

### **Policy and research considerations: dissemination and training**

The need to understand and define natural disasters and environmental degradation sources is critical to the design of prevention and mitigation measures. Governments need to review and assess policy options, as well as the costs and effectiveness of actions to prevent environmental degradation and reduce vulnerability to extreme events. Policies should be designed and executed so as to increase people's understanding of the way human activities affect the environment. Incentives of various kinds can influence them to act in ways that protect the environment and enhance resilience. Taxes and regulations can discourage or prevent resource mismanagement. The opportunity costs of disaster prevention and environmental management should be evaluated in comparison with the cost of postponing action until after disasters occur. At the same time, past experience should help identify vulnerabilities and highlight areas for policy action. Understanding the economic and social consequences of failure to consider disaster-vulnerability in development programs can provide important guidance for policy choices.

Innovation in social organization and financing as well as diffusion of technology are indispensable for mobilizing private initiative, resources, and cooperative action among countries. Disaster management and control technologies are crucial in reducing the impact of expected and predictable natural hazards. Yet, effective prevention and mitigation measures require an adequate understanding of the fundamental causes of natural disasters, of the nature of their effects, and of the techniques for coping with the effects (Merani 1991). International and national efforts should be mobilized in support of urban communities to create, share and reinforce scientific and technological knowledge as well as to encourage local applied research and mechanisms to analyze specific risks and to formulate targeted strategies. Building national and local capacities is thus, a fundamental task that developed nations should address to generate greater self-reliance of professionals in devel-

oping countries to disseminate research findings and to foster application of disaster reduction techniques. At the same time, government policies should encourage and ensure access to technology, information and efficient investment in education while providing incentives for private sector involvement in the development of and application of new technologies. Of particular interest is the transfer of preventive and mitigative technology from industrialized countries and sharing experiences horizontally between those likely to be affected by similar events either in terms of type of disaster, or in terms of the institutional and organizational efforts required.

Social, economic, or even political reasons in developing countries may preclude implementing measures which may be technically possible for developed countries. The obstacles to implementation, however, can be overcome if explicitly defined, feasible strategies are considered. For example, technical collaboration through cooperative ventures deserves further study as an option that could stimulate research and provide the ability to influence strategic choices and ensure a more effective decision-making process, particularly in disaster management. A major international effort is thus required to promote training and the exchange of experience to foster actions that reduce the risks in the urban centers through coordinated scientific and technical means. Priorities should be set, taking into account not only the community as a whole, but the interests of individuals as well.

### **Assessing costs and benefits of government responses**

A key issue in dealing with strategies that integrate disaster awareness into development planning is identifying the major goals of hazard abatement. From an economic point of view, the primary aim of prevention and mitigation investment decisions should be to reduce hazard vulnerability at the least possible cost. Thus, one necessary condition for an optimal policy is that each course of action considered must consider the tradeoffs that minimize undesirable consequences at least

cost. In weighing options, standard cost-effectiveness approaches that assess the actual outcomes of different alternatives associated with environmental degradation and potential natural hazards need to be addressed. This approach requires estimating both the anticipated damages and the cost-effectiveness of alternative response options. Each alternative should be regarded both in terms of the immediate effect and the impact on future economic prospects. The degree of sensitivity of affected human and natural systems may influence the acceptable risks that accompany the different kind of responses and actions to increase resilience. The assessment of costs and benefits may vary for each type of disaster and with the associated regional sensitivity. For example, extremely adverse and unpredictable events, such as earthquakes, would be accompanied by highly damaging effects and excessive costs in densely populated areas where development strategies and the application of technologies have increased the likelihood of damage should an extreme event occur. From a public policy point of view, an integrated approach to allocative efficiency and optimization decisions must consider the expected probability of disaster occurrence in particular locations, the vulnerability of the social and economic systems, and past market responses to disaster experiences. Also, in considering the allocation of public spending, priorities must be set toward those activities in which government participation is most critical.

In order to identify innovative solutions to allocative efficiency and better application of resources to priority problems, new approaches to recognized difficulties must be developed. A crucial question regarding efficiency-oriented policies are the choices concerning resource allocation. Ways to identify priority investments in the context of long-term disaster mitigation strategies remain key issues. An important constraint on both the public and private sector is how to deal with uncertainty factors concerning their decisions in regard to natural disasters. To the extent that natural disaster risk is a function of the likelihood of occurrence of a hazardous event, the uncertainty factor could be incorporated in

the economic analysis as a probability or as the potential threat posed by disasters to capital stock and productive assets (Vermeiren 1989). Reducing unpredictability about future hazards will require sorting human activities and physical sites according to criteria of vulnerability to extreme events. Because various actors involved may have differing objectives as well as diverging perceptions of risks, attempts to determine the effects of natural disasters on a local economy must be made considering prior experiences with hazards. Changes in the expectations—due to changes in resource availability because of a disaster occurrence—will generate a corresponding shift in market allocation of capital and labor. Hence, a key issue in disaster management is the careful analysis of the expected economic and social losses of a given community in the event of disasters. The convergence of public and private interests should be pursued through incentives and regulations, which by reducing vulnerability, may also provide a means to solve the financing problems of raising resources for the implementation of policies.

### **A framework for prevention and mitigation responses**

#### *Bank's activities*

The Bank can assist disaster-prone countries in efforts to reduce their vulnerability through the systemic integration of environmental concerns and risk assessment into its development activities. Bank assistance could be particularly helpful in the case of smaller or poorest countries where disasters may bring about substantial destruction in relation to country size and where the capabilities to take preventive measures are limited.

At the sectoral level the means to minimize the effects of disasters should be considered within a cross-sectoral framework. Natural hazard reduction and environmental management should be a major theme of the Bank's dialogue in disaster-prone countries, as well as an important element in its lending programs. In the specific context of policy-based operations, Bank's support for sectoral projects has had little success in evaluating

these projects against disaster vulnerability. Economic analysis often overlooks hazard recurrence (for example, a country with recurrent floods). In analyzing the recent economic performance of the country, a recent economic report stated that major floods last year contributed to and masked policy shortcomings, although with a return to normal weather and activity levels, these deficiencies have become more apparent in the current fiscal year. This kind of approach tends to conceal the fact that most analyses have failed to assess fully the causal relationship between overall economic performance and the negative impacts of natural hazards. In other words, in disaster-prone countries, the vulnerability factor should be "internalized" in the decision-making process and subsequently, prevention and mitigation components must be built into investment projects and incorporated in national plans and hazard reduction programs.

Procedures for mitigating the impact of future emergencies have been specified in the Bank's Operational Directive 8.50 (September 1989). Because prevention and mitigation issues tend to be multidimensional (involving, for example, multisectoral and environmental concerns, and both short- and long-term considerations), Bank prevention and mitigation assistance may take a variety of forms: (a) dissemination and adoption of hazard-resistant technology, (b) inclusion of mitigation components in normal investment operations and emergency recovery loans (ERLs), (c) preparation of free-standing preparedness and mitigation projects, and (d) establishment of close ties to the international and NGO community involved in disaster prevention and mitigation. Given the size of capital investment in major infrastructure, industry, energy, education, and housing projects, planning, design, and construction options should consider parameters that ensure an adequate margin of safety in the long run, taking into consideration the obsolescence factor if building and lifeline systems are to withstand the physical effects of recurrent disasters.

As part of its follow-up activities or ongoing country dialogue, the Bank can help disseminate up-to-date information on disaster

prevention/mitigation. In sector work and regular investment projects attention should be given to early warning systems and other technologies for emergency preparedness. Specific factors affecting risk or vulnerability such as seismic characteristics, topography and weather conditions, should be identified. Integration of risk assessments should also be considered in policy dialogue where the close connections between disaster proneness and unsound environmental practices would be stressed.

In countries prone to specific types of emergencies, free-standing prevention and mitigation projects is appropriate. Such operations could assist in (a) developing a national strategy, (b) establishing an adequate institutional and regulatory framework, (c) carrying out studies of vulnerability and risk assessment, (d) reinforcing vulnerable structures and adjusting building and zoning codes, and (e) acquiring hazard reduction technology. (World Bank 1989). The Bank is well placed to assist governments to gain access to new technology. The success in acquiring substantial improvements in this area will increasingly depend on the capacity to assimilate and adapt to new forms of organization needed to create strategic alliances among countries. The Bank can play a pivotal role in technology transfer through ensuring the appropriate training of its own staff and through identifying targets for transfer of technology. Practical and proven techniques for reducing potential losses should be applied in Bank's operations in disaster-prone countries. The ultimate objective of the Bank in this respect should be to stimulate dissemination of fundamental knowledge and know-how in hazard prevention and mitigation. Knowledge and managerial skills are central to long-term environmental protection and natural hazard reduction in developing countries.

#### *Public sector policies*

From a decision maker's point of view dealing with environmental hazards implies creating innovative ways to overcome resource constraints and chronic inefficiencies in the process of investment allocations. As mentioned earlier, the greatest difficulty in the

search for appropriate policy reforms and competent legislation and enforcement is the interdisciplinary nature of environmental problems compounded with the existing scarcities of financial resources in developing countries. Thus, the identification of efficient resource allocation alternatives requires (i) establishing priorities according to vulnerability, i.e., marginal cost of disasters; and (ii) effectiveness of vulnerability reduction i.e., the amount of disaster cost that can be avoided for each unit of dollar invested. Marginal economic analysis, together with technological considerations—engineering knowledge, risk assessment, forecasting and construction techniques—should largely determine the economic viability of disaster prevention measures. Precise estimates of the economic value of potential damage to human and productive resources combined with the technical and managerial capacity to use science and technology could offer alternatives to redirect public and private resources and increase the potential for private participation. The design of preventive policy options should be seen as a combined effort between the public and the private sectors. These policy options can be categorized as follows:

- (a) Policies that influence the pattern of urban development to avoid or mitigate the impacts of disaster.
- (b) Policies that offset damages by addressing neglected aspects of prevention-related issues.
- (c) Policies that increase the support of dissemination of research results concerning prevention and mitigation options.

Different types of policies lead to different political conflicts and approaches. The first type of intervention refers to incentives and constraints that operate between different levels in the social structure and are mostly addressed to private sector activities, i.e., lower insurance premiums and lower taxes for those observing land use regulations and/or building codes to encourage disaster-resistant structures (Natsios 1991). The second type includes regulatory measures and land use planning, zoning regulations, hazard insurance, and

building codes. The third type of policy addresses the difficulties of dealing with risk perception at the community level and refers to prevention activities that can be studied at the household and society levels, and include public education, awareness campaigns, evacuation plans, and research and application of scientific knowledge and engineering techniques. In comparing each type of intervention, emphasis should be placed on the technical feasibility of the measures that are advocated, the political acceptability of those measures, and the ability to foresee and avoid possible constraints.

### **How can we facilitate the transition to a safer environment?**

The complex nature of the linkages between urban environmental degradation and natural disasters raises the question as to whether efforts to protect the environment and enhance resilience can be dealt with from an economic perspective that does not address the issues of externalities, market failures, and nonquantitative variables associated with environmental problems. Perhaps the key to developing environmentally safe cities is to assume a mutual complementarity between economic policies that consider the consumption of environmental resources and hazard reduction policies. Enhancing resilience in urban areas should be seen as a means of encouraging incentives for development and private investment. There are several approaches geared to reducing the impact of disasters in urban areas. The success in choosing and implementing the appropriate response depends on (a) at the government level, an understanding of the problems associated with the hazard in question, as well as the available options; (b) at the individual level, economic capability, adequate knowledge, and understanding of the problems associated with the hazard in question, as well as the available options; and (c) at the community level, risk perception as well as access to financing for preventive actions that play a determinant role in the society response to investment decisions.

To meet the challenge, an active stance is needed to bring about major changes and creative ways to deal with the new international political and technological landscape. Redirecting investment toward productive use of scarce resources would help ensure an appropriate balance between development decisions and hazard reduction initiatives. Countries need to strengthen their ability to organize public spending in ways that would improve efficiency of investments and protect the environment. One alternative is to reduce defense expenditures. According to Preston (1991), reduction in defense expenditures would increase domestic saving, allowing a reallocation of scarce resources to other high priorities, and would reduce requirements for external capital. Presently, developing nations' arms spending amount to US\$170 billion a year, over 5 percent of their GDP and up to 20 percent of central government expenditures for the military, a major drain on their financial resources (Hewitt 1991; Glynn 1991). Between 1978 and 1988, developing countries imported US\$371 billion of arms, over three quarters of the arms traded internationally. A war between the great powers is no longer an instrument of political change. Prospects for reducing military spending in developing countries to improve efficiency of investments and reduction of external capital needs are feasible as well. A redirection of investment could concentrate on raising the level of understanding of public officials as to the effective alternatives to abate environmental degradation and to address the need for hazard prevention and mitigation in urban areas. Financial constraints, however central to the problem, are certainly not the only factors leading to unsuccessful attempts to reduce environmental vulnerability and improve disaster management in urban areas. Public officials are faced with many choices that raise questions, and knowledge and understanding of hazards, risks, and options are fragmentary at best. The necessary scientific and technological information and experience are not always available. In many countries there is a need for suitable training. Building national and local capacity in regard to natural disaster preven-

tion and mitigation needs to be integrated with an improved capacity also to deal with environmental emergencies.

### Technology dissemination and application

As noted earlier, policy options are closely linked to the technology available at a given time. Many emerging technologies offer various opportunities to implement new approaches to risk assessment, environmental protection, and disaster management. Recent advances in information technology, computing, and communications have made it possible to obtain improved assessments of potential impacts of catastrophic events. Special efforts are still required to (a) introduce risk assessment and management as a component of urban development activities; (b) assist local governments to develop hazard prevention strategies; and (c) identify mechanisms required for forecasting, monitoring, and warning of hazards. Serious considerations should be given to encouraging international and local government support of new and adequate technologies through technical assistance and diffusion of innovations in developing countries. Efforts to transfer appropriate technologies from developed to developing countries could take into account mutually beneficial new forms of contractual arrangements and alliances among governments and firms. Cooperation might take different forms which include facilitating research and negotiations, and brokering partnerships and joint ventures. This could lead the way for creative combinations to enhance functional capabilities in developing countries while providing new market access for industrial country firms. Collaboration between developed and developing countries requires continuous efforts at human resources development and reduction of barriers to information, capital and trade. Industrialized nations should take the lead in promoting the implementation of realistic international cooperation projects as well as in the offer of development assistance to developing countries. As with any other kind of alliances, the effectiveness of cooperation will depend on understanding what it has to offer

and its rules and obligations so as to achieve and adequate quid pro quo. International cooperation at the highest levels of government, as well as the removal of obsolete public policies could contribute more than any other action to the removal of structural constraints on addressing the changes brought about by urban development in the environment.

However, not all countries are in a position to explore and implement modern technologies fully. In developing countries, barriers, such as economic conditions and social and political structures, have been major obstacles for adopting programs to abate the risks associated with environmental degradation and disasters. To bridge this gap, a new type of cooperation must be forged among countries. Today, industrialized nations have developed an extraordinary capability for innovation, which is not always available and accessible to developing countries. Although industrial growth has been traditionally considered damaging to the environment, increased output does not necessarily imply increased pollution or environmental degradation provided that clean technologies reduce the pollution intensity of output (Wheeler and Martin 1991). Significant improvements in disaster prevention and environmental management could be made with already existing technologies. In most developing countries, lack of capital, scarce financial and managerial resources, inefficient public policies, and inadequate institutional structures are major obstacles to diffusing technical advances. In most cases, creative and relatively modest investments can provide the answer to reduce vulnerability by drawing experience from both developing and developed countries with similar problems, as well as developing channels for mutual collaboration.

### Summary and conclusions

All the evidence and opinions presented in this paper have two themes in common: (a) the two-way relationship between environmental degradation and disaster-proneness, and (b) the need of efficiency criteria for public and private sector interventions to

address environmental problems and disaster related issues.

Mounting concerns about the impact of disasters in populated areas has had important implications for the ways economists, environmental groups, policy makers and private investors have traditionally approached development. The complexity of factors involved in physical and social mechanisms concerning environmental degradation and natural hazards indicates that the objective of enhancing resilience requires fundamental shifts in public policy concerning disasters but also in scientific and technical innovation and dissemination. Analytical tools and programs in developing countries have focused on traditional economic criteria that do not necessarily address complex environmental problems or mitigation and preparedness measures. Developed nations are increasingly recognizing hazard and risk assessment as an important element of a balanced and comprehensive strategy to mitigate the impact of natural disasters. The implementation of this strategy inevitably involves allocation of financial and human resources which are always in short supply. Cost-benefit analyses, therefore are a consideration in determining whether to apply mitigation measures and in choosing between such measures (Merani 1991). The opportunity costs of disaster prevention and environmental management should be evaluated and compared with the cost of postponing action until disasters occur.

A frequently expressed concern about the viability of prevention and mitigation concerns the difficulties policymakers face in balancing the rising ecological and fiscal costs of supporting urban growth. It is argued in this paper that as soon as it is accepted that the least expensive and most rational strategy is integration of risk concerns in the development process, then a much wider array of policy alternatives opens up. More specifically, an efficient outcome will depend on wise use of policy instruments to encourage economic efficiency and environmental protection. For example, appropriate land use to reduce the economic and social impact of disasters, use of past experiences to identify vulnerabilities and use of knowledge and technical judgment

when siting and designing engineering works could be cost-effective approaches to hazard reduction. Reducing environmental vulnerability in urban areas requires a prior, essentially political decision to define the role of both public and private sectors, as well as the level of uncertainty and risk a society is willing to take. In other words, the choice from among different kinds of alternatives is about efficiency in the use of existing resources based on the social perception of risk. A question that arises is whether developing countries have the capacity for ensuring the effective participation of all parties in assessing risk. Such capacity includes an administrative structure and competence to establish a conducive climate for investment and the availability and understanding of new scientific and technical knowledge for risk assessment, monitoring, and warning. International responses to hazard reduction needs can have important implications provided that they build on a number of mutual agreement and that the nature of the tradeoffs involved are fully understood. Policymakers do need to determine the overall objective of disaster prevention in order to make choices between instruments and approaches. Moreover, effective cooperation among central and local governments and the international community on hazard reduction issues requires the share of experiences among countries and regions exposed to similar kind of natural hazards and the competent functioning of local agencies. It is essential to enhance and accelerate the sharing of information and experiences within and across countries and regions, to create and to reinforce assessment techniques, to encourage the adaptation of research results to different contexts, and to strengthen existing human resources, experience and facilities for the implementation of prevention and mitigation programs. Building national and local capacities with regard to natural disaster prevention and mitigation can be made from among a variety of means. Options include

- (a) diffusion of information among governmental decision makers as to the merits and cost effectiveness of hazard reduction programs;

- (b) identification of alternative options for better allocation of investment resources;
- (c) training in disaster mitigation techniques to facilitate the understanding of interactions between natural crisis and human activities; and
- (d) development of methodologies to assist national and local organizations in assessing risks.

Past experiences are helping to identify vulnerabilities and highlight areas for policy action. Understanding the economic and social consequences of failing to take into account disaster vulnerability in development programs can provide important guidance for making policy choices. Without a doubt, long-term benefits to disaster prevention depend on the combined efforts of both developing and developed countries and an adequate understanding of the fundamental causes of urban vulnerability, the potential costs of disasters, and the techniques available to reduce their effects. In view of this need, the Bank could consider formulating guidelines—in the form of an operational directive—to help policymakers implement programs to prevent and mitigate disasters.

Identifying the responsibilities of governments is of prime importance in formulating policy that responds not only to people's interests, but also helps cities function more productively in environmentally safe circumstances. Innovations in social organization and financing as well as diffusion of technology are indispensable for mobilizing private initiative, resources, and cooperation among countries (particularly the transfer of technology from industrialized countries). Social, economic, or political factors may hamper developing countries' efforts to implement measures. These obstacles, however, can be overcome if explicitly defined, feasible strategies are considered, for example, technical collaboration through cooperative ventures deserves further study as an option that could stimulate research and provide the ability to influence strategic choices and to ensure more effective decision-making process, particularly in disaster management. Successful attempts to reduce haz-