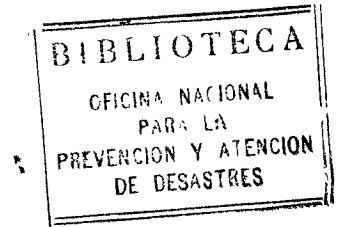
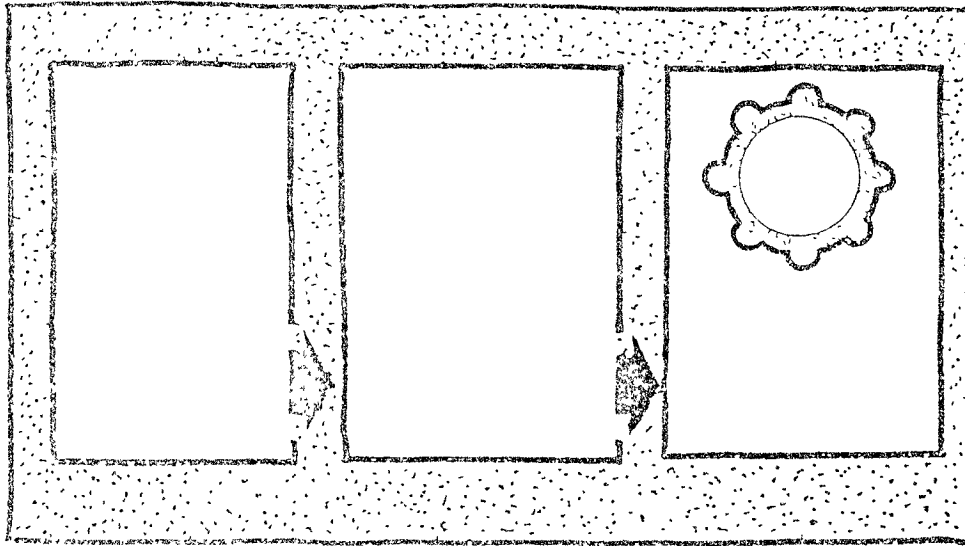


MANUAL FOR THE IMPLEMENTATION OF DISASTER MITIGATION



EXECUTIVE SUMMARY



Prepared for the Office of the United Nations Disaster Relief Co-ordinator (UNDRO)

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U.N.D.R.O. DISASTER MITIGATION MANUAL
EXECUTIVE SUMMARY

1. INTRODUCTION; AIMS, OBJECTIVES AND POLICY
FRAMEWORK OF THE
DISASTER MITIGATION MANUAL

AIMS AND OBJECTIVES

This Executive Summary is an introduction to the UNDRO Disaster Mitigation Manual. This Summary emphasises policy guidelines, while the full Manual contains technical details, data and case studies.

Both this Executive Summary and the full Manual are important. Both should be adopted by governments to assist their disaster mitigation activities. This will reduce the over-reliance on disaster relief, which is the inevitable consequence of inadequate resources, poor planning and lack of foresight.

The objectives of this Executive Summary, and the full Manual, are to disseminate the experience of disaster mitigation that has been gained from a number of projects over several years in many countries. In this way the risks from natural disasters will be reduced, and vulnerable communities will be protected.

The aims of the Disaster Mitigation Manual, as introduced here, are four-fold:

- * To stimulate awareness amongst national and regional planners to include disaster mitigation and related preparedness aspects into their overall land use planning proposals;
- * To help those senior planning officers to understand the nature and extent of the various risks faced by communities and settlements, including the effects of natural disasters on industry, commerce, and agriculture;
- * To demonstrate ways and means to reduce those risks, within the limits of the national socio-economic and socio-cultural context, through proper decision-making and planning;
- * To introduce various measures to implement disaster mitigation plans at the different levels, based on risk assessment results and proper decision-making.

The focus of the Manual particularly includes disaster mitigation planning for the poor, who are most affected by natural disasters but

who are often forced by their economic circumstances to settle on disaster and hazard prone land.

Two aspects of disaster vulnerability are addressed. First, there is the physical vulnerability of communities and nations, in the form of the impact of disasters on buildings and infrastructure. Secondly, there is the vulnerability of people who do not have the resources to protect themselves or to recover from disasters, owing to their low income or poor access to credit. The emphasis here, and in the full Manual, is on the first of these two, but they are interconnected and the second cannot be ignored.

The audience for this Executive Summary is the senior planning officers of government who are responsible for disaster mitigation and other related government policy areas. The audience for the full Disaster Mitigation Manual is the technical and planning personnel within the same and other organisations, who are responsible for preparing and implementing disaster mitigation work.

THE POLICY FRAMEWORK

Effective disaster mitigation does not just happen. It is created.

Moreover, it is created by hard work within government and non-government organisations, by striving to reduce the risks from disasters and the vulnerability of their communities and settlements.

The policy framework with which this occurs has three aspects:

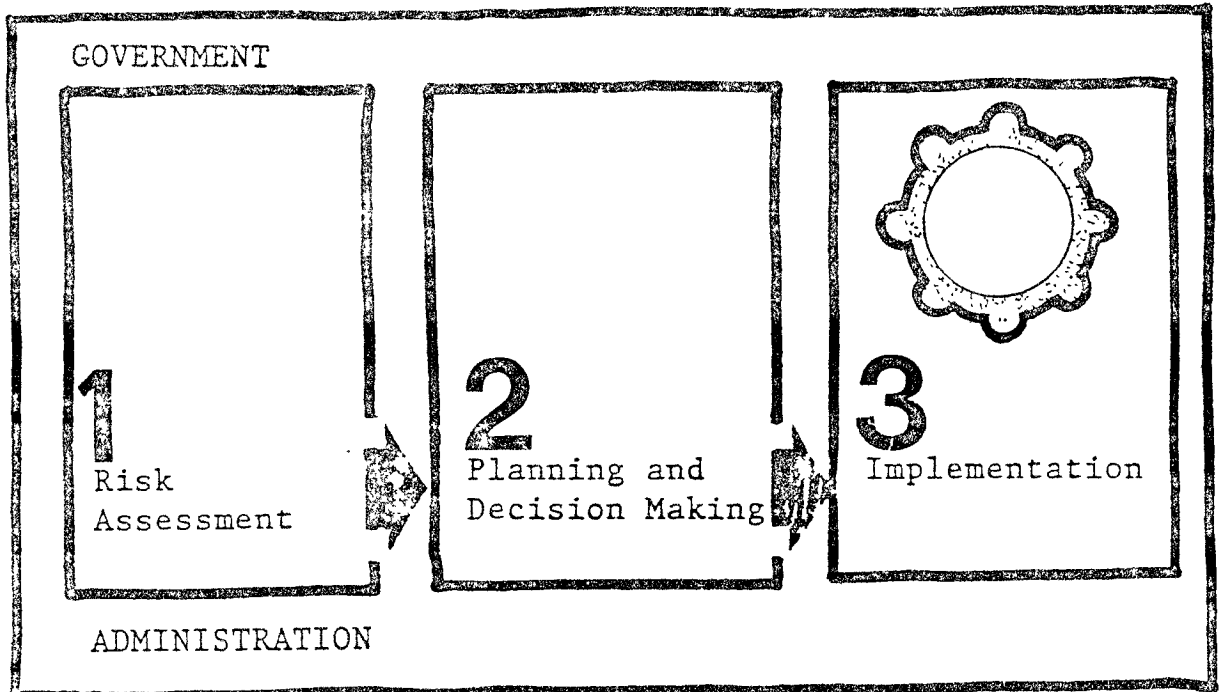
- * **risk assessment:** defining the disaster and hazard problems to be faced;
- * **planning and decision-making:** organising a response to these risks;
- * **implementation:** translating plans and decisions into action 'on the ground'.

But these three important activities cannot operate in a vacuum. The context, or fourth aspect of the policy framework, is the **government administration, which provides opportunities, and constraints, for disaster mitigation planning.**

This policy framework is represented by the diagram in Figure 1.1. Many policy guidelines arise from this framework, and these are summarised in Table 1.1. In turn, these policy guidelines are elaborated in later sections of this Executive Summary and in the full Manual. Both the policy framework and the policy guidelines stress that the three phases of effective disaster mitigation planning lie within the sphere of government administration, which affects the efficiency and nature of all other activities.

Figure 1.1

Policy framework diagram
summarising the context and the
phases of effective disaster mitigation



Policy Guidelines

Table 1.1

Policy Guidelines for disaster mitigation

GOVERNMENT ADMINISTRATION FOR RISK REDUCTION

- * Disaster occurrence is a dynamic and uncertain process.

Therefore, the government institutional framework for disaster management should exhibit potential for change and growth as knowledge of disaster management grows, competence improves, and provincial and local communities develop self-reliance;

- * Almost everyone, every agency, every voluntary group, industry, government department has some measure they can contribute to risk reduction practice.

Therefore, through its institutional arrangements, the essential task of government is to recognise this potential, respond to initiatives, allocate responsibilities, and coordinate effort where this is necessary. It is also important for governments to provide a lead, and give examples of disaster mitigation practice in all that they do;

- * Disaster mitigation is wide ranging in scope, and complex in its relationships with government ministries and agencies.

Therefore, for effective disaster preparedness planning and risk reduction, a clear allocation of roles and responsibilities is essential. Such task definition is needed between central, provincial and local government, and between sector agencies, to facilitate the necessary cooperation, coordination and efficient use of scarce resources.

RISK ASSESSMENT

- * National governments need to develop their risk assessment capability

Therefore, it is necessary to set up research and development organisations, where these are not already established, to undertake all the necessary stages in risk assessment.

- * Data is necessary on hazard and disaster occurrence.

Therefore, collect information in a systematic manner on the frequency, magnitude and location of the relevant hazards.

Table 1.1 (Policy Guidelines) continued

- * Data is also necessary on vulnerability.

Therefore, collect information in a systematic manner on the vulnerability of communities, buildings and economic activities to the effects of natural hazards and disasters.

- * Prediction of future hazards and disasters is a key to effective mitigation planning.

Therefore, develop the predictive abilities of the research and development organisations responsible for risk assessment.

- * Risk assessment should not be undertaken in isolation from planning and decision-making.

Therefore, establish, maintain and develop links between the geo-scientists working in risk assessment organisations and the land use planning and other organisations, so that the results of risk assessment programmes can be useful and used.

PLANNING AND DECISION-MAKING

- * Efficient allocation of resources. Expenditure on disaster mitigation means that other uses of the scarce resources cannot be made: the opportunity for other expenditure must be forgone. The economic health of the country in question is affected by decisions concerning disaster mitigation.

Therefore, the efficiency of expenditure on disaster mitigation must be maximised, and the resources allocated to disaster mitigation should be valued at their 'opportunity cost' (the value to society of the next best alternative use of those resources).

- * Comprehensive planning and decision-making. Decision-making for disaster mitigation can easily be dominated by short-term considerations, especially immediately after a disaster or the threat of a disaster which will create a 'window of opportunity'. However, policies, plans and projects developed in this way without due care are liable to be ineffective or inefficient, and to have unintended consequences.

Therefore, decision-making for disaster mitigation should be as comprehensive as possible, and review a range of alternative strategies against clear criteria (such as economic efficiency, or social equity) so that objectives are met and the performance is evaluated to ensure the spread and continuation of best practices.

Table 1.1 (Policy Guidelines) continued

- * Planning and decision making is a continuous process. It is not something that is only undertaken occasionally, when it appears necessary, or by particular agencies which have 'planning' in their titles. Disaster mitigation planning should occur in virtually all agencies, all of the time, at a level proportionate to the risks being faced.

Therefore, adoption of more systematic approaches can be initiated at any stage and not just with the definition of a new problem or the occurrence of a disaster: it is not wise to wait until everything is in place before beginning the disaster mitigation planning process.

IMPLEMENTATION

- * The major opportunity to develop and/or implement measures will occur in the wake of a major disaster. This is due to the temporary high profile of disaster preventive action, which should be taken advantage of to secure resources and decisions.

Therefore, plans should be developed and where there are political or other obstacles to their implementation they should be maintained in readiness for implementation at the appropriate time, such as when a disaster provides the necessary opportunity for swift action.

- * Experience indicates that the poor are most at risk from disasters.

Therefore, priority is necessary for appropriate measures to protect the the poor and their property. Such measures will include economic inputs and community level programmes.

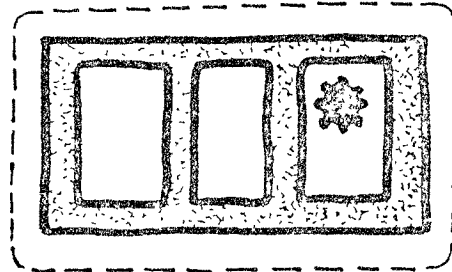
- * A balanced implementation strategy includes 'fail safe' measures which can be used if other measures are not acceptable or are not efficient.

Therefore, it is advisable not to confine mitigation to a single measure, such as laws. Implementing hazard mitigation planning is strongest when there is an interrelated strategy of many parallel approaches.

2. GOVERNMENT ADMINISTRATION FOR RISK REDUCTION

POLICY GUIDELINES FOR INSTITUTIONAL DESIGN

There are three main policy guidelines for the design of institutions and institutional arrangements for hazard and disaster mitigation. Care needs to be taken when adapting existing arrangements to meet these guidelines, so as to fit disaster mitigation functions with other areas of government policy.



- * Disaster occurrence is a dynamic and uncertain process.

Therefore, the government institutional framework for disaster management should exhibit potential for change and growth as knowledge of disaster management grows, competence improves, and provincial and local communities develop self-reliance;

- * Almost everyone, every agency, every voluntary group, industry, government department has some measure they can contribute to risk reduction practice.

Therefore, through its institutional arrangements, the essential task of government is to recognise this potential, respond to initiatives, allocate responsibilities, and coordinate effort where this is necessary. It is also important for governments to provide a lead, and give examples of disaster mitigation practice in all that they do;

- * Disaster mitigation is wide ranging in scope, and complex in its relationships with government ministries and agencies.

Therefore, for effective disaster preparedness planning and risk reduction, a clear allocation of roles and responsibilities is essential. Such task definition is needed between central, provincial and local government, and between sector agencies, to facilitate the necessary cooperation, coordination and efficient use of scarce resources.

However, each country operates in a different economic and political environment, which affects all that its government does. The international political situation may also be crucial, as will be the state of the national economy of the disaster-prone country.

Plans for disaster mitigation therefore have to be realistic, and be designed to operate within the current political and economic situation, rather than against it:

INITIATION

There is no one perfect way to begin. There have been many points of departure. Risk reduction measures against natural hazards may have been routinely practised by public works engineers and river basin authorities. Local communities may practise measures to lessen risk of loss of homes. However, none of this may be happening.

But disaster strikes. A government emergency response is made. It is recognised as being less than effective. There is a call to ensure a more efficient response, for efforts to be made to reduce the risks. Government thus decides to intervene in national life to achieve risk reduction and to ensure disaster preparedness.

Interventions by government in disaster management activities can be thought of as constituting a disaster 'cycle' (as shown in Figure 2.1).

This cycle is followed by another of rehabilitation, reconstruction and of improved preparedness and relief organisation. In this second cycle opportunities arise to apply carefully thought-out risk reducing or mitigating measures.

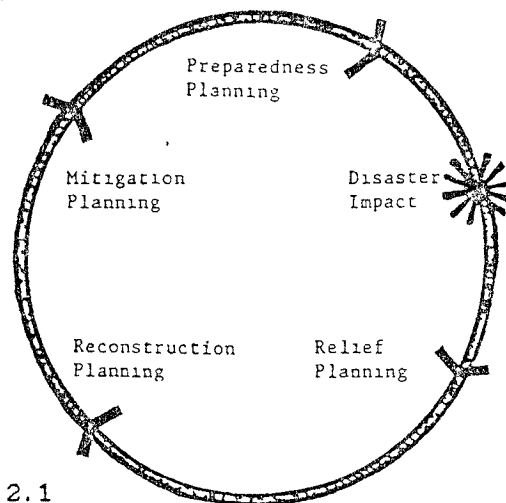


Figure 2.1

Preparedness and risk reduction - or mitigation - can be thought of as being two sides of the same coin. To the extent that mitigation is not practised, so preparedness needs to increase in scale. Humanitarian issues dominate the relief phase and penetrate that of preparedness. Economic issues tend to dominate mitigation procedures and practice. The role of government is always central, however, and its administration must reflect this role.

PATTERNS OF ADMINISTRATION

Once decided on a national response to natural hazards and disasters a Government will generally establish a small Task Force (or 'limited time period committee') to define an organisation and propose its terms of reference. Establishing this task force requires political will and resources.

The terms of reference for the task force or committee's own work may have been given only in outline. An early assignment will be to develop its own terms of reference in an expanded form in order to brief itself and its advisers (see the example in Table 2.1).

The task force and its advisers will be most effective if they are asked to prepare their recommendations to fit within the existing pattern of

Table 2.1

Suggested Terms of Reference
for a National Hazard Mitigation Task Force

- * reviewing existing data relating to national hazards and disasters;
- * recommending an organisational framework that can ensure effective use of existing and supplemented resources so as to respond to the risks;
- * assessing the role and functions of any separate government organisation set up to carry through risk reduction, preparedness and relief actions;
- * recognising the recurrent, maintenance and new project responsibilities of government departments, so as to assess the need for additional resources to review how mitigation of the risks might be approached strategically;
- * drafting the content for a Law/Ordinance (should one not exist);
- * establishing the role and duties of individuals and organisations in a counter disaster framework;
- * devising a time schedule, in draft, of the implementation periods for acting on the recommendations made;
- * advising on the role for non-government organisations
- * advising on any further assistance that may be required to act on the recommendations if they are accepted by government.

(Note: this Executive Summary and the associated
Manual does not address itself to the
planning of disaster relief measures)

government administration. Four basic forms of national organisation offer different opportunities and constraints (see Figure 2.2):

Figure 2.2. Models of government administration for risk reduction → SEE NEXT PAGE [10A]

- * In Model 1, above, the organisation/directorate is embodied in the Chief Minister's Office and includes high level representation from Ministries and their executive departments;

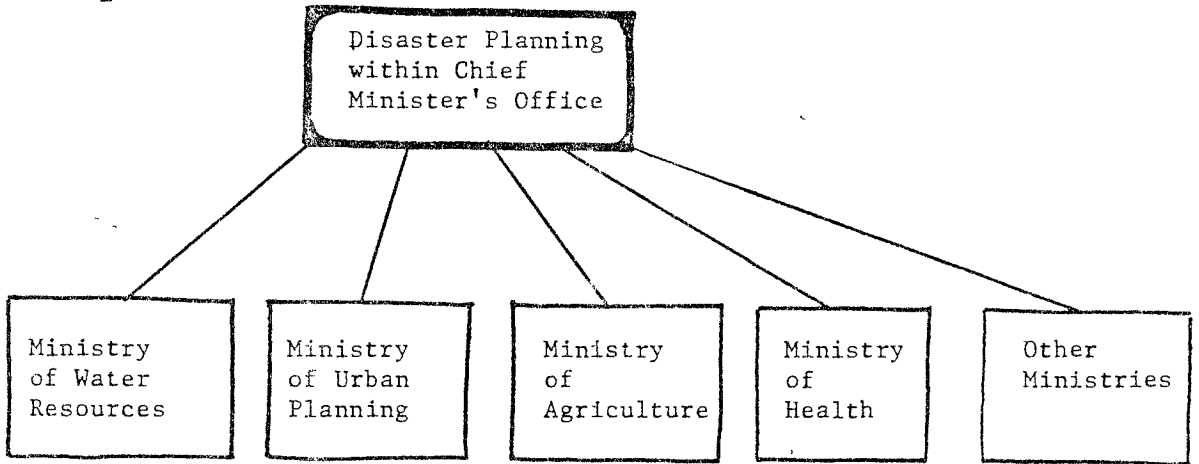
This model is successful if the Chief Minister gives full support to disaster mitigation. However, if this commitment is not sustained, then this model will not operate satisfactorily.

- * In Model 2 the organisation/directorate is itself made a Ministry (possibly incorporating Reconstruction and Rehabilitation as parallel ministerial tasks);

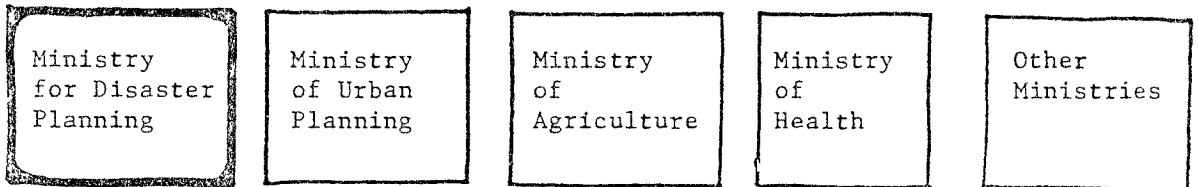
This model gives clear identity to disaster mitigation, but takes away important disaster mitigation responsibilities from other key Ministries and agencies.

- * In Model 3 each Ministry or its executive department has a Disaster Preparedness and Mitigation Unit which has a representative on a co-

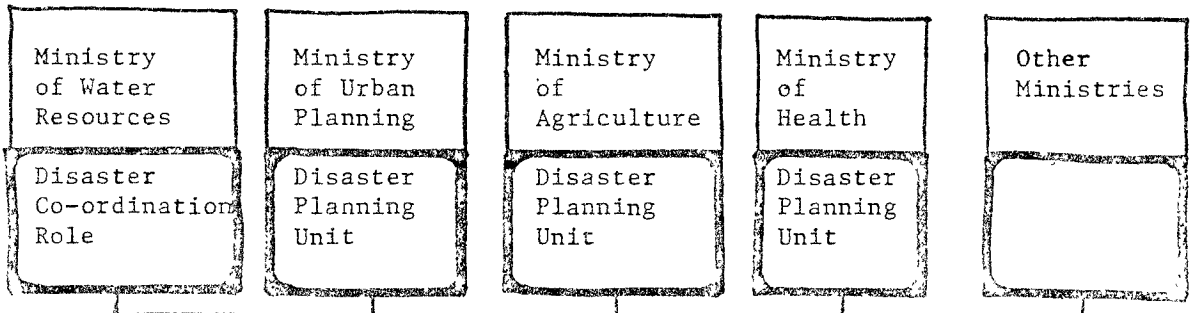
Model 1



Model 2



Model 3



Model 4

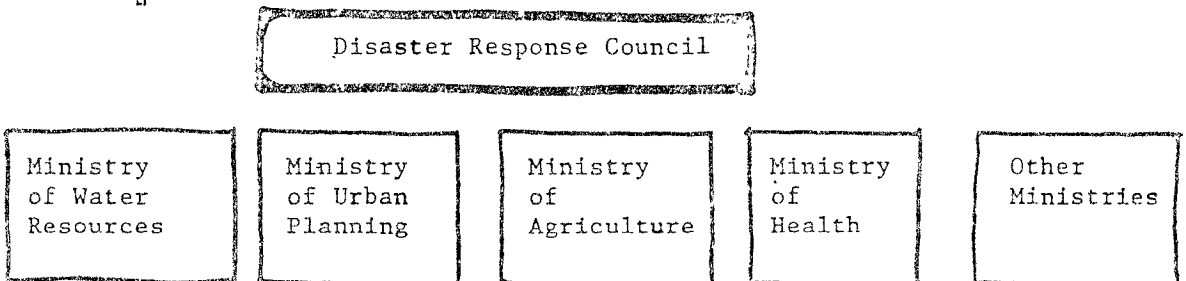


Figure 2.3 Models of government administration

ordinating committee which is managed by one of the Ministries (e.g. Ministry of Social Welfare, or Housing and Local Government);

This can perpetuate unsatisfactory competition between Ministries and result in 'buck passing'. However it does ensure that all responsible agencies are involved.

- * In Model 4 disaster mitigation is the responsibility of a semi-autonomous body. A Disaster Response Council or a Counter-Disaster Assistance Organisation is established, reporting infrequently to the Chief Minister (although perhaps only through the Annual Report process);

This model can result in mere tokenism, although a separate 'think tank' for disaster mitigation can be useful.

Two variants of these include:

- * Any of the above but with Emergency Services, Search and Rescue and Relief Organisation operating almost completely independently of the National Disaster Management Organisation - which is responsible for overseeing the disaster cycle as a whole;
- * Any of the above but with representation on government committees of private industry, commerce and voluntary agencies.

Government precedent in administration will influence the choice between these six possible systems. Some general criteria apply, however, if effectiveness is to result:

1. The expression of political will needs embodiment at the highest possible level. This is essential, since both preparedness and risk reduction practises are 'horizontal' activities and cut across the 'vertical' responsibilities of sector ministries.
2. The National Disaster Organisation should have a permanent staff. This need not be large.
3. Using its legal standing the Organisation has leading and co-ordinating functions throughout all government departments on the subjects defined in its operating terms of reference.
4. On the whole the Organisation should rely upon the existing government structure. For this to be effective, the Organisation has to obtain and maintain the commitment and support of departments and authorities having access to resources and expertise.
5. Any national level Organisation should have an internal administration that reflects both its terms of reference and the political will and need for continuity of leadership and direction.

This leadership, guidance and direction can only be effective if the representation of interested parties is complete. In addition to senior representation from Ministries and Departments, authorities having a specific geographic responsibility have significant interest and resource contributions to offer (e.g. urban development bodies, irrigation projects and river authorities). Universities, Engineering Institutes, voluntary agencies all can offer contributions in planning and implementation.

OBJECTIVES OF THE NATIONAL DISASTER ASSISTANCE ORGANISATION

When the Task Force has reported, the Government may then respond and set up a more permanent body to develop the recommendations or express the will embodied in a Disaster Management Act.

The work of this more permanent National Disaster Organisation is directed towards co-operating with other organisations and communities to achieve greater local self-reliance in responding to the risks from natural hazards. The National Disaster Organisation thereafter organises its programme of activities to reflect these aims and means, as suggested in Table 2.2.

As the co-ordinator of national counter-disaster operations the Organisation allocates by delegation the necessary responsibilities to other agencies and departments. In this respect hazard and risk reduction studies are primarily a task of regional and international liaison and interpretation. However the Organisation needs to identify measures designed to prevent the effects of natural phenomena resulting in major disasters.

Detailed execution of the measures are then the responsibilities of designated departments, as are preparedness and relief measures designed to achieve rapid effective response in face of natural hazard. This includes short term rehabilitation, which involves immediately executable programmes often to be carried out through voluntary agencies within one month of the declaration of a provincial or national disaster. These measures should be so designed as to not pre-empt more widely based medium and long term mitigation rehabilitation and construction.

RISK REDUCTION IN THE NATIONAL DISASTER MANAGEMENT PLAN

It is impracticable and undesirable to attempt to concentrate all arrangements for disaster management in the National Disaster Organisation, because many mitigation measures are local in origin and routine in nature. The concept of disaster management is, therefore, based upon the following specific policy guidelines:

- * The encouragement and support of local self-reliance in the face of disasters, and of local accountability for performance under emergency conditions.

Table 2.2

Programming responsibilities
of a National Disaster Organisation

- * monitoring and evaluating the execution of functions designated under the Disaster Management Act 198xx
- * establishing liaison with agencies and persons pursuing hazard and risk reduction studies and the commissioning such studies;
- * preparing a National Disaster Management Plan;
- * ensuring that disaster prevention and mitigation measures are reviewed by appropriate agencies, when development projects are at a feasibility stage;
- * ensuring that disaster mitigation procedures are followed within responsible agencies and by the private sector;
- * the promotion of community self-reliance and accountability in disasters;
- * ensuring national preparedness;
- * the identification of, and the setting of, performance levels in relief work;
- * the possible stock-piling of emergency supplies;
- * establishing and maintaining effective liaison with Provincial and Metropolitan disaster organisations;
- * undertaking public awareness campaigns and assisting other organisations to do so;
- * organising and encouraging training programmes for teams and for key persons;
- * evaluating applications for disaster assistance preparedness and mitigation funding (through a sub-committee);
- * superintending the activities of the National Emergency and Co-ordination Centre (if this is a separate body);
- * other programmes as may arise or be delegated to the Organisation.

(Note: this Executive Summary and the associated Manual does not address itself to the planning of disaster relief measures)

-
- * the allocation of responsibilities for the detailed planning and execution of relief operations in the provinces and metropolitan areas to their respective governments.
 - * The defining of the National Disaster Organisation function as ensuring that Provincial, Metropolitan and local community plans come into being and to provide co-ordinating functions linked with regional and international level preparedness.
 - * In so far as it is possible, emergency planning should conform to the normal administrative chains of command, where these are responsive to the communities' needs.
 - * To ensure that mitigation and preparedness responsibilities are spread widely; to use available resources effectively through delegation to existing agencies as an extension of their specialist skills.
 - * The National Disaster Management Plan allocates responsibilities so that agencies and departments can contribute to the collective purpose, undertake mitigation strategies in areas of the specific concern, and prepare emergency and contingency plans that can be integrated with others to support local self reliant effort.

In this way mitigation procedures do not constitute a separate programme of government. Rather the attitudes conveyed lead to changed designs and practices in a wide range of existing programmes. The mitigation strategy will form just one of the plans of the national disaster plan portfolio. The objectives will include:

- encouragement of self-reliance
- ensuring that mitigation supports developmental efforts
- ensuring that guidelines to good practise are widely known.

The following also have to be considered:

- * information for plan preparation
- * characteristic knowledge bases
- * formulation of a national risk reduction strategy
- * mitigating measures
- * the risk reduction strategic plan
- * risk reduction in the community
- * mitigation and the economy
- * risk reduction and the development process

THE WORK OF THE DISASTER ORGANISATION

The effectiveness of a Disaster Organisation is highly dependent upon the administrative and technical leadership of its chief officers, together with their ability to maintain a representative committee structure and a coherent decision making framework.

In this respect, it is human for committees to sink rapidly to the lowest level of representation offered by any one of its constituent members. Status is involved. *One does not attend a committee which colleagues of the same level of office in parallel organisations ignore.* Then the Disaster Management Organisation becomes side tracked. Its work perhaps supported by enthusiasts but 'out of sight' of the government administration as a whole.

This must not happen to your committee! The presence and pressure for action by the Chief Minister or Cabinet Minister responsible is a help. It is easier to maintain high level representation if those who have to attend do not have to do so too often. And when they do attend they find the meetings very well structured: pointing to big decisions and with well summarised background papers indicating what decisions would be consistent with the objectives of the task force - to improve preparedness and improve risk reduction - and satisfy wider government economic and developmental objectives.

The use of a separate executive group and a working group to handle or study particular elements of the disaster organisation's work is a key to keeping key meetings clear for major items of decisions. With such a framework of committee and workshop there is a greater possibility of considering issues thoroughly and in an environment suited to coming to decisions. Such choices are not finally a matter for a Disaster Organisation but their mitigation report will form a key element in the justification to government of project design, cost and location.

INSTITUTIONAL AND POLICY APPRAISAL

Evaluating the disaster mitigation effectiveness of government and its administration requires a two-fold approach:

- * appraising existing government policies in all relevant areas
- * appraising existing government practice
- * appraising existing government institutions relevant to disaster mitigation

Government policies. To alleviate disaster-caused problems in a meaningful way governments may have to stop or shift certain other policies which at first sight do not appear to be relevant to disaster mitigation.

Complete policy shifts may be necessary, for example to stop subsidising agricultural developments in disaster-prone areas which encourage people to move there. It may also be necessary to discontinue public building programmes in these areas, since any government development will encourage private development and thus increase vulnerability.

Therefore all related government policy areas need to be reviewed by a National Disaster Organisation, to prevent the build up of vulnerability caused by the unintended effects of government land use, agricultural or indeed any other policies. Implementing any such policy shift may involve, or necessitate, institutional change. This is because the

institutional status-quo may block policy change and thus inhibit comprehensive and meaningful disaster mitigation.

Any planned approach to disaster mitigation by a National Disaster Organisation must also examine all government policies and practices which might be exacerbating vulnerability in the relevant area. Those sectors which need attention in this respect include *at least* the following:

- * agricultural policy
- * building regulations
- * land use planning
- * transportation policy
- * regional development policies
- * social security support services
- * forestry
- * water resources

The questions to be addressed in this policy analysis include the following:

1. Is any aspect of these government policies directly or indirectly contributing to the occupation of disaster-prone areas?
2. Are any government policies or practices directly or indirectly exacerbating the vulnerability of communities occupying disaster-prone areas?
3. What policy shifts are needed to reduce the vulnerability-increasing effects of existing government policies?

These questions should be addressed at a senior government level, with adequate inter-departmental consultations.

Government structures. The institutional structures of those parts of government with responsibilities for disaster mitigation may not be adequately tailored to the types and levels of risk experienced by the country concerned.

Government institutional structures therefore need to be evaluated to determine their efficiency and effectiveness in responding appropriately to reduce risks and vulnerability. Consideration should be given to the appropriateness of the following:

- * institutional policy objectives
- * administrative jurisdiction
- * financial resources
- * enforcement powers
- * administrative flexibility and discretion
- * staff quantity and quality
- * decision making effectiveness

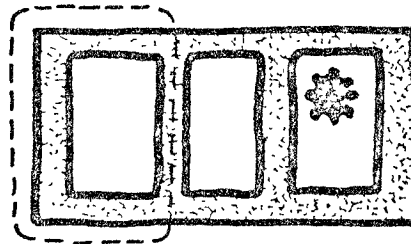
What is important in this analysis is that disaster mitigation in many situations may be more to do with correcting certain existing policy and

institutional imperfections, rather than the investment of new resources in the hope of 'buying' communities out of their vulnerable situations.

3: RISK ASSESSMENT

POLICY GUIDELINES

Five main policy guidelines are important for risk assessment. These will determine the way that risk assessment is approached, the personnel involved, the sequence of data collection programmes, and the links between the risk assessment and settlement planning.



- * National governments need to develop their risk assessment capability.

Therefore, it is necessary to set up research and development organisations, where these are not already established, to undertake all the necessary stages in risk assessment.

- * Data is necessary on hazard and disaster occurrence.

Therefore, collect information in a systematic manner on the frequency, magnitude and location of the relevant hazards.

- * Data is also necessary on vulnerability.

Therefore, collect information in a systematic manner on the vulnerability of communities, buildings and economic activities to the effects of natural hazards and disasters.

- * Prediction of future hazards and disasters is a key to effective mitigation planning.

Therefore, develop the predictive abilities of the research and development organisations responsible for risk assessment.

- * Risk assessment should not be undertaken in isolation from planning and decision-making.

Therefore, establish, maintain and develop links between the geo-scientists working in risk assessment organisations and the land use planning and other organisations, so that the results of risk assessment programmes can be useful and used.

RISK ASSESSMENT CAPABILITY: ESTABLISHING MULTIDISCIPLINARY TASK FORCES

For meaningful risk assessment, specialist multi-disciplinary task force groups are needed, to include geoscientists, engineers, planners, environmentalists, economists and sociologists/anthropologists. These

groups need to identify hazardous land in and around centres of population and to make a detailed analysis of these hazard prone zones.

The task force groups should initially be organised (i.e. for 1 year) on an ad hoc basis, with their own funding, temporary staff and equipment. Full use of maps, aerial photographs, satellite images and statistical data of all settled land should be guaranteed without restriction.

In the medium term these ad hoc task force groups should be converted into more established forms of co-operation between the settlement planning teams, and the organisations responsible for geo-scientific and environmental assessments. The regional administration should play an important role in drafting regionally applicable policy guidelines within a national policy on disaster mitigation.

In the longer term a more regular form of co-operation between planning teams and Institutes responsible for geo-scientific and environmental studies should be institutionalised as a fully integrated section in settlement planning teams.

SEQUENCE OF DATA COLLECTION AND ANALYSIS

There are three basic stages in the sequence of risk assessment:

- * Definition of causes. The causes of hazards and disasters must be established before other data is collected;
- * Assembling the historical record. This data is the baseline for predicting future hazard and disaster events.
- * Predicting future hazards and vulnerability. These predictions are the baseline for planning and decision-making for hazard mitigation.

Following these stages carefully and systematically should result in data useful to those making plans and taking decisions about hazard mitigation.

HAZARD DATA COLLECTION AND DATA MANAGEMENT

The rapid growth of settlements in hazard prone areas calls for careful studies of the environment, terrain configuration, and sub-soil conditions, particularly in the sub-urban zones.

It is therefore essential, to indicate clearly with which variables to describe the different aspects of environment, terrain configuration, and sub-soil conditions; the form in which they should be presented; the type and form of data needed, and how this information should be communicated to the various professions involved in its use (Table 3.1).

Table 3.1

Types of hazards and disasters discussed
in this Executive Summary and Manual

PRINCIPAL FLOOD HAZARDS

The main hazards, posed by floods, can be summarized as follows:

- Rain falling in the flood-susceptible areas and their immediate surroundings;
- Heavy rains and/or snowmelt in the upper catchment;
- Incursions of sea water along exposed coasts and particularly where an important tidal range exists and strong on-shore winds occur.

The main parameters for flood assessment include:

- Location and size of flood plain areas;
- Meteorological data on rainfall amounts and intensities
- Hydrological data on magnitude and frequency of floods;
- Hydraulic data on flood flows.

PRINCIPAL EARTHQUAKE HAZARDS

Earthquake damage may be caused by various types of earthquake:

- Ground shaking of different severities;
- Differential ground settlement; soil liquifaction;
- Land and mudslides, ground lurching and avalanches;
- Ground displacements along faults;
- Flood from dam failure, tsunamis and seiches;
- Fires resulting from earthquakes;
- Pollution from chemical and similar plants resulting from damage of plants due to earthquakes.

The other earthquake hazards are related to water, fire and pollution, as a secondary effect of the above mentioned primary earthquake hazards. Secondary effects sometimes could be of much larger scale than those caused by ground shaking and soil instabilities.

The main parameters for earthquake hazard assessment include:

- Location and size of known hazard zones;
- The number and magnitude of earthquakes experienced in each zone;
- The geological, geomorphological and hydrological characteristics of each zone;
- Threshold magnitudes;
- The correlation between seismic intensity and distance;
- Tectonic maps;
- Peak ground acceleration data.

Table 3.1 continued

PRINCIPAL HAZARDS FROM HIGH WINDS

The main causes include:

- Tropical cyclones;
- Tornadoes;
- Thunderstorms;

The main parameters for assessment include;

- Wind speed records;
- wind direction data;
- Associated pressure conditions and rainfall.

PRINCIPAL LANDSLIDING HAZARDS

The basic causes of slope instability include:

- Those inherent in the rock or soil, in its composition or structure;
- Those, like inclination of undisturbed slopes, that are relatively constant;
- Those that are variable, such as groundwater levels;
- Those which are transient (seismic vibration) and some are imposed by new events, such as construction activity
- Those landslides which are triggered by rainfall or earthquakes (or both).

The basic parameters for landslide assessment include:

- Geological data (lithology);
- Geomorphological data (slope angles, etc);
- Hydrological data (especially groundwater);
- Seismicity.

Type and form of data

The complexity and interdisciplinary character of urban planning and implementation require clear concepts. A key question is which maps, data, and decision-making tools are required for the various project phases and sub-phases in order to implement plans at regional and local level in accordance with timing and budgets fixed in development plans.

Apart from different types of geo-scientific data, different forms of land use, socio-economic and demographic data will also be required at the various stages of decision making, planning and implementation. The form of information, including the level of accuracy, speed of data collection required and the scale, all need to be in line with the requirements of each project phase.

Sources of information

Many sources of hazard information exist. Aerial photographs and satellite images, intensively used by geo-scientists but still much less by planners, are a very useful source of information. They reduce the cost and time of geo-scientific assessments since a rational and cost-effective programme can be devised for minimal field research, drillings, and/or geo-physical measurements.

However, this data is of only marginal use for information dissemination to and communication with the prime users of numerical information: economists, sociologists, administrators, and other groups involved in decision making. Therefore spatial and statistical data need to be combined.

The combination of remote sensing techniques (aerial photographs and satellite images) and microcomputers can, if fully integrated in the whole assessment and planning team, improve information dissemination and communication between the various professionals involved in both planning and economic evaluation.

This facility will enable the teams to propose alternative plans, with different scenarios, as a basis for socio-economic and political decision making provided that uniform data collection and mapping techniques are applied.

Creation of data banks

Disasters should be viewed as a problem of economic development and that, as with all such problems, they should be resolved in a systematic manner by concerted action beginning at the level of national data collection.

Therefore data banks on disaster-related topics should be established at local, as well as at regional and national level. The data should be assembled in a uniform way, including all location and severity data, and data regarding the expected hazard return periods. They should also include land use, socio-economic and cultural data of all elements at risk in the hazard prone land.

The data for the data bank should be collected and analysed in such a manner that economic evaluations can be made for the various scenarios as a basis for plan formulation and decision making.

Information dissemination and communication

Communication of information between experts in different disciplines often causes immense problems. The most commonly practised form of information dissemination and communication between geoscientists, environmentalists and settlement planners, occurs when the engineer requests specific maps and data from these disciplines.

The problem of communication between the geoscientist and the environmental planner on the one hand, and the land use planner, on the other, should not be ignored. It gradually increases with the increasing and more complex role of the environmental sciences in urban development.

Bringing the geoscientist, environmentalist and land use planner more closely together at an early stage of settlement development planning and disaster mitigation should therefore be encouraged and actively stimulated. This is the pre-planning phase, prior to socio-economic and political decision-making on future settlement extensions and improvements. It is best pursued as a learning process using the task force approach.

Presentation of data

The form and content of geoscientific and environmental assessments for settled land, and particularly the manner of presentation, should be appropriate to the needs and capabilities of the user.

Virtually all natural phenomena liable to cause disasters share one common feature. This is that although it may not be possible at the present stage of scientific knowledge to forecast *when* they are going to happen, it is often possible to predict with a reasonable accuracy *where* they are likely to occur, for example in flood plains, seismic areas or slopes liable to landslides.

Hazard maps are therefore basic to both risk assessment and data presentation and communication between professionals. A hazard zoning map is a means of the presenting hazard levels together with the probable associated intensity of magnitude of each hazard zone. The map consists of a series of defined areas of particular magnitude or risk level. Besides dividing the area to be studied into zones, having different hazard probabilities, the map may provide other relevant data such as the extent of damage where the hazard occurs, hazard duration, erosion, sedimentation etc.

Other products of risk assessment should be directly applicable to decisive action concerning practical preventive or corrective measures, land use planning, proposed construction, legislation, insurance or whatever purpose is involved. These actual needs must be determined,

and the less that intermediate interpretation of the scientific results is required, the more direct and effective the results will be.

This does not mean that the final product should only consist of a greatly simplified presentations, readily grasped by the layman, but the data presented should be sufficiently user-orientated.

LOSS ASSESSMENT AND VULNERABILITY ANALYSIS

In effective risk assessment, hazard assessment - and associated mapping - is followed by vulnerability analysis to determine the communities, buildings and economic activities that are at risk from natural disasters.

Vulnerability analysis

Vulnerability analysis is basically an inventory and analysis of elements at risk, including all relevant socio-economic and cultural data in the area identified as hazardous. Based on hazard assessment and the identification of hazard zones, the vulnerability analysis is intended to examine and evaluate risk, and to estimate the level of acceptable risks in connection with socio-economic conditions and political interests.

For existing situations, the risk is probably stable. But vulnerability analysis and risk assessment in existing situations is only half way to solving the problem. Proposals for improvement are necessary. Otherwise only the status quo is given to decision makers, which is probably already known, or expected.

For new developments, the risk aspect is flexible. Changes in land use can be combined with improvement of the existing conditions. Then an analysis can be made in respect to economic benefit and safety level.

Vulnerability analysis is not a purely technical matter. It is a multidisciplinary problem involving socio-economic and even political judgement because disasters affect not only the physical environment, but the whole social and ecological system, political structures and economic activities.

The level of acceptable risk can determine the policy for reduction of the hazard, integrated into the general development planning processes. Such a policy would estimate the technological and economic capacity to absorb the difference between "high risk" and "optimum risk" in relation to the costs of risk reduction. It would establish a body for inspection and

control, and it would set up criteria for risk evaluation and for estimating acceptable risk levels.

Risk and loss assessment

Risk assessment means the integrated analysis of the risk of a hazardous system of activity and their significance in an appropriate context. It incorporates risk estimation and risk evaluation. Risk assessment can be made on the basis of both empirical and theoretical data. Full inventories (i.e. by structural type and presented by number and floor area) are needed for risk assessment calculations. Loss assessments can be made, based upon empirical data in the field, after a disaster has occurred.

In order to reduce costs and time for these risk and loss inventories, existing statistical and spatial technical data banks from various government bodies should be used. Only those data which are needed in addition to available data should be collected, either in the field or through remote sensing techniques.

These new data should be incorporated in the total "knowledge-bank" of the government, for balanced decision making for settlement and planning, thereby including the reduction of risks as one of the elements in comprehensive development.

The reliability of risk assessments is closely related to the quality and quantity of the existing data, such as available geological, hydrological and land use data, maps, aerial photographs, satellite images and statistical data.

RESULTS AND OUTPUTS

One of the most important results of an efficiently managed risk assessment programme will be the continuing development of organisations, Institutes or a team of professionals with the capability to undertake risk assessments. This should be coupled with an active research and development programme to continue to develop skills and expertise in this areas.

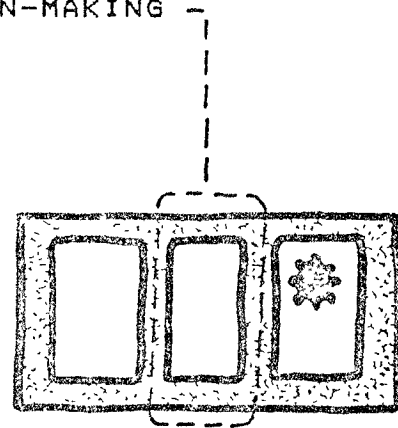
A continuing record will also be established of hazards and disasters that have occurred in the past. What also will result is an increasing predictive capability by the relevant experts that will help to forecast the location and severity of hazard events in the future.

In addition the hazard assessment programmes undertaken by these organisations and teams will produce maps and other data, for planners and decision-makers, which define hazard risk zones. Vulnerability data and maps will also define the populations and buildings at risk in these zones, and the economic activities that could suffer from future hazards and disasters. This data then forms the baseline from which planning and decision-making can begin.

4. PLANNING AND DECISION-MAKING

THE NEED FOR A SYSTEMATIC APPROACH

Countries, regions and communities need to respond as systematically as possible to the natural disasters that they face. If they do not do this, their scarce resources will be wasted, and their communities will face unnecessary loss of both life and property.



The need to identify plans to mitigate disasters follows directly on from the accurate assessment of risks: that assessment indicates the scale of planned response that is necessary. Planning then leads to the adoption and implementation of measures and strategies to reduce these risks, or to reduce the vulnerability of communities to the damage and loss of life that would otherwise occur.

However, even if risks cannot be assessed accurately, and reliance has to be put on intuitive risk assessments based perhaps only on local anecdotal knowledge, a systematic and planned response is nevertheless still more efficient than "crisis response" following disasters.

Care has to be taken, however, not to 'over-plan': over-preparedness is expensive and may mean that disaster mitigation itself is subsequently discredited when disasters do not occur. Planning and decision-making is not a mechanistic science but involves judgement requiring skills in many disciplines, rather than the simple application of rule-books.

Three issues are important: first, policy guidelines and strategies,, second, planning and decision-making techniques, and, thirdly, expected outputs.

POLICY GUIDELINES

Disaster mitigation involves complex decisions, not least because it is concerned with events that may have a low probability of occurrence. Investment in disaster mitigation may also be expensive. Therefore it is necessary to consider carefully the efficiency with which these scarce resources are used.

A number of decision-making techniques can assist this choice of disaster mitigation policies, plans and projects. These techniques are founded on a number of policy guidelines, including the following:

- * Efficient allocation of resources. Expenditure on disaster mitigation means that other uses of the scarce resources cannot be made: the opportunity for other expenditure must be forgone.

The economic health of the country in question is affected by decisions concerning disaster mitigation.

Therefore, the efficiency of expenditure on disaster mitigation must be maximised, and the resources allocated to disaster mitigation should be valued at their 'opportunity cost' (the value to society of the next best alternative use of those resources).

- * Comprehensive planning and decision-making. Decision-making for disaster mitigation can easily be dominated by short-term considerations, especially immediately after a disaster or the threat of a disaster which will create a 'window of opportunity'. However, policies, plans and projects developed in this way without due care are liable to be ineffective or inefficient, and to have unintended consequences.

Therefore, decision-making for disaster mitigation should be as comprehensive as possible, and review a range of alternative strategies against clear criteria (such as economic efficiency, or social equity) so that objectives are met and the performance is evaluated to ensure the spread and continuation of best practices.

- * Planning and decision making is a continuous process. It is not something that is only undertaken occasionally, when it appears necessary, or by particular agencies which have 'planning' in their titles. Disaster mitigation planning should occur in virtually all agencies, all of the time, at a level proportionate to the risks being faced.

Therefore adoption of more systematic approaches can be initiated at any stage and not just with the definition of a new problem or the occurrence of a disaster: it is advisable not to wait until everything is in place before beginning the disaster mitigation planning process.

Adopting these policy guidelines means that a wider range of appraisal is necessary than is often used in evaluating disaster mitigation plans. This wider range is reflected, first, in the decision making techniques discussed below. It is also reflected, secondly, in the appraisal framework discussed in the section of this Executive Summary on the role of government, which demonstrates the need for careful analysis of both government policies and disaster mitigation projects (page XX).

PLANNING: A MULTI-LEVEL APPROACH

Planning should take place at all levels of government and the community. Particularly important are the following levels:

National master plan.	Where the scale of disasters facing a country warrants a national approach, a national master plan will give a framework within which
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regional and local community
planning can take place;

Regional planning.

A regional approach is necessary to ensure that all sectors are taken into account when making decisions and when allocating disaster mitigation resources. It should also ensure that local communities work together to maximise the effectiveness of safety measures, especially when coordinated action covering whole river catchments or other large geographical areas is necessary.

Community-level planning.

The community needs to harness its limited resources in the most efficient way, with a systematic or planned approach to using its energies to the maximum effect. Such community plans need not be written statements, but should be the subject of community debate and agreement on a chosen plan of action 'on the ground'.

A national-level organisation with disaster mitigation responsibilities should monitor the activities of other planning organisations at lower levels of government.

DECISION-MAKING STRATEGIES AND TECHNIQUES

Decision-making

A number of ideas about systematic decision-making exist but it is generally recognised that decisions should be made in a logical sequence rather than in a random or disjointed manner.

This logical sequence is characterised in Figure 1, which shows that a number of steps are required between the definition of the problem - the risk assessment - and its solution. Implementation is followed by the analysis of the performance of the measures adopted, so that lessons learnt are reflected in future decisions:

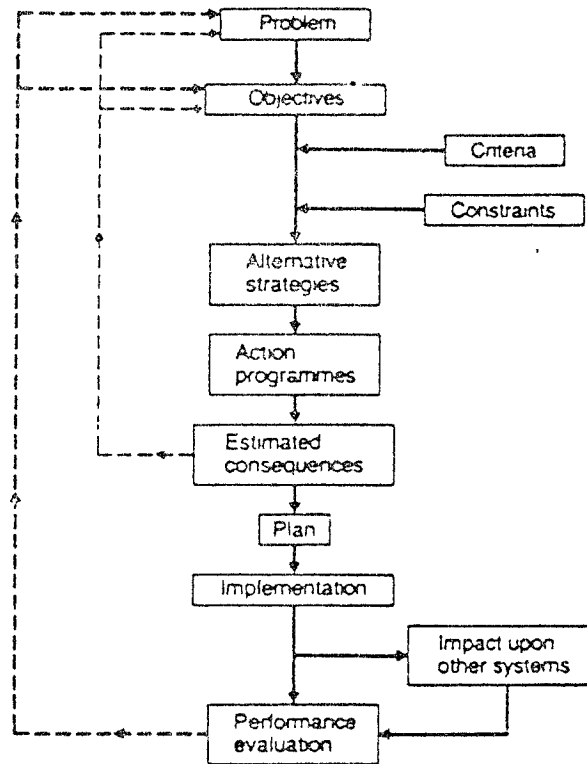
Problem

This is a risk assessed as being serious enough to warrant concerted action to protect vulnerable property and lives.

This information arises out of an efficiently executed risk assessment programme, as discussed

Figure 4.1

Systematic decision making (from Mitchell, 1971)



	<p>in the previous Section of this Executive Summary. It takes the form of maps, data and other information on hazards and on vulnerable communities, buildings and economic activities.</p>
Goals/objectives	<p>Goals set standards of disaster mitigation, in the form of levels of protection, such as the number of buildings or people protected within a given time scale, or at a certain overall cost.</p>
Criteria	<p>Criteria are 'benchmarks' against which decisions are made, and are set in relation to the problem identified and the objectives set. They can include technical, economic, political and other criteria and they need to be ranked in order of importance.</p> <p>Economic criteria might include prescribed levels of cost-effectiveness, or the relation between benefits and costs, or simply cost limits. Technical criteria might include a specified design life, a certain given standard of safety, while social/cultural criteria might involve protecting certain heritage sites, cultural monuments, or particular minority communities, or equity of treatment for all people affected.</p>
Alternative strategies	<p>A range of strategies must be evaluated against the criteria adopted, to determine which most easily or successfully meets the objectives set in relation to that criteria. Thus structural solutions should be compared with non-structural alternatives, and short term solutions compared with longer term investment. The range of choice of alternatives should be wide enough to encompass all policies, plans and projects that are technically, economically,</p>

politically and environmentally feasible.

Plan

The plan adopted will be a strategy (or a number of strategies) to be implemented in a given timescale at a given cost. It should be an agreed statement or understanding of how the goals and objectives are to be met, perhaps as a series of projects, and include arrangements for plan implementation.

Implementation

This involves putting the plan into action, through the investment of resources in completing projects designed to meet the objectives as outlined in the plan.

Performance evaluation

The performance of the projects that constitute the plan should be evaluated in a systematic manner to determine the extent to which the objectives are met and the problem solved. Performance evaluation should begin at the initiation of implementation, so that correctives can be applied to the projects and plan at an early stage if feedback indicates that alternative decisions would better meet the objectives that have been set.

The real test of performance of mitigation measures will come when disaster next strikes, but planners and government should not wait for this disaster event but should be continually monitoring the efficiency of mitigation measures ahead of that disaster occurrence

The 'ideal' decision making sequence above is not always achievable.

In reality, planning and decision-making is a continuous process and the adoption of more systematic approaches can be initiated at any stage and not just with the definition of a new problem or the occurrence of a disaster. Thus, the evaluation of past disaster mitigation strategies or projects may indicate better strategies, or the emergence of new criteria can create alternative objectives.

Furthermore, as stressed throughout this Summary and the accompanying Manual, decisions cannot be separated from their economic and political

context. Therefore the 'ideal' decision-making sequence in Figure 1 has been modified, and made more complex, to give the situation shown in Figure 2. Here the decision-making sequence begins with any catalyst (not just a disaster) and is distorted by national economic influences, sectional interests, post-rationalisation of decisions already made, and lack of adequate technical inputs including risk and vulnerability data.

Nevertheless, adopting the systematic steps involved in good decision making and shown in Figure 1 should be the *aim* of all concerned with disaster mitigation, so that the objectives in terms of vulnerability reduction can be achieved in the most efficient manner possible.

Economic appraisal techniques

Efficient allocation of a disaster-prone nation's scarce resources is assisted if projects and policies are subject to some form of economic analysis to determine whether the investment in the proposed policies, plans and projects would yield a higher return to the nation or the community if spent in some other way. In this respect it should not be forgotten that disaster mitigation is both expensive and risky.

Many techniques have been devised to quantify the worthwhileness of this type of expenditure. These techniques, however, have many problems and unthinking application of, for example, benefit-cost analysis will lead to considerable problems, not least when attempting to evaluate loss of life. Nevertheless *some* form of comparison of the costs of disaster mitigation with the outcomes of that investment should begin to suggest that decision-makers ask whether that expenditure is useful, worthwhile or the best use of those scarce resources.

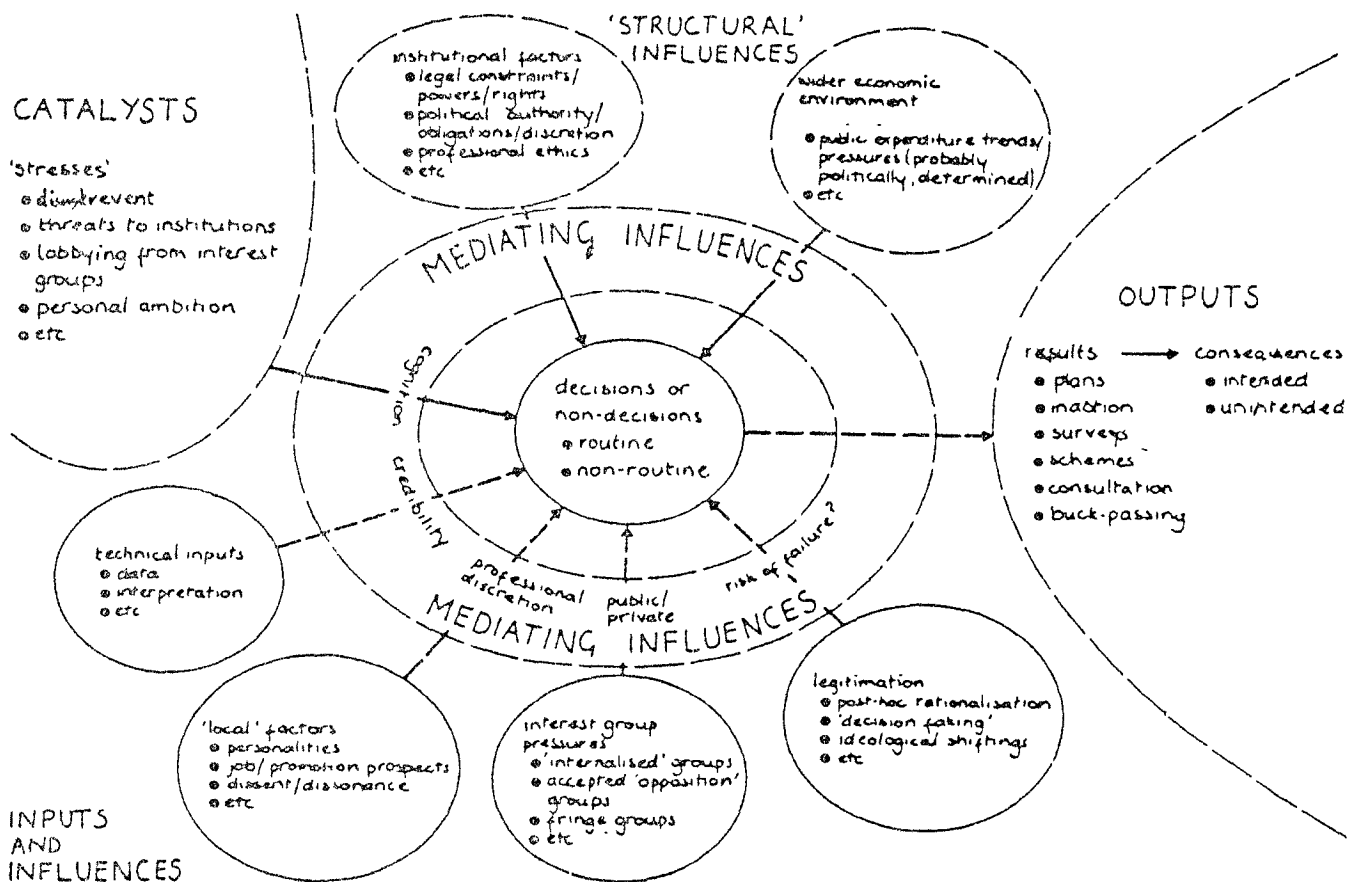
Many different approaches are available, and the techniques chosen will vary with the perspective of the user and the degree of sophistication possible in the particular circumstances. In addition to financial appraisal, which judges the returns to those investing in disaster mitigation, there is a range of economic analysis methods. Two basic alternatives are as follows:

- * Cost effectiveness analysis This attempts to produce the most effective solution to a particular problem at a given, set, cost. It relegates economic efficiency to a second order of importance, in relation to technical or other considerations. The approach is also often used where many of the benefits of investment are 'intangible' and therefore cannot be quantified in any comprehensive benefit-cost analysis.

Cost effectiveness analysis of disaster mitigation plans and projects would *assess the lowest*

Figure 4.2

Decision making in a political context
(from Penning-Rowsell et al 1986)



cost methods of achieving the chosen strategy for minimising damage and loss of life from natural disasters.

This approach should be used when the benefits arising from disaster mitigation are unclear, or where there is a given amount of money for disaster mitigation that could not be increased even if it could be shown to be worthwhile to spend more. The drawbacks of this approach are that some of the money spent may not be wisely used, and that either more or less resources could be the better solution for the country and communities concerned.

* **Benefit-cost analysis** This attempts to maximise the economic efficiency of investment decisions by comparing the costs of plans and projects with their anticipated benefits. These benefits and costs are measured at their opportunity costs - that is the value of the next-best opportunities for those resources - and uses indices such as the benefit-cost ratio or net present worth to rank projects in terms of their economic efficiency.

"Extended" benefit-cost analysis and Environmental Impact Assessment are techniques for attempting to incorporate non-market products of investment in this kind of analysis, such as social equity or environmental and cultural resources.

In disaster mitigation, some form of benefit cost analysis (fully quantified or otherwise) would *assess the costs of mitigation plans and projects (in terms of capital expenditure or revenue costs) and compare this with the likely economic outcomes, ultimately in terms of increased gross national product of the country concerned.*

This approach requires more data than cost-effectiveness analysis, and is more time-consuming. However it should mean that the scarce resources available for disaster mitigation are used in the wisest possible way, and that the intended

effects of that investment (that is, the benefits) are clearly identified for subsequent monitoring during the implementation stages of disaster mitigation.

Nevertheless, economic appraisal of disaster mitigation cannot be complete, or an answer in itself, because many non-economic aspects of hazards and disasters need close attention in decision-making. The approach does, however, provide a *framework* for identifying which decisions are most economically efficient, and a systematic approach to the allocation of scarce resources.

Many different levels of analysis are possible, from the *simple and intuitive* to the *sophisticated and computer-based*. The Manual includes examples and recommendations of all of these, and recommendations about how to make quick decisions in circumstances of limited data. The prime importance is to give decision-makers the benefits of a systematic framework within which to make their decisions.

These decisions may ultimately be political or dominated by other constraints which over-ride the economic analysis, but at least the decision maker will appreciate the economic costs of those political decisions.

OUTPUTS FROM PLANNING AND DECISION-MAKING

The outputs from systematic planning and decision-making will be clear-cut decisions that link economic considerations and safety to factors such as protecting human life and cultural issues.

The mitigation projects will have considered all available alternative strategies, including 'doing nothing', and will have involved a wide range of consultations with those affected so that the approaches adopted will have the support of local communities and political leaders.

The plans will be more realistic in that their implementation will have been considered as part of the plan-making process, and the solutions adopted should link as closely as possible to the risks identified and the vulnerability of the population affected.

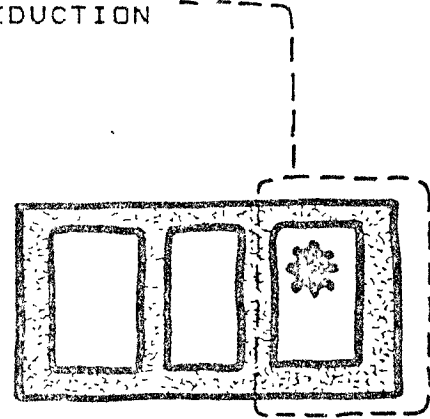
As part of the appraisal process both government policies and institutions will have been evaluated. In the former case this will ensure that there are not contradictory but unintended policies in related spheres of government that are exacerbating risks and increasing vulnerability. In the latter case, a systematic approach will evaluate whether the structure and powers of government systems are appropriately tailored to the required disaster mitigation tasks.

Plans and projects resulting from good decision making and adequate appraisal should ensure that the scarce resources of disaster-prone countries are not wasted on schemes that are not cost-effective or economically efficient.

In this way disaster mitigation can assist the development process by ensuring that wise decisions are taken and that investment in disaster mitigation gives the country concerned the best return from all available resources and helps thereby to promote self-sufficiency and resilience to disasters that might occur in the future.

5. EFFECTIVE IMPLEMENTATION OF A STRATEGY FOR RISK REDUCTION

Implementation involves converting a disaster mitigation plan into reality 'on the ground': it is the introduction, development, evaluation and maintenance of disaster mitigation measures. It is thus a vital stage in disaster planning and follows on from risk assessment and planning, since without implementation nothing is achieved.



Targets for Mitigation Implementation

The preceding sections of this manual have covered the process of Risk Analysis and Decision Making. In turning to the subject of implementation it is essential to recognise that protection is being provided with two objectives:

- (a) to reduce deaths and injuries;
- (b) to reduce property losses of buildings and economic assets.

These losses could be direct (i.e. immediate damage as a result of the disaster impact) or they could be indirect (i.e. longer-term damage to livelihoods as a result of a factory being out of production for a long period of time). Indirect losses are likely to be less tangible but can be of a greater, far-reaching social and economic impact than the highly visible direct losses.

Different measures are needed to select targets and address these situations, and the Decision Making process already identified has described a systematic way to determine suitable areas requiring protection.

In identifying targets for mitigation it is important to emphasise that they are all moving targets - none are static. As patterns of vulnerability rapidly change, due to such pressures of urbanisation, environmental degradation and population growth, assessment techniques, implementation strategies and mitigation actions will also need to adapt to relate to this dynamic context.

POLICY GUIDELINES

There are three key policy guidelines for the effective implementation of an integrated strategy to reduce risks from natural hazards:

- * The major opportunity to develop and/or implement measures will occur in the wake of a major disaster. This is due to the temporary high profile of disaster preventive action, which should be taken advantage of to secure resources and decisions.

Therefore, plans should be developed and where there are political or other obstacles to their implementation they should be maintained in readiness for implementation at the appropriate time, such as when a disaster provides the necessary opportunity for swift action.

- * Experience indicates that the poor are most at risk from disasters.

Priority is necessary for appropriate measures to protect the the poor and their property. Such measures will include economic inputs and community level programmes.

- * A balanced implementation strategy includes 'fail safe' measures which can be used if other measures are not acceptable or are not efficient.

Therefore, it is advisable not to confine mitigation to a single measure, such as laws. Implementing hazard mitigation planning is strongest when there is an interrelated strategy of many parallel approaches.

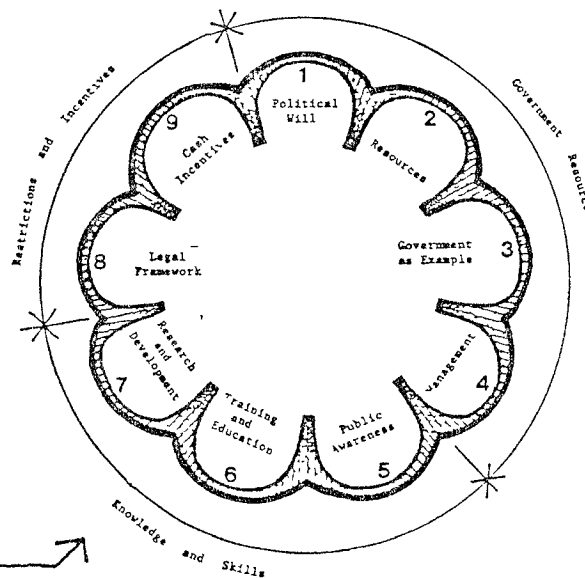
These policy guidelines will affect the requirements and mechanisms to be adopted, the type of measures implemented, and the strategy and tactics adopted for implementation.

IMPLEMENTATION: REQUIREMENTS AND MECHANISMS

The plan of a castle symbolises a balanced strategy for risk reduction. Each bastion represents one of the necessary vital elements to protect lives and property. This castle metaphor is useful for two reasons: first, the implementation strategy has to be as strong as possible to resist the powerful and extreme forces that are uniquely experienced in a disaster. Secondly, just as many castles have collapsed by internal neglect rather than external pressures, the strategy has to be strong enough to withstand public and political apathy that inevitably prevails in the long period between the stimulus of major disasters.

The following are nine crucial requirements and mechanisms for effective implementation: they are the bastions of the castle.

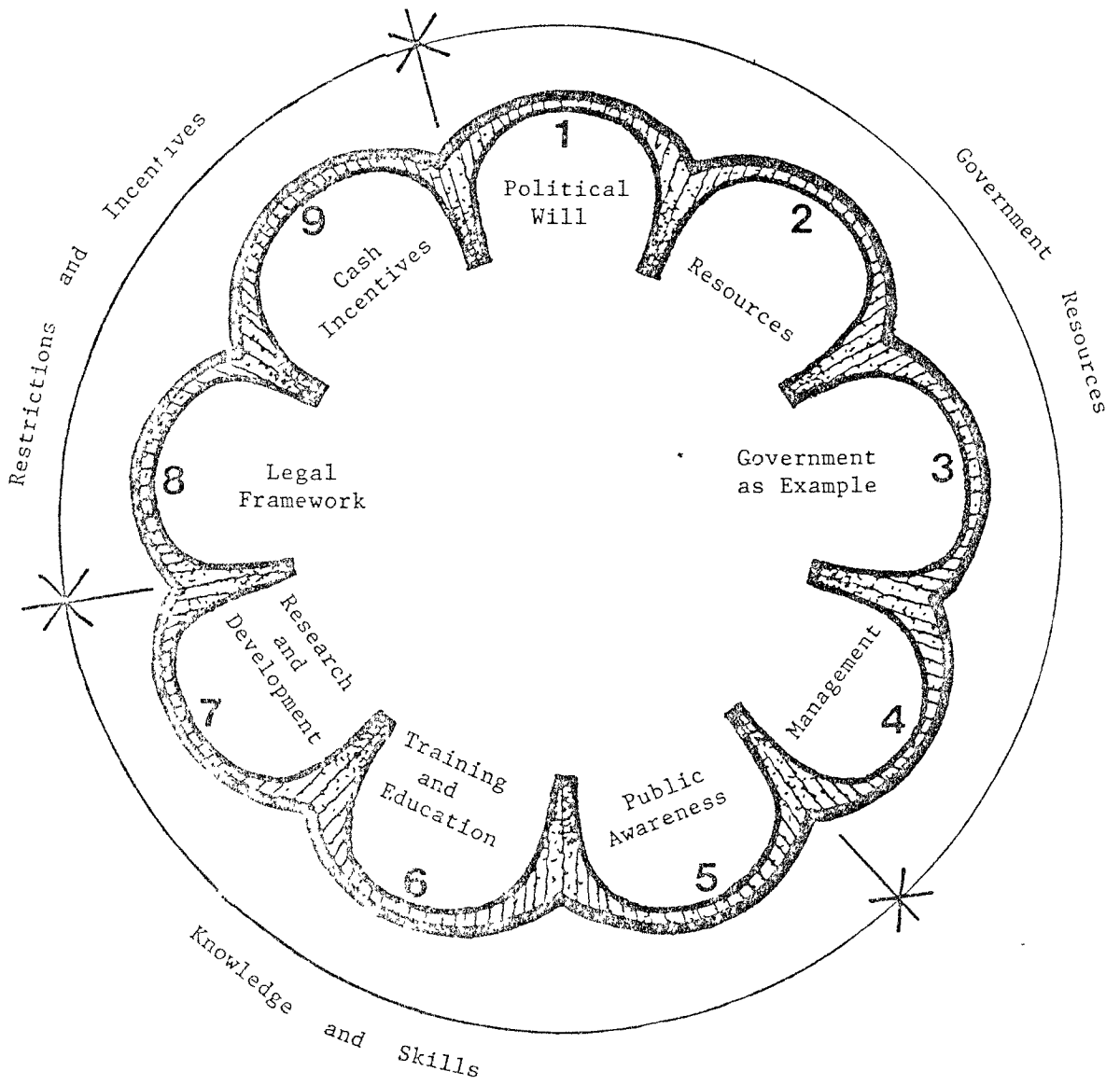
Fig 5.1 Castle Implementation Symbol
Governmental resources



1. **Political will and commitment.** Without strong pressure from the centres of political power in a given country to introduce, develop and maintain disaster protection measures, then all other activities are likely to be at best token responses. Political will is most likely to originate from the major failure of measures to counter a disaster. Therefore responsible and concerned officials may need to draft their proposals down to the last detail and await the inevitable disaster, which will serve as a catalyst and lead to positive and rapid action without the delay in plan formulation at that stage.
2. **Resources.** No disaster mitigation strategy can succeed without some resources, however modest, and the allocation of these resources from other competing government or private sources requires power to be exercised in favour of disaster mitigation rather than those other functions of government.

Such effective management may grow out of the annual task of preparing the national budget. For the expenditure of modest sums of money on a continual basis, there are major potential benefits in lives that can be saved and property protected. This is both the aim and output of a balanced risk reduction strategy.

3. **Government Models.** An excellent way to communicate the need for safe environments is for governments to provide an example of safe practice so that all the buildings or services they construct and maintain are built to high safety standards. This will have two effects, firstly the designers, builders and engineers who construct in a safe manner will learn from this experience. Secondly, the physical environment will become progressively safer in key areas where protection is of paramount importance.



agency or even officials to have the overall responsibility for co-ordinating risk reduction actions. Laws can be drafted by one sector of a government which bear no relationship to how they will be implemented by another, for example how they are financed or taught. Such laws may even prescribe safety measures which have still to be developed by yet another government agency.

Therefore effective implementation of disaster mitigation requires strong management, to integrate all elements into a cohesive pattern. Disaster mitigation also requires foresight. Without this leadership and skills at many different levels of government, and in the private sector, implementation will be slow and patchy.

Knowledge and skills.

5. Public awareness. Via their taxes the public pays for risk reduction measures, and many will be involved directly or indirectly in their implementation, particularly their maintenance. Therefore the public needs to be informed about the nature of hazards, their vulnerability, and about safety measures. Also the 'motor' that drives a risk reduction strategy, and puts continual pressure on governments, is a heightened public awareness of the issues and opportunities for protective action.

At the specific level of preparedness planning the public will be directly involved in local community level safety precautions. Implementation of effective disaster mitigation is also likely to require developing new programmes or new works. This will require many different skills, from those of the disaster relief agency to those of the scientist and engineer.

6. Training and education. After a disaster strikes, a long term education programme is likely to be necessary to prevent the recurrence of similar disasters in the future. Therefore if buildings have failed in an earthquake, or crops have been lost through flood impact, then it will be necessary to educate architects or agriculturalists in techniques to resist these processes. Builders and farmers need to be trained how to apply improved hazard resistant techniques.

New laws requiring innovative measures will always imply that someone is trained to use them. Therefore this education element in disaster mitigation is vital, yet because of its low political profile it remains the most neglected of all the mitigation measures.

7. Research and development. Implementation will be effective and efficient if it builds on a continuing programme of research and development in all aspects of disaster mitigation, including risk assessment, planning, the effectiveness of alternative measures and the performance of mitigation planning itself.

Restrictions and incentives

8. Legal framework. Laws represent restrictions for governments and communities but they are essential for disaster mitigation implementation for two reasons: first, they establish safety standards, and secondly, they constitute a vital element in public education.

However there are persistent problems in their introduction and use. Often they are hastily drafted and enacted after a disaster to express political concern. To achieve haste they may be based on an inappropriate model that relates to a totally different culture or economic situation. Thus, the California Seismic Design Code has formed the basis for earthquake safety codes throughout Latin America, in many highly inappropriate situations.

A further problem concerns law enforcement. Many poor countries simply cannot afford to set up an adequate system to enforce laws - and consequently legal controls lose their essential public respect.

The final problem concerns the relevance of laws to the poor. Frequently standards of building that require additional expenditure are enshrined in laws which are totally irrelevant to poor families. World Bank statistics indicate that just under 50% of the world's population of 5,000 million currently survive on an annual average income of \$270 or less: to them the costs of disaster mitigation are an awesome burden.

9. Cash incentives. As a contrast to the 'stick' of legal constraints, cash incentives provide a 'carrot' that can offer inducements for individual families, entire communities or large companies to adopt disaster resistance.

Incentives can include cash grants or low interest loans to family units to make their homes more resistant to high winds. Or they can extend to an entire community who may use a 'community incentive grant' to raise the ground floor level of their homes to make them flood resistant.

Reduced insurance premiums can be used to encourage middle-income families to build above flood plains, and tax incentives can be offered to the private sector to comply with hazard resistant building codes in the design of office buildings, factories etc.

RISK REDUCTION MEASURES

Implementation includes using the many 'means' to apply specific safety measures. These measures are in two categories - those that are structural (i.e. flood barriers) and those that are non-structural (i.e. hazard/disaster warning systems).

These measures are normally developed through the difficult process of learning from failure, and devising improved ways to resist the forces of flood, high winds or seismic impact. They will be implemented in a wide variety of sectors: building construction, agriculture, forestry, industry and the essential 'lifeline' services - telephones, water, sanitation, roads etc.

The effectiveness of any of these risk reduction measures can be evaluated in two ways. First, by their general acceptance and normalisation, as they are absorbed into the broad programme of development as natural elements of good (or normal) practice. Secondly, by their testing in a disaster, followed by subsequent damage surveys

that will inevitably result in further fine-tuning of the safety measures.

STRATEGY AND TACTICS

Implementing an integrated disaster mitigation strategy will be speeded up when attention is given to the six key issues set out below:

- * The timing of measures and their introduction: the need to capitalise on disaster impact (or even some other country's disaster) in order to stimulate political concern.

Therefore, advantage must be taken of disaster situations to begin the process of disaster mitigation planning and implementation, even if this means that certain problems such as inadequate data have to be ignored in the short term.

- * Integrating the elements. A continual need will exist to balance an effective risk reduction strategy - whilst integrating the various elements already identified.

The order in which the measures are developed is of critical importance. Perhaps an ideal sequence would be: public awareness leading to political will, leading to management, leading to the parallel and interactive processes of drafting laws and the development of risk reduction measures. Finally training/education and cash incentives will be required to apply such measures.

Most countries will have some of these elements already in place which may be highly effective. In this situation the strategy will be to develop other protection elements to support and build upon existing strengths, and begin the long process of constructing a mitigation measure which might not yet exist in any shape or form.

Therefore, disaster mitigation should not concentrate on a single measure, but should adopt a multi-level approach involving a long time-scale.

- * Focussing on key areas where action is most needed. The focus of the strategy will be on overall protection of an entire community and its property. However given limited resources and unequal patterns of vulnerability, the risk assessment and planning processes should identify priority targets for safety measures.

This sharp focus should first be aimed towards the vulnerable poor. Secondly, it will be directed by certain criteria leading towards other priority targets such as:

- the maximum number of people to be protected for given resources (i.e. protecting multi-occupancy buildings rather than individually occupied dwellings);

-
- 'lifeline services' (i.e. water, sanitation, medical facilities, communication systems etc);
 - elements of long-term economic importance rather than short term (i.e. protect factories rather than shops);
 - food stocks.

Therefore, prioritisation is an essential part of implementation of disaster mitigation strategies.

- * Building an effective management system. An effective management co-ordination system is essential, but as the castle symbol suggests, management may well be self-defeating if it is based upon a hierarchical model which is unresponsive to community needs. Rather, implementation needs to be a balanced participatory system in order to relate to the diversity of levels of community and to governmental agencies in the various sectors, ministries and administrative structures.

Therefore, effective co-ordination will embrace all the spheres of government, the private sector, non-governmental agencies and the concerned community.

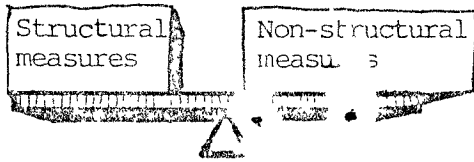
- * Linking all disaster mitigation measures into normal practice. A successful strategy will be to 'lose' the risk reduction measure into normal practice. Put another way, risk reduction measures need to be absorbed into the development programme of any hazard prone developing country.

Architects, engineers, house builders, home owners and occupants in many developed countries have become so familiar with fire resistant building measures that they virtually cease to notice their existence. This may have the negative impact of creating a false sense of security, but in positive terms it means that fire protection has been absorbed into building practice and public awareness, causing a major but hidden reduction in vulnerability.

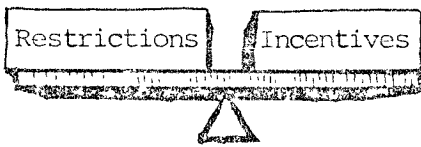
A parallel of this process is to compare the way preventative medicine has been gradually accepted as a normal process of public health care in all responsible communities.

Therefore, the aim in implementing preventative risk reduction measures will be to incorporate them into government structures, traditions, curricula, laws, training schemes, normal credit systems of financial incentives, political practices and public awareness.

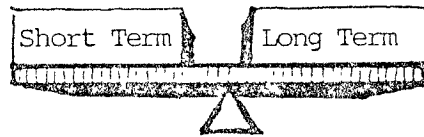
Pursuing **Maintaining a balance.** As has been repeatedly stated, mitigation is most effective when a variety of strategies are adopted (as the castle symbol of Fig. 5.1 indicated). In addition a diversity of implementation techniques are needed which will be indicated in the next section. These varied strategies and techniques should ideally operate in parallel. Therefore a subtle balance is needed between diverse forces rather than pursuing a single course of action at the expense of another. The following five balances are typical examples:



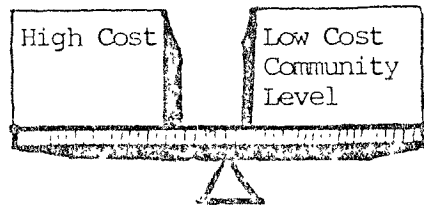
• Structural measures such as the actual strengthening of buildings against earthquakes balanced with a non-structural measure of training local builders to implement such techniques.



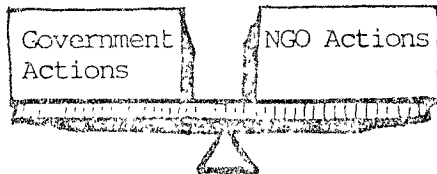
• Restrictions such as bye-laws or land-use controls balanced against incentives such as cash grants, tax remission to achieve safety, or for middle class and commercial targets the use of insurance.



• Short-term needs to achieve rapid results, such as building controls balanced against long-term needs like the development of a comprehensive land-use planning system for all hazard-prone areas.



• High cost technical, or technological measures such as the development of a computer-based warning system balanced against the need to introduce low-cost community level measures that will be relevant to a non-technical, low-income public such as advice on the dangers of building homes on steep unstable slopes or on 'fill' within seismic areas or locations subject to landslides.



• Governmental actions such as the introduction of new seismic safety legislation balanced by activities undertaken by non-governmental organisations such as community based programmes to build flood walls to contain rivers to avoid damage to homes and settlements.

Therefore, an effective and carefully maintained strategy is likely to be a balance between many forces or activities, which may be in conflict with each other for funding support, or on account of their relationship to various government agencies or ministries.

Or, as can be seen in the above balances, the contrasts are between extremely varied criteria, which implies the need for well informed officials managing the mitigation process.

This diagram indicates the following typical measures:

- A. Slope Stabilisation
(against earthquake induced landslides, rain induced landslides, erosion, mudslides, etc.)
- B. Protective walls to contain rivers
(against slow-rising and flash flood impact).
- C. Protective bunds or dykes
(against flood or cyclone induced coastal surges).
- D. Raising the level of settlements or individual house units
(against flood impact, cyclone induced coastal surges or tsunamis).
- E. Flood control measures
(these include land drainage, water storage, warning systems, water flow controls).
- F. Planting of shelter breaks
(against cyclone force winds by varied tree or shrub planting measures).

Note: Planted shelter breaks against cyclone wind speeds will be of two types, firstly a belt along exposed coastal areas of up to several hundred metres wide to break up the severe force of winds and also to stabilise sandy soils against erosion caused in storm surges, and also circular planting belts surrounding entire exposed settlements. The circular form is essential due to the rotation of cyclone winds there will be no obvious prevailing direction of winds. (This is the reason why the shelter break appears twice on Figure 1.)

- G. The relocation of settlements

This is an option in certain severe situations but there will be strictly limited opportunities to relocate particularly unsafe settlements at risk from all types of hazard. (See page 46, item 4.2 - Relocation of settlements in Shelter after Disaster, UNDRO, United Nations 1982, for a fuller treatment of the relocation issue.)

2. Building Safety Measures

These are related to three diverse contexts:

- (1) Reconstruction planning
- (2) New building within hazard-prone areas
- (3) The existing building stock.

MITIGATION ACTIONS

Having adopted the strategy and tactics noted above, this section of the manual will address a number of practical actions that could result from this methodical approach. The focus will be maintained on building or building related measures. However, it is important to note that there are appropriate mitigation actions that can be followed in other sectors of environmental planning such as agriculture, forestry, soil stabilisation, fisheries and industry; But they all remain outside the scope of this project, with the exception of a brief reference to tree shelter breaks as they relate to the protection of human settlements.

THE IMPLEMENTATION OF MITIGATION MEASURES

1. Environmental Measures

These can be divided into two categories, firstly the environmental measures described below:

Environmental Measures that relate to the Safe Siting of Settlements

(See Figure 1 for a visual description)

Fig 1. DIAGRAM INDICATING THE RANGE OF CERTAIN ENVIRONMENTAL PROTECTION MEASURES TO PROVIDE PROTECTION FROM CYCLONES, FLOODING, EROSION AND LANDSLIDE

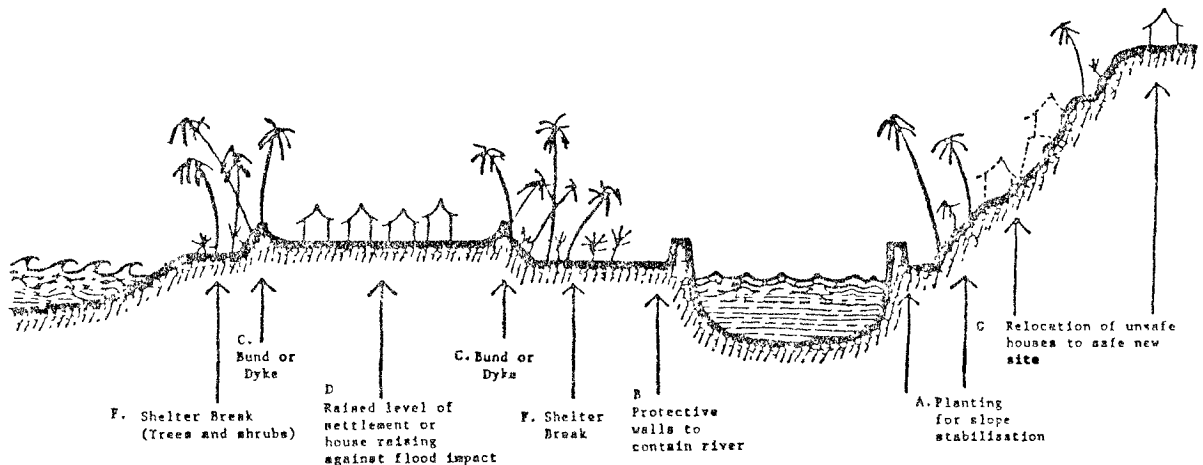
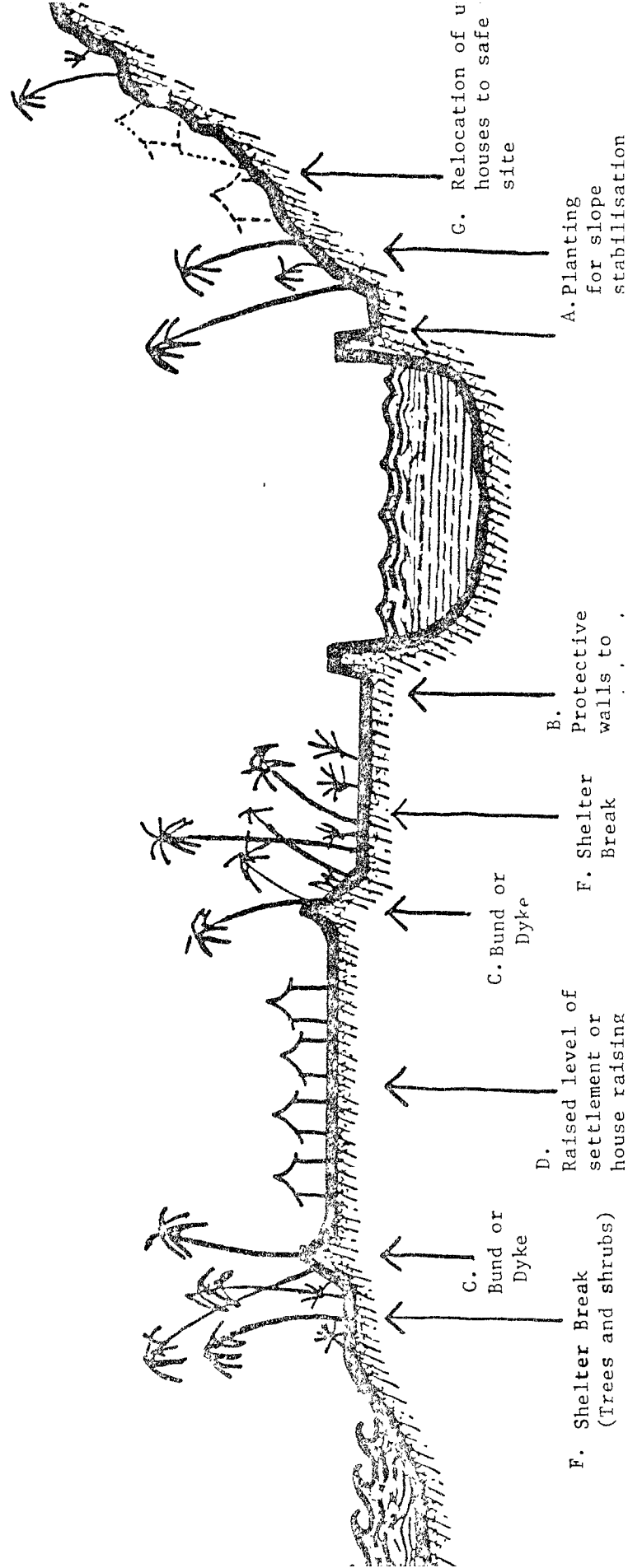


FIG. 1. DIAGRAM INDICATING THE RANGE OF CERTAIN ENVIRONMENTAL PROTECTION MEASURES TO PROVIDE PROTECTION FROM CYCLONES, FLOODING, EROSION AND LANDSLIDE



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The first reconstruction context is the easiest option to apply in view of the availability of funds and high political necessity to take appropriate and tangible action to rebuild. Normally it is not difficult to incorporate safety measures into this process.

The second 'new building' context is never an easy path, but it can occur particularly in the aftermath of a disaster when there is a high level of sensitivity to the need for improved safety to people and structures.

The third 'existing building stock' context is formidable in the scope and scale of what is required. Existing buildings/settlements may be regarded as perhaps 95% of the problem in most countries whilst categories (1) and (2) may together constitute as little as 5%. Therefore selected targets need to be identified by adopting a strong prioritisation policy that will start with 'lifeline buildings' (see page 52)

CONTEXT 1

Reconstruction Planning

Reconstruction offers the best 'environment' for the introduction of new safety measures. The measures described in the subsequent sections can be uniquely introduced at this time. However, there are two major conflicts to note;

- The frequent conflict between FAST and SAFE reconstruction.
- The necessity to balance the forces of REFORM (which should always include safety measures) with the even more powerful forces of CONSERVATISM, where authorities and citizens desire to replicate the existing settlement.

Evidence would suggest that the forces of reform and conservatism need to be carefully balanced since the demands of safety (or urban improvements that don't relate specifically to hazard reduction) are obviously essential. But in addition the equally potent demand for cultural continuity is a necessity for the community in order to retain the image of the previous destroyed or damaged settlement, in the rebuilt environment.

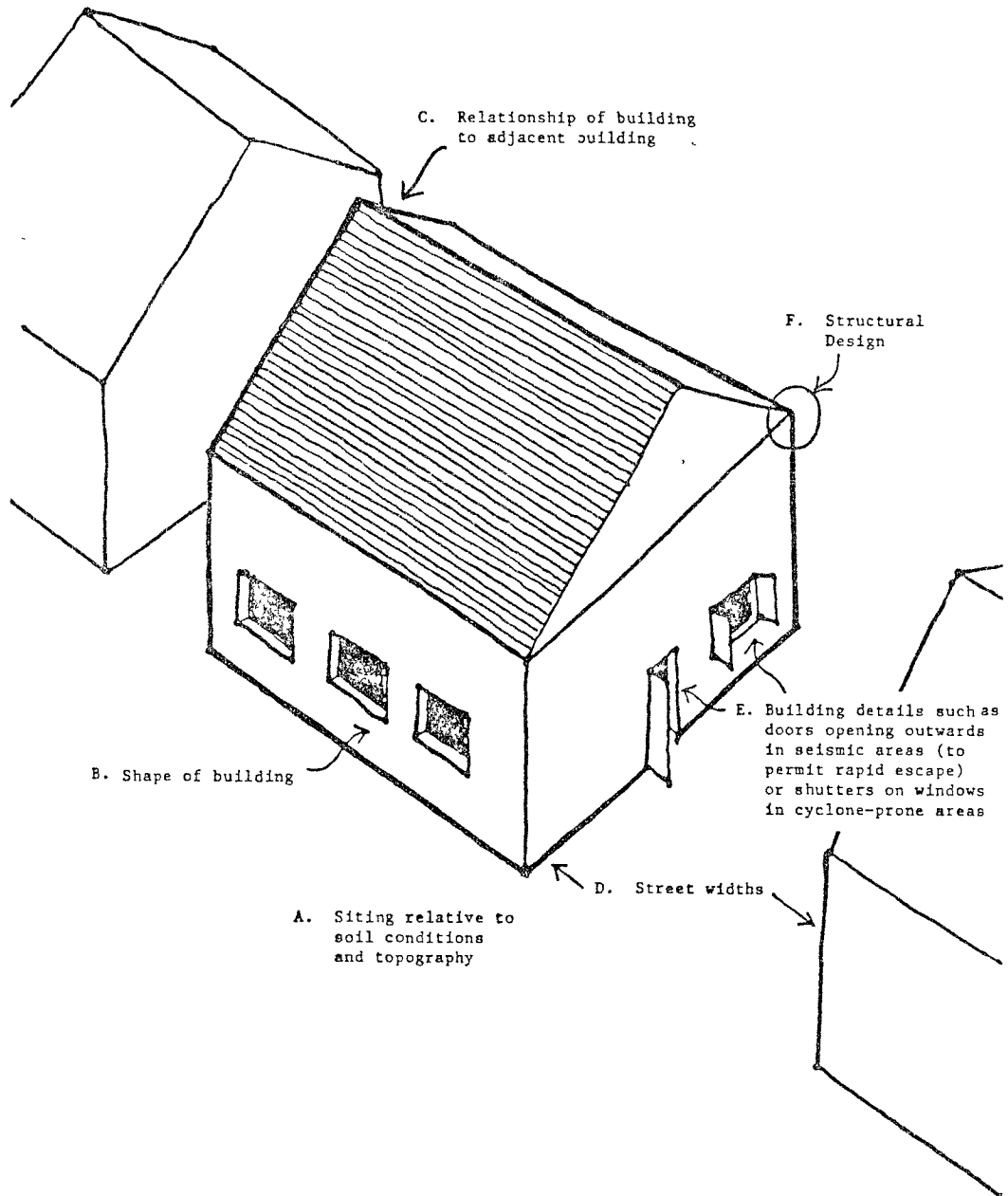
For further information on the opportunities in reconstruction planning to introduce mitigation measures, see item 4.1 'Reconstruction: The Opportunity for Risk Reduction and Reform', pages 39-45, Shelter after Disaster, UNDRO, United Nations, 1982.

CONTEXT 2

New Buildings within Hazard-prone Areas

The new building work can be in the reconstruction context (as noted above with its special considerations) or within the normal process of new development (see Fig. 2 for a diagrammatic representation of the measures to achieve safety).

Fig. 2. SUMMARY OF MEASURES TO ACHIEVE SAFETY IN THE DESIGN OF NEW BUILDINGS



SUMMARY OF SAFETY FACTORS

A. Hazard Resistant Siting

This will relate to soil conditions, topography, avoidance of unstable slopes, seismic faults, proximity to flood-prone coastal or river situations.

B. Configuration of Buildings

This relates to two factors, firstly that of urban form and the proximity of one building to another, and secondly to the shape of a building relative to hazard impact. For example, certain shapes of buildings (rectangles) have a higher seismic resistance than other

forms (L shaped or E shaped structures). In a similar manner the configuration of building is vitally important in cyclone-prone areas.

C. Relationship of Building to Adjacent Buildings

In earthquake, landslide, and cyclone hazards one building can severely damage another as it moves, collapses or as debris is blown from it to another structure. Therefore the proximity of one building to another is highly critical, and it will vary according to the specific hazard. Inevitably this factor raises a conflict in areas of high density such as squatter settlements where every available square metre of land is developed. In new zoning controls it is essential to incorporate requirements that control building relationships, with specific advice on the spacing of buildings.

D. Street Widths

A related issue to the proximity of buildings is a concern to preserve street widths to approximately twice the height of buildings. This requirement is for two reasons, firstly in the case of earthquake impact falling debris will pose less of a hazard in wide streets, rather than very narrow ones for people who have managed to escape from their homes. Secondly, if streets are too narrow it is always a major problem for emergency vehicles (ambulances, fire engines, etc) to gain access for rescue or fire-fighting purposes.

However, it is pragmatic to recognise the conflicts in this advice in hot climates where shade is needed or in high density zones where wide streets diminish already meagre land holdings.

E. Building Details

The development of behavioural studies of occupants of buildings during disaster impact is revealing important data on such matters as the most effective escape routes, whether external doors do need to open outwards in seismic areas, etc. In addition, window and shutter details are critically important in areas subject to high winds in order to avoid a building's roof being blown off by internal pressure.

F. Structural Design

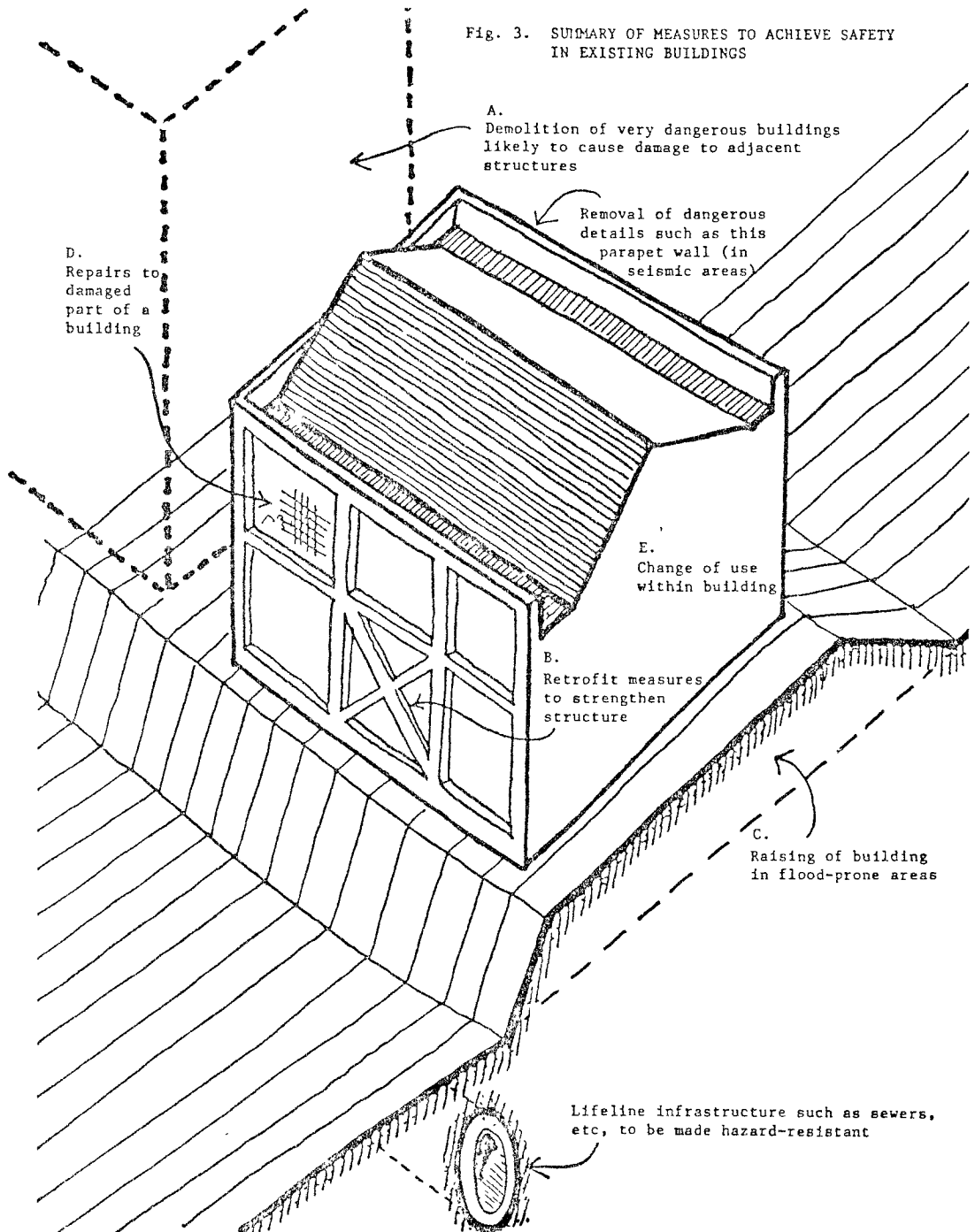
There are obvious design implications in creating structures to resist the impact of abnormal seismic, wind or flood water forces. Whilst knowledge is well established for high investment building technology (engineered structures) there are extensive vernacular building traditions where there is very limited knowledge of precise structural safety requirements. This is an appropriate target for research and development initiatives.

CONTEXT 3

Existing Building Stock

Attention to this category can involve physical measures as well as planning measures. (See Fig. 3 for a summary of measures to achieve safety in the improvement of existing structures.)

Fig. 3. SUMMARY OF MEASURES TO ACHIEVE SAFETY IN EXISTING BUILDINGS



PHYSICAL MEASURES

A. Demolition of Unsafe Buildings

In certain instances where buildings have been severely damaged in a disaster, where they are highly vulnerable, or where they are a lifeline installation, demolition may be the only appropriate solution. However, given economic realities this will be a rarely used option.

Demolition may relate to specific unsafe building elements, such as unbuttressed parapet walls, tall unreinforced chimneys, etc.

B. Retrofit

Structural measures will need to be adopted. Typical examples of this process in a seismic region could be to remove dangerous parapet walls, or to insert structural measures such as sheer walls or triangulated bracing. In areas subject to high winds, measures could include strengthening the roof structural connections, installing shutters on all windows, and in buildings within surge areas to modify the substructure so that all supporting walls are at right angles to the flow of flood waters.

In view of the vast cost in strengthening all buildings against hazard impact it is necessary to be highly selective and a subsequent topic - 'Lifeline Measures' (see below) will address the issue of establishing priorities.

C. House Raising

In flood-prone areas it may be possible to rebuild a house on a raised base. (This is particularly appropriate for timber frame structures.

D. Repairs

A neglected area of the subject is the need to repair damaged structures in a safe manner. Specialist advice will generally be needed here since damage will weaken a structure that may be highly vulnerable to future hazards. Therefore repairs will be needed that are structural rather than cosmetic.

PLANNING MEASURES

E. Change of Use

Following a structural analysis of buildings, certain vulnerable structures may need to change their patterns of use. For example, a warehouse, with minimal occupation may replace a workplace with multiple occupation.

In all the above actions to reduce risks a recurring theme has been the need to develop priorities, both in new building and more specifically in attention to the existing building stock. Therefore the following topic can relate to all three contexts of Reconstruction, New Building and the Existing Building Stock.

LIFELINE MEASURES AND GOVERNMENT MODELS OF SAFE PRACTICE

A priority focus of governments will be on the safety of roads, bridges, water supplies, sewage systems, electrical and telephone services, and strategic buildings such as radio/TV stations, medical buildings, police stations, buildings of public assembly, schools, etc.

OUTPUTS FROM IMPLEMENTATION

The output of an effectively implemented risk reduction strategy is protected lives and property, increased local self-reliance, and an

educated population able to plan itself to reduce its vulnerability to future disasters.

But in much more specific terms effective implementation will apply with a sharp focus to certain lives that are particularly at risk, and on property that a given community cannot afford under any circumstances to lose. This will be the minimum standard of protection, but above this, as the strategy expands, it can embrace all areas of life.

In very few countries the development of protection will need to 'start from scratch' - with minimal measures in place. In most countries (whether industrialised or developing) some of the measures listed here and in the full Manual will already exist - but they may need to be developed.

What is needed is a long time perspective, recognising that it may take at least 50 years to implement measures step by step to build up a strong 'castle' of integrated risk reduction.

But to reach the end of this road requires the first step to be taken. That is where this Executive Summary, and the full Manual, will provide both the map for planning that route and certain key information on the necessary technical details for building a sound, long-lasting and socially responsive approach to disaster mitigation.