYNAMIC AND INCREMENTAL CHARACTERISTICS OF THE FRAMEWORK

In order to address the problems of planning for human settlements in disaster-prone areas, a flexible conceptual framework is suggested. The framework is a guiding, dynamic tool for understanding the totality of the mitigation planning process. Its partial or total application will necessarily require adaptation to different national and local contexts. It is a vehicle for a common understanding of and co-ordination between its components. The framework serves as a starting point for efforts to assist:

- International, national, regional, sectoral and local organizations in the integration of natural-hazard concerns into spatial social and economic development plans; this integration is possible both at the level of overall development planning and at the level of specific programmes and projects dealing with, for example, construction, transportation, industry and resource development;
- In the assessment of the vulnerability of existing human settlements to the disruption that may be caused by natural hazards;
- In the generation of the information necessary to identify linkages and conflicts between natural hazards and development options;
- In the formulation of policies and guidelines to reduce disaster vulnerability;
- In the implementation of guidelines to reduce disaster vulnerability;
- In the identification of national and local institutional apparatuses and administrative arrangements that are necessary for policy formation, guideline generation and guideline implementation;

In the identification of training, education and public information programmes that facilitate the participation of the concerned communities in the application and maintenance of disaster mitigation programmes.

The conceptual framework, illustrated in the figure below, consists of the following elements:

Information concerning environment, development and disaster, and information analysis;

Disaster-mitigation policy formation;

Disaster-mitigation guidelines;

Disaster-mitigation guidelines implementation;

Institutionalization, integration and co-ordiantion;

Maintenance and control of mitigation systems;

Education and training.

INFORMATION

The purpose of an information system is to identify the information required to integrate natural-hazard considerations into the development planning and management process and vice versa, that is, to identify current and future development activities that may impinge upon vulnerability, to facilitate the identification, collection and retrieval of relevant information, to assist in the process of analyzing issues, identifying conflicts and defining priorities and to help in the process of public and private decision-making.

CHARACTERISTICS OF THE INFORMATION SYSTEM

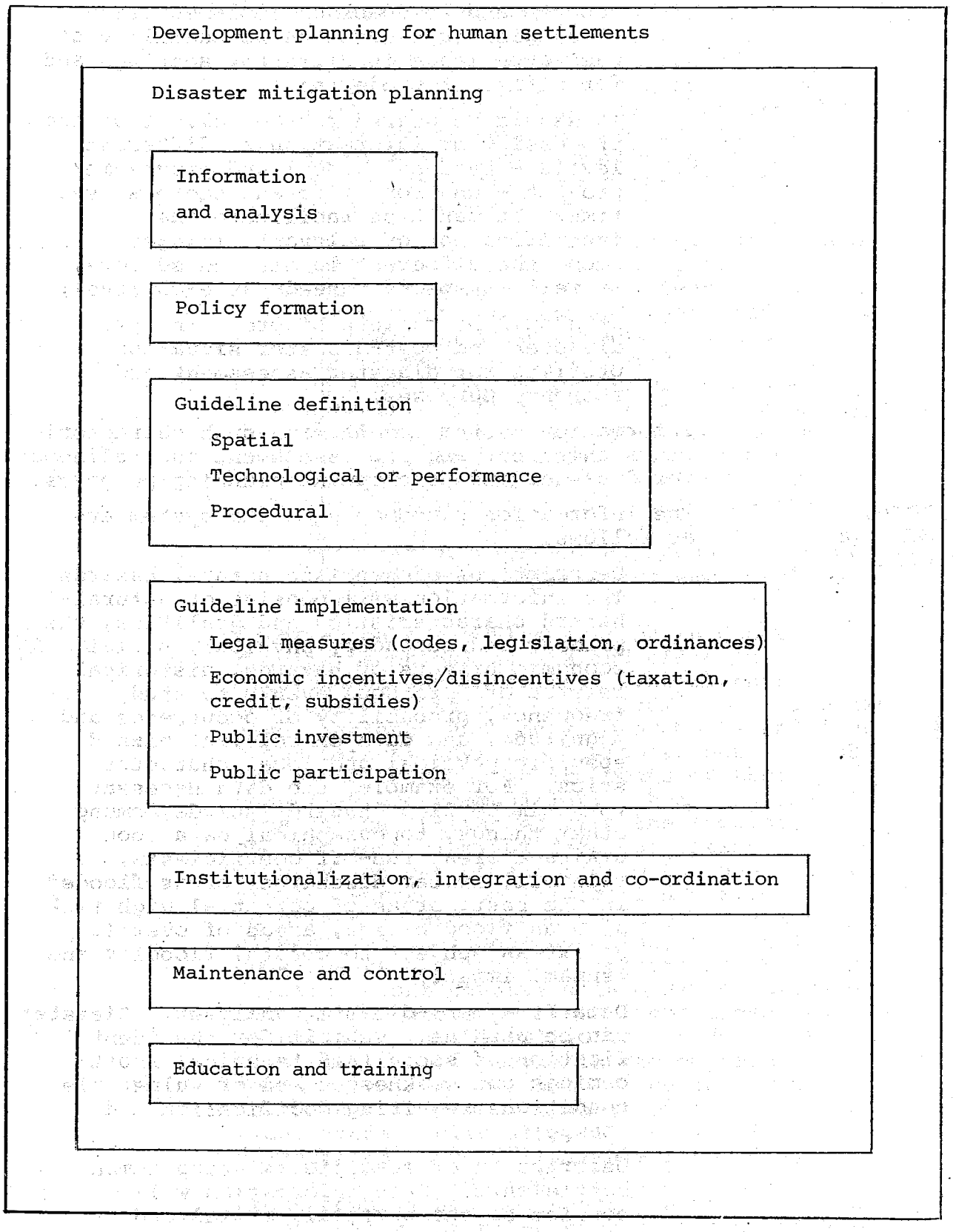
The characteristics of the appropriate information system are as follows:

It should be adapted to the requirements of development planning and management, that is, it should be issue-specific and goal-oriented;

It should be organized in such a way as to facilitate the identification and formulation of specific problems and needs and the analysis of possible approaches to solving the problems within the framework of development goals in an incremental and gradual fashion;

It should be conceived as a dynamic, continuous process so that the information can be constantly updated in order to

Figure 1. Conceptual framework for disaster-mitigation planning



maintain its relevancy. It should allow for the maintenance of a regular flow of critical data, provide an information base allowing planners and decision-makers to intervene in the development process on a regular basis and provide reports and feedback on implementation strategies to ensure the re-usability of past experience in different settings and for different projects;

It should be geared to the collection and processing of information at different levels - national, local and programme/project - and for different sectors over time. It can thus facilitate the identification of relevant linkages among the different levels and sectors, as well as specific needs at each level;

It should be capable of providing pre-disaster and post-disaster situation profiles for disaster assessment and response purposes.

Information system models with such characteristics exist but require assessment and refinement for disaster and development planning purposes.

INFORMATION COMPONENTS OF THE SYSTEM

The information components of the system are as follows:

Descriptions of specific natural hazards. The information will consist of natural-hazard characteristics and qualities, the primary and secondary physical, social and economic effects of hazards, historical records of hazardous events to study frequency, probability of occurrence and magnitude, and data on relevant hazard-specific physical and local characteristics. For example, the data necessary to estimate flood hazard include, among other things, topographical data about drainage area, run-off coefficients, rainfall, stream discharge, areas flooded in the past, areas of potential high risk such as flood plains, areas of overflow and areas subject to coastal flooding and tsunami impact;

Data from post-disaster analyses. Disaster can be used as a vehicle for the identification of social and technical shortcomings and weaknesses and of vulnerable conditions requiring modification and change;

Description of specific existing human settlements. This information will consist of the physical, social and economic factors that characterize the specific human settlement. According to

the particular needs in each case, this information can be collected on a macro-scale, to reflect the physical, spatial and temporal development of a country or of relevant spaces such as urban, rural and natural areas, focal points of activity, networks of interaction and communication, economic activities, resource use and natural environment features, and on a micro-scale, to reflect specific patterns of human settlement at the community level in time and space, morphology of built areas, density, configuration and activity dimensions;

Data on development options. Development options are the physical, social and economic components of a development project or strategy and their individual or combined alternatives. Data on development options should be provided on a macro-scale and/or micro-scale, as appropriate to the level of the planning authority, and they should be adapted from physical, social and economic information and management systems. This information should describe the different options and implications of specific development approaches in terms of their economic, social and physical effects.

INFORMATION SOURCES

Information collection systems in general require technical skills and efficient maintenance and management systems that developing countries often lack. On the other hand, national and local governments and local organizations have considerable knowledge of the socio-economic environments of their countries and communities. Thus, the required data can be abstracted from the regular, ongoing mechanisms of data collection in each country and can be adapted to the needs of the disaster-prevention information system. Co-operative arrangements can be established between international agencies, national Governments and local organizations in disaster-prone countries in order to exchange information about problems, approaches and solutions. In the collection of data, the participation of people in the concerned communities is important, since they can contribute information about social organization, needs, cultural patterns, physical characteristics and available resources. Most of the information that exist in a disaster-prone country has not usually been collected specifically for pre-disaster or post-disaster planning and management, and adaptation

procedures will therefore be required. Post-disaster evaluations can provide valuable lessons for use in other contexts, and case studies may be useful in predicting what kinds of development will increase or decrease vulnerability. A standard format should be developed for case studies, because generalizations about the past can be applied only if experiences can be compared, evaluated and summarized.

FORMATS

The information collected at different levels for national and local development planning and at the programme/project level can be processed and organized into various formats:

- Base maps, indicating existing natural conditions;
- Hazard assessment maps, indicating hazard distribution by type, intensity, frequency and cause;
- Base maps of settlement patterns, indicating the spatial, sectoral and temporal organization and distribution of socio-economic activities. Of special importance in base maps is the identification of the location of dangerous industries (chemical plants, oil-storage plants, gas-storage plants, nuclear facilities) and the location of services and industries that are vital to communities (hospitals, water-treatment plants, utilities, transportation and communication networks and focal points of activities);
- Development maps, identifying specific development options in time and space at different levels (patterns of human settlements, types of economic activities, resource use and physical environmental development planned for the future);
- Matrix analyses, to be used in conjuction with these maps. Various analytical techniques such as economic input/output analysis and environmental impact matrices can be sued;
- Historical analysis, illustrating how past activities have resulted over time in the creation of vulnerable conditions. For example, the induced movement of communities into marginal and exposed locations reduces their subsistence capacity and self-reliance, thereby increasing their vulnerability to the effects and after-effects of disaster.

ANALYSIS TOOLS AND PURPOSES

The overlay of hazard-assessment maps on the one hand and of existing human settlement patterns

and development options on the other allows the specification of two-way constraints and conflicts resulting from the interactions between a natural system (hazards) and socio-economic/spatial development.

DISASTER-MITIGATION STRATEGIES

DISASTER-MITIGATION OPERATIONAL GUIDELINES

Disaster-mitigation guidelines 10/ are those which actualize policy in a specific country or locale, and they are thus the action-oriented components of the mitigation policy framework. To be applicable, guidelines have to be specific and adapted to the particular socio-economic context and local condition in each country and to the specific natural hazard prevalent. However, operational guidelines can be suggested by international agencies to provide a general framework that can subsequently be adapted to problems specific to each country and to individual locales.

There are three broad categories of disaster-mitigation guidelines. First, there are spatial guidelines which, as a function of natural-hazard potential, specify the location of different socio-economic activities at the macro-level (zonal planning) and in greater detail at the micro-level (land-use planning). The definition of guidelines to prevent or mitigate disasters requires information about the incompatibilities and constraints between natural hazards and development. For example, development in flood-plain areas contributes to flood hazards. When land is built up, changes are introduced in the soil structure and in the drainage and run-off patterns. Development in fact modifies natural soil infiltration and drainage, thus contributing to flooding in the same way as unregulated agricultural practices do. One way of managing the total run-off is to locate open spaces strategically so that they can collect and store water. In this way, the location of agricultural land, parks, recreational areas and other open spaces may help reduce the potential for natural disasters. In a multi-hazard context, the same strategy is beneficail for earthquake hazard reduction. On the basis of this information, guidelines can be derived indicating which activities should be permitted, and such guidelines can be incorporated in the overall development plan.

Secondly, there are technological or performance guidelines that define the quality

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10/ For a broad discussion of operational guidelines on disaster mitigation, refer to UNDRO monographs on disaster prevention and mitigation, vols. 1-6.

of the built environment in terms of quality of construction, the type of materials that can be used, the quality of workmanship required, etc., in order to reduce the potential damaging effects of disasters. Standards for the structural resistance of buildings, directly correlated with the levels of risk identified and with the guidelines for land use, control building design and methods, as well as materails of construction. For instance, special building standards to limit flood damage can provide for elevation on piles or stilts, construction with water-resistant materials, the provision of bulkheads close to low-level entrances and the provision of refuge rooms with access from lower levels of buildings.

Thirdly, guidelines can be formulated in respect of the analysis procedures that proposed programmes and projects must undergo. These guidelines must specify the types and magnitudes of activities requiring analysis, the procedures to be used, the responsible parties, where the cost is borne, the nature and procedures for a final determination and the ways in which supervision and enforcement are to be carried out.

Guidelines have to be realistic, suited to existing capabilities and resources and, in general, consistent with the socio-economic conditions in an area. To be effective, guidelines have to be enforceable and therefore compatible with administrative mechanisms, development programmes and institutions. In addition, they must be compatible with the cultural norms of the society in which they are implemented, realistic, responsive to the requirements of different social groups, economically feasible, adapted to financial and resource constraints and appropriate to local technologies. Finally, guidelines must not be tools of prohibition only but must guide activity by facilitating desirable courses of action. The formulation and implementation of guidelines should be a dynamic process in which changes are made in response to problems that arise or are perceived during implementation. Thus, they require a mechanism for continuous feedback and evaluation of their performance.

DISASTER-MITIGATION GUIDELINE IMPLEMENTATION

The role of national Governments, in concert with provincial and local governments, is of critical importance in the implementation of disaster-mitigation guidelines. The methods that government bodies can use in order to implement guidelines are as follows:

Legal measures (codes, legislation, ordinances, etc.);

Economic incentives/disincentives (taxation, credit, subsidies, etc.);

Public investments to effect desired development patterns (infrastructure and services such as roads, fire protection and land acquisition);

Education and training.

Legal measures. Legal controls to influence land use and development, building codes to regulate construction activities and ordinances to regulate the behaviour of the public have been widely used in recent years, especially in developed countries. In many cases, regulations and codes have been transferred from developed countries to the developing countries, with the result that their implementation has proved socially, economically and technologically impracticable. 11/ Exclusive reliance on regulatory mechanisms is not adequate in developing countries and will not serve the goals of a disaster-mitigation policy. In many developing countries, although the legal mechanisms are in place, enforcement mechanisms are lacking. Thus, in addition to restrictive measures such as legislation, codes and ordinances, other approaches that are of a facilitating nature and adapted to indigenous societal constraints are required.

Economic incentives/disincentives. Fiscal and financial incentives, a useful tool for disaster mitigation, can be formulated to discourage development in disaster-prone locations and to promote development in desired sites. Taxation can be used to penalize development in high-risk areas. As an implementation instrument in developing countries, taxation is currently relevant to the traditional sectors of the economy only, since the marginal sectors are largely outside the tax system. Economic incentives can be provided in the form of subsidies, grants or low-interest loans for specific types of buildings and activities and for specific locations. Insurance schemes for fires and floods are mechanisms now primarily used in the developed countries to encourage the public to adhere to zoning regulations and building codes specifically designed for disaster prevention. In developing countries, these systems do not generally exist because the capital resources necessary to create insurance funds are lacking

11/ For example, in the reconstruction of Managua after the 1972 earthquake, the construction codes adopted were based on the California construction codes and resulted in economic and social inapplicability.

and because much activity takes place outside formal development structures. Modified systems of taxation and insurance could become components of a disaster-mitigation strategy integrated with development planning.

Public investment. This can be a powerful instrument of public intervention to guide rational development and to facilitate and stimulate needed development activities. It can provide a balance between public intervention and private-sector activities. Public investment as an implementation measure for disaster mitigation should be designed to give direction to development and should be congruent with the framework of long-range, cross-sectoral and spatial strategies. Public investment strategies may consist of the direct purchase of land to create land banks, to provide a ready supply of land for development or to be permanently withheld from development. Another form of public investment strategy is the provision of infrastructure for direct growth away from hazardous land in areas planned for development or the preservation of natural resources to protect the ecological balance of an area. The extent to which public investment can be used as a disaster-mitigation implementation mechanism is subject to the economic and administrative conditions in each country and the availability of resources for investment.

Education and training. In many disaster-prone areas, substantial sections of the population that are vulnerable may not be reached by these formal disaster-mitigation guideline implementation mechanisms. Programmes of education and training can provide an alternative mechanism for reaching marginal groups, increasing their awareness of natural-hazard vulnerability and incorporating them into the process of disaster mitigation and prevention. Training could, for example, provide guidance concerning minimum standards for construction and familiarize the population with simple and inexpensive methods to strengthen the resistance of houses to natural calamities. Research has shown that the resistance of timber houses to hurricanes can be greatly increased by the use of inexpensive bracing and by increasing the depth to which piles are pushed into the ground. Adoption of appropriate roof slant and metal attachement to the structure can reduce the incidence of roof blow-out during high-wind situations. Training can also increase people's awareness of the necessity to avoid vulnerable locations, to adopt appropriate building design and layouts, and to co-operate with the efforts being undertaken by national and regional authorities in the field of disaster prevention and mitigation. Education and training can help

improve the efficiency of some of the other implementation mechanisms mentioned above. For example, training concerning the vulnerability of certain locations for siting housing, coupled with a programme of public investment in infrastructure and services in areas that are risk-free, can guide the process of human settlements development in a manner that promotes improved disaster mitigation.

INSTITUTIONALIZATION, INTEGRATION, AND CO-ORINDATION

The generation of information, policies and guidelines and the implementation of guidelines to mitigate disasters are a function of the institutional structure and capabilities in each country and locale. National and local development plans and area-specific projects usually involve a complex set of public agencies at various administrative levels and private-sector actors. The inclusion of mitigation and prevention considerations in the development planning and management process required adequate support and co-ordination among jurisdictions and sectors. 12/

A division of responsibilities among agencies at different levels, a lack of co-ordination among sectors and a lack of communication among decison-makers at each level and in the private sector can hamper the development process. In many cases, the institutional framework for disaster mitigation and prevention is either completely lacking or is located within the civil defense system only and is therefore limited to immediate post-disaster response. Integration throughout the disaster stages and effective prevention and mitigation efforts require a comprehensive and co-ordinated approach that presupposes both an overall national development strategy and individual strategies at local levels. Support of local-level institutions and organizations facilitates self-reliance and integrates the different planning levels into the overall process.

If the institutional framework is lacking, it should be built up in an incremental fashion as a disaster-mitigation function of development and administration. This co-ordinating function would include the identification of cross-sectoral, area-wide and long-range

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12/ In Japan, where disaster countermeasures are taken by different ministries, the national Government co-ordinates their activities in a comprehensive fahsion; from this point of view, the National land Agency, as the Secretariat of the Central Disaster Prevention Council, plays the role of co-ordinator of disaster countermeasures.

development and mitigation concerns, the establishment of policies, the provision of assistance to sectoral agencies in developing responsive programme proposals and the provision of assistance in co-ordinating sectoral programmes during the budget review process. This co-ordination function can be performed, for example, by an interministerial commission or special unti responsible to the head of Government and institutionally integrated through a participatory framework aimed at co-ordinating local and national strategies. The first steps for creating such a forum can be taken in connection with the establishment of an information system that reaches across space, sectors and time.

The mechanisms of institutionalization at all levels can serve as focal points for the initiation and co-ordination of the services necessary at every pre-disaster and post-disaster stage. These focal points can be integrated with the state, provincial and local government systems.

MAINTENANCE AND CONTROL OF MITIGATION SYSTEMS

The maintenance and control of mitigation systems are essential to ensure their functional capability and improvement through time. Effective maintenance and control can be implemented through public participation in the decision-making process of the system and through its financial benefits and consequences. The former method entails public information and awareness campaigns, the latter implies the realization by the public of the costs and benefits of the system. Maintenance and control systems have to be implemented both at the national and local levels, stressing the importance of inputs by individuals to the system.

EDUCATION COMMUNCIATION AND TRAINING

Disaster mitigation is likely to be successful only if efforts are an integral part of everyday life, not something unusual or extraneous to normal activities. Adjustments in what is perceived as normal may permit the more successful implementation of mitigation strategies than the introduction of radically innovative measures. Appropriate education on disaster-mitigation systems is an essential way of advancing the threshold of the normal.

A programme of education and training can serve as a means of conveying information and sharing responsibility concerning a potential disaster event. A well-designed education and training programme can constitute a key vehicle for the incremental introduction and upgrading of the necessary information, policy formation, guideline formulation, guideline implementation, integrated institutionalization mechanisms and maintenance and control systems.

Three essential and overlapping types of education and training activities need to be considered:

Public information, concerning available programmes, known hazards, emergency procedures, sources of information and individual responsibilities;

School training, involving the inclusion of disaster-mitigation topics in curricula at the primary, junior, secondary and tertiary levels of education, including vocational training;

Awareness training, concerning the specific allocation of responsibilities for programmes, procedures and sources of information among public officials and selected private-sector groups such as developers, industrialists and those who build and renovate their own homes;

Technical training, concerning methods of data collection, analysis, design, construction, planning, management, administration and so on for those with direct public and private responsibilities in the field of development and disaster mitigation.

A continuing programme of education and training should be designed as an integral part of the phased introduction and upgrading of development and disaster-mitigation planning and management activity. Experience has shown that those development programmes that work best are based on experience and learning, so that the participants in the process expand their appreciation of problems and potential solutions, increase their knowledge and skills and broaden the scope of their concerns incrementally, dynamically and organically. The education and training function should be seen as essential to, and indeed the focal point of, efforts to enhance the effectiveness of disaster prevention, mitigation and recovery activity within the context of the development of human settlements at all levels.

The organization and use of communications media such as radio are critical for the diffusion of information and the conveying of warnings concerning impending disasters, especially in areas that are not served by other communication systems such as telephones or where these systems are likely to be disconnected. 13/

13/ For a detailed discussion of the importance of communications media in disasters, see Disasters and the Mass Media (Washington D.C., National Academy of Sciences, 1980).

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