Chapter 4

Information Requirements for Pre- and Postdisaster Assistance

This chapter has two basic purposes: (1) to discuss the data requirements for pre- and postdisaster response; and (2) to examine current information collection and usage practices at the AID/OFDA. The stated objective of the AID/OFDA's international disaster assistance program is to respond to the needs of disaster victims. The following discussion details the serious problems of defining and measuring these needs and shows that the pursuit of this objective involves both pre- and postdisaster information requirements.

Data Requirements for Disaster Response

The Committee has identified four key types of information related to international disaster assistance: (1) hazard analysis, (2) vulnerability analysis, (3) disaster-relevant resource analysis, and (4) assessment of agent impact and victims' needs.[1] These information requirements have relevance to the entire range of pre- and postdisaster problems, and they should be of concern to all agencies prepared to respond to disaster-generated problems. Their interrelationship can be simply illustrated. Hazard and vulnerability analyses are directly related to problems of disaster mitigation and preparedness. However, data gleaned from these analyses are also of potential use in measuring disaster impacts, which, of course, dictate short-term response modes. Furthermore, the importance of measuring disaster impacts is not exclusively tied to the immediate emergency period. The effects of disaster have both long-term and short-term dimensions, and their measurement is a necessary component of both recovery activities and subsequent hazard and vulnerability analysis. Thus the conceptual framework for evaluating disaster response must be broad, and the effects of short-term emergency response must be viewed in relation to their long-term consequences.

The largest number of U.S. government disaster relief operations have been in response to natural disasters. The conceptual framework provided in this chapter has as its greatest relevance to this type of disaster, and, in that sense,

[1] Selected references relating to information requirements for pre- and postdisaster response are included in Bibliography B at the end of this report.

this chapter is directed to what have previously been the more frequent and continuing operational needs of the AID/OFDA. However, the greatest percentage of U.S. government disaster assistance expenditures during the period 1965-1975 has gone to disasters involving civil strife and civil war; the vast majority of these expenditures are tied to two events: the previously mentioned civil wars in Pakistan (Bangladesh) and Nigeria-Biafra. Our discussions of hazard analysis and vulnerability analysis have little applicability to civil strife or civil war disasters. Our discussions of the analysis of disaster-relevant resources and the assessment of agent impact and victims' needs, while still clearly relevant, exhibit little appreciation of the tremendous operational problems presented by events of these kinds.

1. *Hazard Analysis* For purposes of this discussion, a hazard is defined as a potentially harmful condition whose existence and magnitude of occurrence can be expressed in probabilistic terms. Hazards analysis involves the collection and assessment of data on past or potential hazards in terms of their nature, causes, frequency, distribution, and effects. Although this section draws selectively from existing scientific knowledge about natural disasters to illustrate points of discussion, the primary purpose here is not to summarize the current state of knowledge regarding the entire range of disasters that confront humanity. Instead, this section deals in a generic sense with the basic methods and resources of hazard analysis as they relate to a rational assessment of disaster events and to decisions about how to respond to these events. For example, the implementation of realistic disaster prevention or preparedness measures is directly dependent upon the ability to evaluate hazards and to anticipate the occurrence of potentially harmful events. Thus the goals of hazard analysis are to understand the patterns of occurrences and the effects of past events and to predict the same for future events.

The emphasis here will be on natural disaster agents of geophysical origin, because the predictive potential of hazard analysis is presently somewhat greater for events of these types.[2] However, one should also note that hazard analysis has been applied to a variety of human activities and technologies, most often in an attempt to isolate risk-benefit trade-offs.[3]

An extensive list of geophysical agents might include tropical cyclones; tornadoes and severe local storms; river and flash floods; earthquakes; tsunamis; lightning-induced large-scale fires; weather-induced droughts, frosts, and freezes; volcanoes; landslides; avalanches; and coastal erosion. All of these

[2] See G. F. White and J. E. Haas, *Assessment of Research on Natural Hazards* (Cambridge, Massachusetts: The MIT Press, 1975).

[3] For a review of this literature, see A. J. Van Horn and R. Wilson, *The Status of Risk-Benefit Analysis* (Cambridge, Massachusetts: Harvard University, Energy and Environmental Policy Center, 1976).

geophysical agents produce disasters of varying frequency and intensity. Each represents a complex series of events, and many are highly interrelated. Tropical cyclones, for example, may include the effects of direct damage from high wind, as well as secondary effects in terms of storm surge and flooding. Similarly, earthquakes may cause direct damage due to ground shaking and secondary effects through tsunamis and landslides. Geophysical events may also work in combination, as in the case of forest and grass fires involving the coincidence of intense fire, wind, and lightning.[4] The major natural disasters of recent experience have resulted primarily from droughts, tropical cyclones, floods, and earthquakes.[5] Analyses of these various hazards are based on recorded data on the effects of relevant hazard criteria such as those cited above. A specific product of hazard analyses could be a map indicating areas likely to be hit hard by expected natural events. In the case of earthquakes, such a map may indicate zones associated with the estimated peak intensity of ground motion over a particular period of time. Long-term estimates of this kind are uncertain to a significant degree and, thus, are generally expressed in probabilistic terms.

Hazard analysis and hazard forecasting require large amounts of analytic data. For example, climatological studies require a long record of comprehensive and reliable data—the longer the period, the more accurate the analyses and forecasts. More specifically, a tropical cyclone emergency requires meteorological monitoring and real-time forecasting. Monitoring is carried out by collecting data from networks of stations that observe surface and upper-air conditions, by interpreting cloud pictures transmitted by satellite, and by using special facilities such as weather radars and reconnaissance aircraft. The requirements for forecasting are concerned with the intensity of the tropical cyclone, its direction and speed of movement, the expected place and time of landfall, the strength of the wind, the amount and duration of rainfall, and the probability of storm surge.[6] Earthquake hazard analysis requires data

[4] For general overviews of the event patterns of natural hazards, see A. E. Scheidegger, *Physical Aspects of Natural Catastrophes* (Amsterdam, Netherlands: Elsevier Scientific Publishing Company, 1975); B. A. Bolt, *et al.*, *Geological Hazards* (New York: Springer-Verlag, 1975).

[5] This point is documented in the AID/OFDA historical data files as well as by a number of global overviews of disaster events. One should note again, however, that the validity of much historical disaster impact data is questionable. See, for example, J. Dworkin, *Global Trends in Natural Disasters, 1947-1973*, Natural Hazards Research Working Paper No. 26 (Boulder, Colorado: University of Colorado, Institute of Behavioral Science, 1974). See also, E. K. Kroeger, "Disaster Management in Tropical Countries," *Tropical Doctor*, Vol. 6 (1976), pp. 147-151; J. H. Latter, "Natural Disasters," *Advancement of Science*, Vol. 25 (1969), pp. 362-380.

[6] See A. V. White, *Global Summary of Human Response to Natural Hazards—Tropical Cyclones*, Calgary Report No. 19 (Calgary, Canada: 22nd International Geophysical Congress, 1972). See also, World Meteorological Organization, *Quantitative Evaluation of Disaster Risks—Tropical Cyclones* (Geneva, Switzerland: WMO, 1977).

provided by seismographic-monitoring programs that can be expressed on maps depicting seismicity, seismic risk, faults, and geologic hazards. These are based on probability estimates developed from frequency analyses of historical data. Considerable recent interest has also been directed to earthquake prediction, although there is currently much uncertainty about both the form that scientifically credible earthquake predictions will take and when these predictions will be forthcoming.[7] However, earthquake scientists agree that, in order to develop a reliable earthquake prediction capability, a network of highly sensitive instruments must be deployed; these instruments are used to monitor precursors such as microearthquakes and fault movements, as well as the day-to-day activity of major faults.

From the above examples one can see that hazard analysis depends on large amounts of data, a variety of methodological tools, and scientific judgment. In both the study of the mechanisms of natural phenomena and the estimation of future hazard patterns, advances are largely dependent on the acquisition and processing of relevant environmental data. Expansion of the volume and quality of data resources is essential to the improvement and application of the present predictive methodologies. For most geophysical hazards the instrument records and historic records cover only a minute portion of the time scale of geophysical events. Furthermore, detailed data collection has been limited largely to the developed world. Most of the developing countries currently suffer from limited data resources and inadequate systems for monitoring and data collection.[8]

The data collection methods are available, but the collection and utilization of technical data to mitigate disasters is lacking. For example, the reduction of a potential natural disaster risk requires the mapping of the risk at appropriate scale. Such mapping must be based on some understanding of the mechanisms of the phenomena, the locations and intensities of past occurrences, and the characteristics of its past impacts on human settlements. These maps might include, among other things, location of floodplains, areas of wind exposure, areas subject to coastal flooding and tsunami run-up, active volcanoes, indication of slope instability, zones of earthquake risk, and avalanche risk. Ideally, such mapping should be carried out at scales appropriate to the size of the planning unit—i.e., the larger the planning unit, the higher the scale. Although the preparation of such maps is of value for many planning applications, only a small proportion of the land area of the earth is covered adequately by current maps, even at a scale appropriate for planning

[7]See Panel on Earthquake Prediction of the Committee on Seismology, *Predicting Earthquakes: A Scientific and Technical Evaluation—With Implications for Society* (Washington, D.C.: National Academy of Sciences, 1976).

[8]This point is noted in a recent article on the drought in West Africa. See R. Baker, "The Sahel: An Information Crisis," *Disasters*, Vol. 1 (April 1977), pp. 1-23.

at a national level.[9] Because the costs of hazard mapping are great, developing societies generally tend to place low priority on this activity.

Present methods of environmental data acquisition include direct observations, instrument observations (which are more or less elaborate according to the dimension to be measured), and satellite observations utilizing the most advanced technology for remote sensing of the earth's surface and atmosphere. New systems for data acquisition generally supplement rather than displace traditional or conventional systems.[10] The organization of data collection involves local informants; networks of observing stations; telecommunications; and data processing at national, regional, and world centers. For example, with regard to meteorological data, the World Weather Watch program of the World Meteorological Organization (WMO) in the United Nations attempts to integrate the various observation techniques. The program includes three basic components: a Global Observing System, a Global Telecommunication System, and a Global Data-Processing System. The primary objective of the World Weather Watch is to make available to each member of the WMO the meteorological data and related environmental data required both for efficient meteorological services and for research. The three basic systems are being steadily implemented as national and international resources permit. Meteorological satellites are already providing a wide variety of data for both operational and research purposes. The advances to be expected in satellite technology and the further development of techniques for the interpretation of satellite imagery will enhance the capabilities for monitoring and mapping natural hazards.[11]

The measurements of the physical characteristics of natural phenomena have direct implications for issuing warnings. For example, a tropical cyclone can be detected at an early stage of its existence, and its subsequent history can be monitored in satisfactory detail. Cyclones can therefore be forecast with a useful degree of accuracy and reliability. In the case of phenomena such as cyclones, a warning system is of obvious value and is indeed indispensable for effective action to prevent and to mitigate disaster. A tropical cyclone warning system has the added advantage of providing an early warning of the possibility of a flood and storm surge that may be produced by the

[9]See V. A. Hood, *A Global Satellite Observation System for Earth Resources: Problems and Prospects*, report from the American Society of International Law to the National Science Foundation, Monograph NSF-RA-X-75-014 (Washington, D.C.: National Science Foundation, 1975).

[10]See Committee on Remote Sensing for Development, Board on Science and Technology for International Development, *Remote Sensing from Space. Prospects for Developing Countries* (Washington, D.C.: National Academy of Sciences, 1977).

[11]See D. S. Simonett, "Possible Uses of Space Satellites for Disaster Warning, Monitoring, and Damage Assessment," *The Role of Technology in International Disaster Assistance: Proceedings of the Committee on International Disaster Assistance Workshop, March 1977*, Committee on International Disaster Assistance of the Commission on Sociotechnical Systems (Washington, D.C.: National Academy of Sciences, 1978)

cyclone. In addition, any warning system must include not only environmental monitoring but also the preparation and dissemination of forecasts and warnings. Thus any warning system must necessarily be tied to local observations and to the local transmission of warnings. Information about local forecasts and warning alerts will, of course, be useful also for nonlocal disaster assistance programs.

The theme that runs throughout this discussion of hazard analysis is the need for accurate information--information needed to make rational judgments in anticipation of or in response to disaster situations. That same theme will characterize the discussion of the other three areas--vulnerability analysis, disaster-relevant resource analysis, and assessment of agent impact and victims' needs. It should not be inferred from comments here that the Committee believes the AID/OFDA must be a comprehensive storehouse of integrated hazard analysis data. The Committee does suggest that the above kinds of data are of considerable importance to all the AID/OFDA programs. For example, the relationship of hazard analysis to the AID/OFDA technical assistance and planning programs is direct. Currently available techniques of hazard forecasting and analysis would be most helpful to developing countries; the AID/OFDA provides one possible mechanism for promoting and instituting various forms of technology transfer. Specifically relevant to this report is the fact that hazard analysis provides important information for impact assessment and is therefore relevant to the AID/OFDA's disaster relief program as well. Moreover, the Office has a developing computer data bank, and it seeks to use the data bank for planning, operations, and technical assistance. The Committee believes that the Office must first consider the information requirements for disaster response in an analytical sense and then determine what it can reasonably accomplish with its own information system. The aim in this chapter is to contribute to both of those endeavors.

2. *Vulnerability Analysis* Vulnerability is generally referred to as the second component of disaster risk and is defined as the susceptibility to loss of a population at risk when a hazard of a given magnitude occurs. Population at risk specifies the number and distribution of persons and physical structures exposed to a hazard. Vulnerability analysis involves the collection and assessment of data on population and structures at risk, including data on the performance of buildings and lifeline systems during previous hazard events. Thus hazard and vulnerability analyses must be viewed in tandem. The vulnerability of an object or a community should not be thought of as a unique value. Rather we might speak of a "vulnerability function" representing various risks for a range of natural phenomena. Hazard analysis is largely concerned with the study of natural events over which man has little control. Vulnerability analysis is concerned with the human response systems to natural hazards that enlightened humans may control. All human actions that

either aggravate or mitigate the effects of natural hazards must be taken into account in assessing vulnerability.

Natural disasters are precipitated by natural events, but the actions of humans significantly aggravate the effects of natural disaster. Practices that degrade the quality of the environment contribute directly to increased disaster risk. Destruction of vegetal cover by overgrazing, deforestation, and urbanization dramatically increase the risk of destructive flooding and soil erosion. The apparent impact of these practices is subtle, but their effects may take a dramatic toll in loss and suffering.

The vulnerability of human settlements may be expressed in terms of probable future losses from natural disaster. These losses include death, injury, and damage to property, as well as secondary losses: economic loss from reduced commercial activity and loss of public revenues, of employment, and of services. Also, in the aftermath of disaster, there may well be medium- and long-term health effects, especially in vulnerable developing countries. Although more research into these long-term health effects is needed, one can see that any natural event that adversely affects water supply or crops will eventually affect the health of some of the population. Floods and storm surges may contribute to the pollution of wells and to the spread of disease. Destruction of crops or grain reserves will eventually be reflected in the deterioration of nutritional status. All of these factors increase vulnerability to a range of secondary losses. These secondary losses, which often greatly overshadow immediate losses, usually go unreported, although they are no less real for the disaster-stricken community.[12]

Vulnerability may be reduced by both temporary and permanent measures. Temporary measures are typically undertaken in response to disaster warnings based on forecasts of impending events. Temporary measures are often limited to evacuation and to attempts to reduce immediate property loss. Permanent measures to reduce vulnerability are based on long-term hazard analysis and may include nonstructural solutions, such as public education, environmental management, land treatment, reforestation, erosion control, tree breaks, wetlands preservation, coastal zone management, and land-use regulation, as well as structural solutions. In both the temporary measures of disaster preparedness and the permanent measures of disaster prevention there are two approaches to vulnerability reduction: avoidance

[12] A well-documented case is malaria in Haiti, following Hurricane Flora in 1963. That hurricane caused extensive damage to housing in Haiti—about 68 percent of the houses in the affected area were destroyed and most of the roofs were blown away. The disaster occurred during the course of an extensive malaria eradication campaign and flushed away the residual insecticide that had been sprayed on the walls of dwellings. A severe malaria epidemic, involving about 75,000 victims, developed approximately two months after the hurricane. Haiti's subsequent problems with malaria may have been in some way related to the occurrence of this hurricane. See M. F. LeChat, "The Epidemiology of Disasters," *Proceedings of the Royal Society of Medicine*, Vol. 69 (June 1976), pp. 421-426.

and resistance. Evacuation in the face of emergency and the recognition of hazard zones in land-use planning are two ways of avoiding the impact of disaster-causing events. On the other hand, emergency efforts at flood fighting and at providing structural reinforcement for buildings are actions directed to resisting the force of the natural event.

Analyzing vulnerability is an information problem, and the measurement of the vulnerability of a community or society to several types of disasters at any given point in time is extremely difficult. At the minimum, the following kinds of data would be required for *known hazard-prone areas*: number and geographic distribution of population, buildings, and lifeline systems (e.g., public works, medical facilities); measurements reflecting catastrophic loss potential (e.g., structures of high occupancy, such as schools and places of public assembly); and measurements reflecting vulnerability to secondary losses (e.g., industrial and commercial locations, dangerous materials storage). Once again, however, it is important to distinguish between vulnerability to specific disaster agents and general conditions of vulnerability and need in any given society. For example, the lower the basic economic condition of a society, the more vulnerable it is to a wide range of physical, economic, social, and political crises. If a society has high mortality and morbidity rates, basic nutritional inadequacies, poor sanitation systems, insufficient food supplies and distribution systems, and poor medical care systems, that society is obviously vulnerable to a host of problems. And if that society is undergoing urbanization with insufficient economic growth, its cities face severe difficulties. Compared to these conditions, vulnerability to geophysical hazards such as earthquakes and floods becomes insignificant. Thus the primary issue is not the vulnerability to "disaster," but vulnerability in terms of the general level of societal development. However, response at that level would require a long-term development strategy rather than a short-term disaster assistance program.

In view of the need for an understanding of broad societal conditions, this section will illustrate the vulnerability to specific natural disasters with a brief discussion of physical structures and lifeline systems. Buildings shelter and support most human activities. Thus the prevention of building collapse also prevents much human suffering, the reduction of building damage greatly reduces property loss, and the continuous functioning of buildings supports emergency activities and encourages the return of normal economic and social functions. Natural events affecting buildings may be measured in terms of the added loads they imply. Earthquakes and extreme winds, for example, produce closely related dynamic loads and mobilize similar resistance mechanisms. Many natural events are characterized by increased lateral loading, lifting, or extreme vertical loading. Generally speaking, simple structures are built primarily to resist gravity; when subjected to strong forces in other directions, they fail. Much disaster damage can be eliminated through relatively simple measures that tie the elements of buildings together: tie roofs to walls; tie walls to foundations; and tie together frames to resist lateral and lifting forces of earthquakes, winds, and floods. Concern for structural performance under the extreme loading conditions of natural events is not only limited to conventional buildings, but also relates to the improvement of disaster resistance in lifeline systems such as water, power supply, transportation, and communication systems. Although measurement is less well developed here, concern for the resistance of lifelines is acute, because, as extended network systems, they are more likely to be exposed to damaging natural events and because their failure is of potentially greater consequence than the failure of isolated structures.[13]

While the results of the scientific study of natural events may be applied universally, studies of vulnerability and social response to natural disasters are to a much greater extent confined to specific locations. Consider the case of building codes. In the developed countries, extensive engineering research has been carried out on the performance of buildings and facilities under natural hazard loadings. Sophisticated means of analysis and design have been developed. This work is to a large extend reflected in most recent design standards. However, it is generally restricted to sophisticated and expensive building types.[14]

The building types covered by existing building codes from the developed countries are of limited relevance to the developing world, where, during natural disasters, the great bulk of building-related fatalities have occurred in simple nonengineered structures, typically of adobe or other local construction. Social and economic factors affecting construction in developing countries include shortage of funds and materials; heavy migration of rural population to urban centers; rapid population growth; insufficiently developed communications, transportation, and distribution systems; shortage of skilled labor; and often low standards of workmanship.[15]

[13] For discussion of these topics, see W. F. Reps and E. Simiu (eds.), *Design, Siting, and Construction of Low Cost Housing and Community Buildings to Better Withstand Earthquakes and Windstorms*, prepared for the U.S. Agency for International Development by the National Bureau of Standards, Report No. NBS, BSS-48 (Washington, D.C.: U.S. Department of Commerce, National Bureau of Standards, 1974). See also N. J. Raufaste and R. D. Marshall, *Progress Report on Design Criteria and Methodology for Construction of Low-Rise Buildings to Resist Typhoons and Hurricanes*, prepared for the U.S. Agency for International Development by the National Bureau of Standards, Report No. NBS, SIR-74-567 (Washington, D.C.: U.S. Department of Commerce, National Bureau of Standards, 1974); R. V. Whitman, *et al.*, "Analysis of Earthquake Risk for Lifeline Systems," *Proceedings of the U.S. National Conference on Earthquakes Engineering* (Oakland, California: Earthquake Engineering Research Institute, 1975), pp. 377-386.

[14] See, for example, R. V. Whitman, *et al.*, *Methodology and Pilot Application*, Seismic Design and Decision Analysis Report No. 10 (Cambridge, Massachusetts: MIT, Department of Civil Engineering Report R74-15, 1974).

[15] One should note that considerable improvement of the hazard resistance of structures

Information gaps concerning vulnerability are particularly pronounced in developing countries. Many local materials or construction systems have not been studied scientifically. Their technical design parameters are therefore not known. Records of natural-event occurrences are not available in many regions. Even if the required data were available, the application of building standards to low-cost or low-income housing for disaster prevention purposes is a matter that requires considerable flexibility. The administrative costs are high. The development and implementation of building standards are costly; the greater the resistance of a structure to physical damage, the more costly the structure becomes.[16] Low-income groups in most developing countries can ill-afford the additional costs required for substantially increased structural strength to prevent houses from collapsing in the face of wind, water, or seismic shock.

The conclusion to this section is similar to the final comments about hazard analysis; namely, the Committee does not believe that the AID/OFDA should necessarily become a comprehensive storehouse of data on vulnerability. However, the above kinds of information are of direct relevance to all of the AID/OFDA disaster assistance programs. Given the potentially vast amount of information that can be generated, both the location of stored data and the distribution systems for its use become increasingly important issues–issues particularly timely because both the AID/OFDA and the UNDRO are attempting to develop centralized data-retrieval systems. For example, information on vulnerability that may be used in developing disaster mitigation and preparedness programs is to a large extent tied to specific countries or geographic areas. These uses suggest that the location of vulnerability data should be decentralized. However, both vulnerability and hazard analysis data are important for agent impact assessment and subsequent disaster response. Effective use of vulnerability and hazard analysis data in this context therefore implies ready accessibility to a centralized information system by groups within the affected country and also by international disaster response agencies.

3. *Disaster-Relevant Resource Analysis* Disaster response requires a broad range of human and material resources. Human resources are personal

---

widely used in developing countries may be achieved by relatively simple measures. These include the horizontal bracing of certain types of roofs over adobe masonry houses, rational distribution of openings in shear walls, provision of adequate walls or frames to withstand concentrated seismic load action, reinforcement of critical areas susceptible to being overstressed, and strengthening of connections at critical joints. See Ranfaste and Marshall, *op. cit.*

[16] See, for example, R. D. Larrabee and R. V. Whitman, *Costs of Reinforcing Existing Buildings and Constructing New Buildings to Meet Earthquake Codes*, Seismic Design and Decision Analysis Report No. 28 (Cambridge, Massachusetts: MIT, Department of Civil Engineering Report R76-25, 1976).

skills and knowledge that can be utilized in organized responses to disaster-generated demands. Material resources may take the form of specific disaster-relevant items such as debris-clearance equipment or particular kinds of facilities, such as hospitals. Thus these resources are logically those that relate to either agent- or response-generated demands. Agent-generated demands include task areas, such as warning, preimpact preparation, search and rescue, care for the injured, restoration of essential individual and community services, protection against continuing threat, and maintenance of community order. Response-generated demands include problems, such as communication, continuing assessment of the emergency situation, the mobilization of human and material resources, coordination, and control.

If the primary objective of international disaster assistance is to respond to victims' needs that have not been met at the local level, it is important that agencies like the AID/OFDA have documented information on the capability of developing countries to respond to various disaster-generated demands. Two general information requirements in this regard have emerged: the first relates to the *level of disaster preparedness* in the disaster-stricken society, and the second relates to what might be referred to as the *general resource profile* of that society.

a. *Level of Disaster Preparedness* Level of disaster preparedness is not something that can be readily measured either quantitatively or qualitatively, and disaster research has yet to document precisely the utility of preparedness activity. For example, the existence of a disaster plan does not necessarily mean that the operational capabilities to carry out the plan also exist. Furthermore, there is no necessary relationship between the level of detail in a disaster plan and its usefulness. To the contrary, a cumbersome and out-of-date plan may do more harm than good. The more general point is that disaster planning must be seen as a continuous process rather than a completed product. Although level of preparedness is difficult to document, there are a number of relevant items of information that can be monitored.

First, citing the existence of national, regional, or local disaster plans is of little use, but specific descriptions of their contents gives some insight into the problems being considered. Second, the levels of hazard analysis and vulnerability analysis that have been completed in a society suggest an impetus to preparedness and should be documented as should any mitigation measures that have been taken. Third, standby emergency facilities and equipment (e.g., emergency operations centers and specialized communications equipment) should be recorded wherever they exist. All of the above represent specific dimensions of societal preparedness that outside responding agencies should be aware of in organizing their own responses. However, since preparedness is a constantly changing process and must be reasonably continuous to be effective, it logically follows that the monitoring of that process should also be sustained. In the case of the AID/OFDA, this suggests the necessity for regular contact between its technical assistance staff and officials in developing countries, so that information about preparedness can be updated. This information should form the basis of a detailed and integrated written assessment of societal preparedness that becomes a part of the basic preparedness profile of the country.

A fourth preparedness information item relates to disaster experience. Although communities experiencing repetitive emergencies have not been systematically studied, there appears to be some consensus in the literature that disaster experience involves a learning effect that may contribute to preparedness.[17] Disaster experience would include such indicators as the frequency of disasters and disaster threats and aggregate measurements of previous agent impacts. The logic is that certain events may represent a disaster for one community, but not for another because of the second community's considerable experience with repetitive emergencies. The disaster impacts may be similar and the societal and community characteristics may be similar, but the ability to cope may still vary substantially. However, one should note that the interpretation of this learning effect is generally couched as a societal and cultural adjustment to an event whose magnitude is anticipated. Experience can also provide a false reference for future preparedness requirements, because predicting the occurrence and magnitude of future events on the basis of past experience involves uncertain probabilistic judgments.[18]

A fifth preparedness information item suggests that time has a diminishing effect on the level of disaster preparedness when there has been no intervening disaster event. For example, the occurrence of disaster often leads to a flurry of planning activity, but these efforts noticeably weaken with time when no new threats or impacts from disaster actually occur. This same planning is also tied to a particular experience and may be only partly generalizable to other events. Thus the historical timing and patterning of events are important sources of preparedness data as well.

In all of the above, the Committee does not argue that any information system can maintain a definitive accounting of the level of societal preparedness for disaster. At present, there is some documented knowledge of *selected* aspects of preparedness at the national level of *some* societies. Far less is known about preparedness at the regional levels of these societies and very little about what is going on at local levels. But there is an even more basic technical problem. Although the Committee believes that most researchers and practitioners in disaster work are convinced that disaster preparedness

[17]See R. R. Dynes, E. L. Quarantelli, and G. A. Kreps, *A Perspective on Disaster Planning* (Washington, D.C.: Defense Civil Preparedness Agency, 1972).

[18]See I. Burton, R. W. Kates, and G. F. White, *The Human Ecology of Extreme Geophysical Events*, Natural Hazards Research Working Paper No. 1 (Toronto, Canada: University of Toronto, Department of Geography, 1968).

helps, everyone concerned knows far too little about the actual relationships between disaster preparedness and effective disaster response. However, the Committee is quite willing to argue on logical grounds that preparedness is an important social as well as technical dimension. As noted earlier, there are many information cues about preparedness that should be monitored and stored.

b. *General Resource Profile* Communities and societies vary greatly in their basic economic, social, and political conditions, and these variations relate to their abilities to cope with disasters. For example, disaster preparedness is not generally well developed in some areas of the United States, but the U.S. domestic disaster response capability is clearly enhanced by the tremendous amount of resources that can be mobilized to cope with the effects of disaster.

Any community or society has everyday needs that must be fulfilled. People require food, shelter, clothing, medical care, education, and other basic services, and these translate into demands for production, distribution, and consumption activities. Since these activities require some degree of order in their performance, various social control mechanisms are developed to insure conformity to laws and other norms. The allocation of resources to needs takes place in the context of an organized division of labor. The larger the social unit, the greater the demand for goods and services; and the greater the capability to generate resources, the more complex will the division of labor become. The implication is that the everyday resources of the community or society are in many ways quite important for disaster response. In some cases the importance of the resource does not manifest itself until after impact, e.g., the fortuitous proximity of bulldozers to roads that must be cleared. In other cases, the relevance of the resource is obvious before disaster strikes, e.g., the distribution of medical facilities. Disasters create broad demands for supplies, facilities, human skills, and organizational resources. These resource needs can never be completely anticipated, and, even if they could, there would still be problems in mobilizing them. Developing societies are generally deficient in the types of resources discussed here. At the same time, however, human communities are tremendously adaptive in responding to disaster events. In any event, the primary information problem is to isolate resources that are likely to be disaster relevant.

A discussion of health services points out resources that are likely to be disaster relevant and should therefore be measured. The health facilities in a country will be of substantial importance to relief officials in many disasters, but knowledge of their location relative to disaster sites will be crucial. Thus, at the minimum, the location of principal hospitals should be an important part of resource analysis. If microzoning is impossible, hospitals should at least be grouped by districts or provinces. Making geographic (rural versus urban) and administrative (public versus private) distinctions wherever pos-