

THE SOCIOECONOMIC IMPACTS
OF
DISASTERS

Report and Summary of Proceedings of
the Fourth International Research and Training Seminar
on Regional Development Planning
for Disaster Prevention

Nagoya , Japan
4-5 October 1990

United Nations Centre for Regional Development
Nagoya, Japan

The World Bank
Washington D.C. , U.S.A.

UNCRD Meeting Report Series; no. 45

United Nations Centre for Regional Development
December 1990

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FOREWORD

In recent years, there has been an increasing alarm over the occurrence of disasters, including earthquakes, floods, cyclones, and volcanic eruptions. In June and July 1990, major earthquakes in Iran and the Philippines resulted in great losses, leaving vivid memories of these tragedies. When such disasters occur, people suffer from both physical and economic damages. A large number of lives are lost, and various kinds of facilities and housing are destroyed. In developing countries, where limited resources are available for national development, little attention has been given to disaster prevention measures; this has resulted in enormous losses when natural disasters strike, and in turn, imposes further constraints on national development. Thus, long-term post-disaster rehabilitation and reconstruction programmes as well as short-term emergency relief and recovery programmes need to be incorporated in their comprehensive regional development planning process.

To help meet these needs, the United Nations General Assembly adopted a resolution designating the 1990s as the "International Decade for Natural Disaster Reduction (IDNDR)." The objective of this resolution is to reduce the loss of life, property damage, and social and economic disruption caused by natural disasters, through concerted international efforts. The Decade opened in 1990, after a two-year preparatory period. Programmes concerning the Decade are now being undertaken in various parts of the world, and several are in the process of being considered.

As one of the major IDNDR activities, central and local governments of Japan and UNCRD co-organized an IDNDR International Conference 1990, Japan held on 27 September - 3 October 1990, in the cities of Yokohama and Kagoshima, Japan. The purpose of the conference was to promote the exchange of information and experience in disaster countermeasures along various countries during the initial year of the Decade.

Following the conference, UNCRD organized the Fourth International Research and Training Seminar on Regional Development Planning for Disaster Prevention held in October 1990, in Nagoya, Japan. Discussion at this seminar focused on the socioeconomic impact of disasters, especially on the lessons learned through the 1989 Loma Prieta earthquake in U.S.A. The output from the presentations and discussions of the seminar is summarized in this report.

The seminar's success was largely due to the active participation of experts, academicians, administrators, and numerous other individuals from developed and developing countries. Our heartfelt thanks are extended to those who contributed to the preparation of the seminar as well as during its entire conduct. We owe a special thanks to the various persons from the World Bank, Aichi Prefectural Government, Nagoya City Government, and the Tokai Bank Foundation; to all invited experts who presented their papers and comments, and cooperated in the seminar as chairpersons, speakers, panellists, discussants, and rapporteurs at each session; and to all participants. We look forward to their continued collaboration in the years to come, especially during the IDNDR.

25 December 1990
Hidehiko Sazanami
Director, UNCRD

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INTRODUCTION

BACKGROUND

The United Nations Centre for Regional Development (UNCRD) has been focusing its efforts on the importance of regional development planning for disaster prevention from its inception. In 1986, UNCRD organized the International Seminar on Regional Development Planning for Disaster Prevention in collaboration with related Japanese and foreign organizations.

Provided with the seminar recommendation summarizing the future direction of activities, UNCRD established the Regional Disaster Prevention Unit and started full-scale research and training activities on regional development planning for disaster prevention. Consequently, UNCRD intends to organize a training seminar on regional disaster prevention annually as one of its research and training activities, which will serve in concrete terms as a contribution to the IDNDR.

Since 1987 UNCRD has organized four International Research and Training Seminars on Regional Development Planning for Disaster Prevention – successively in 1987, 1988, 1989 and 1990 -- with the participation of experts and professionals both from within Japan and abroad. The first seminar was held in October 1987, in Tokyo and Nagoya, Japan, in collaboration with the Government of Japan. The seminar consisted of the expert group meeting held in Tokyo, and the training seminar held in Nagoya. The main objectives of the seminar were to: Investigate ways, at the expert group meeting, to strengthen the resilience of communities in developing countries through the integration of pre-, mid-, and post disaster measures in regional development planning; and set guidelines, at the training seminar, to compile curricula and teaching materials for organizing UNCRD'S pending training seminar.

The second International Research and Training Seminar on Regional Development Planning for Disaster Prevention was held in July 1988, in Shimizu, Japan, sponsored by the Institute for Social Safety Science, Japan and the Earthquake Engineering Research Institute, USA. The seminar consisted of six workshops during which the following themes were discussed: Policy problems in earthquake prediction; public and private preparedness ; earthquake vulnerability/damage estimation; fire hazards after an earthquake; short-term emergency responses; and long-term recovery .

The third International Research and Training Seminar on Regional Development Planning for Disaster Prevention was held in September 1989, in Nagoya, Japan. Discussions were undertaken focused on the following three themes: Flood disaster prevention and mitigation strategies from the viewpoint of information systems; Institutional arrangements to investigate the ways in which measures against flood disasters can be incorporated into regional development planning, such as through land-use regulations, safety evaluation of development and regional conservation, and infrastructural arrangements; and community participation to create safe residential environments.

This fourth International Research and Training Seminar on Regional Development Planning for Disaster Prevention held discussions on issues focusing on the socioeconomic impacts of disasters.

OBJECTIVES

The main objectives of this seminar are to consider the socioeconomic impact of disasters, with special focus on metropolitan contexts from the aspects of socioeconomic consequences of the disaster and reconstruction process, and to discuss issues on the identification of problems and necessary countermeasures. It also intends to identify the research topics requiring substantial attention at each institution concerned, including UNCRD, during the Decade and to provide the guidelines for training programmes with proper training materials which will be utilized in UNCRD'S training course on disaster management.

THEMES

The following issues are to be discussed at the seminar:

(1) Socioeconomic Consequences of Disasters in Metropolitan Areas (Case Study of the 1989 Loma Prieta Earthquake) .

- Issue 1: Socioeconomic Consequences of the Earthquake.
- Issue 2: Effects of Damage in the Transportation System.
- Issue 3: Impact on Small Businesses.
- Issue 4: Role of Earthquake Insurance.

(2) Socioeconomic Influences in the Reconstruction Process.

- Issue 1: Socioeconomic Consequences of Disasters
(Case Study of Latin America and Caribbean Countries) .
- Issue 2: Socioeconomic Consequences of the 1923 Great Kanto Earthquake .
- Issue 3: Socioeconomic Assessment of Rehabilitation/Reconstruction.
- Issue 4: Urban Planning after Disasters.

COLLABORATION

This seminar was co-organized by UNCRD and the World Bank in collaboration with Aichi Prefectural Government, Nagoya City Government, and the Tokai Bank Foundation.

This seminar was well attended, with thirty participants from developing and developed countries (Bangladesh, Belgium, Egypt, Fiji, France, Iceland, India, Indonesia, Japan, Mexico, Peru, Philippines, Turkey, United Kingdom, and U.S.A.), and two representatives from United Nations Organizations (the World Bank and the Economic Commission of Latin America and the Caribbean), and attended by more than one hundred other persons who were involved in some way with disaster mitigation and management, including national and local government personnel, researchers, journalists, and private company personnel.

SUMMARY OF PROCEEDINGS

1. OPENING

OPENING ADDRESS, by Hidehiko SAZANAMI , Director, UNCRD

Ladies and Gentlemen:

On behalf of the United Nations Centre for Regional Development, (UNCRD), let me express my heartfelt thanks to all of you for participating in the Fourth International Research and Training Seminar on Regional Development Planning for Disaster Prevention.

Since its establishment in 1971, UNCRD has dealt with issues relating to regional development in the rural and urban regions of developing countries. A major setback to the progress of regional development in those countries has been the repeated incidence of large-scale damage resulting from natural disasters. The need to minimize these adverse impacts has come to be increasingly felt in recent years. This has led UNCRD to a close investigation of the context of regional development planning.

The result of these effects was manifest in the International Seminar on Regional Development Planning for Disaster Prevention, organized by UNCRD in 1986, in collaboration with related Japanese and foreign organizations. Provided with the seminar recommendation, summarizing the future direction of activities, UNCRD established its Regional Disaster Prevention Unit and began full-scale research and training activities on regional development planning for disaster prevention in order to establish a comprehensive regional development planning method, to include disaster management technologies for the purpose of natural disaster mitigation.

Consequently, UNCRD intends to organize an annual training seminar on regional disaster prevention as one of its research and training activities, which will serve as a concrete contribution to the Inter-national Decade for Natural Disaster Reduction (IDNDR). Since 1987, UNCRD has organized three International Research and Training Seminars on Regional Development Planning for Disaster Prevention, successively in 1987, 1988, and 1989, with the participation of experts and professionals both from within Japan and abroad.

During these Seminars discussions were undertaken and views exchanged on comprehensive disaster prevention strategies in pre-, mid- and post-disaster phases. Participants raised many useful recommendations, which constituted valuable contributions to disaster prevention measures (earthquakes and floods) in urban and regional development planning.

The Fourth International Research and Training Seminar on Regional Development Planning for Disaster Prevention focuses upon issues relating to the socioeconomic impacts of disasters, with special focus on the metropolitan context from the aspects of socioeconomic consequences of disasters and the reconstruction process. In general, rapid urbanization causes population concentration into a few selected metropolitan areas. Much of this inflow of population to metropolitan areas is composed of those belonging to the low-income groups.

from rural areas. Upon reaching the metropolitan areas, in-migrants build low-cost accommodation in hazardous areas which should really remain uninhabited. Accordingly, vulnerability to disasters in metropolitan areas is gradually increasing. Thus, disasters in the metropolitan context in developing countries display complex phenomena combining a number of factors, including not only physical factors but also social and economic factors .

On the basis of this background, I am confident that the results of the Seminar will improve preparedness against natural disasters and help in mitigating their adverse impacts, in all nations, especially those from the developing world which are most prone to natural catastrophes.

At present, preparation is underway to implement the various programmes of the IDNDR in both developed and developing countries. I am sure that your endeavours will be a valuable contributory input for those engaged in formulating action programmes for the IDNDR. With this hope and trust, permit me to declare open this Fourth International Research and Training Seminar on Regional Development Planning for Disaster Prevention.

Thank you all.

PRESENTATION OF THEMES, by Isao Tsukagoshi, Senior Disaster Management Planner, UNCRD

Ladies and gentlemen:

On behalf of the Seminar Secretariat, I would like to briefly explain the objective and background to the seminar.

The resolution made at the 42nd United Nations General Assembly with regards to natural disasters that result in widespread damage specifically pointed out that the effects of such disasters may damage very severely the fragile economic infrastructures of the developing countries, and thus hamper their development process.

The report presented by the Secretary General at the 44th United Nations General Assembly raised, as one of the priorities for IDNDR action, a shift in emphasis to pre-disaster planning and preparedness while sustaining post-disaster relief capabilities. From this point of view, the foremost goal of the IDNDR is to formulate pre-disaster planning and preparedness measures for disaster-prone developing countries. The question is how we work together to reach this goal.

Since there are numerous disaster-prone regions throughout the world which require specific programmes and operations for disaster prevention, it would take many years and a massive budget to satisfactorily complete such operations in order to attain a less hazardous world. Therefore, a clear order of priority must be given to those programmes and operations. With this in mind, it is only natural that priority be placed in accordance with the vulnerability of the regions concerned.

However, the assessment of vulnerability factors is not a simple task. We need accurate information forecasting for indirect disaster impacts, such as socioeconomic impacts in particular, in addition to knowledge of disaster risks, and the amount of direct damage. We have to formulate a model of socioeconomic impacts that can assess how a disaster might hamper the economic development process of a developing country. This is the primary reason why we have planned and organized this seminar under the title of "Socioeconomic Impacts of Disasters."

The second reason results from our concern about the mitigation of damage. Until we can meet the goals of the IDNDR, we shall always have to cope with the occurrence of disasters without sufficient armour to protect ourselves and be obliged to attempt to minimize damage with the capabilities at hand.

In order to deal with this issue, it becomes absolutely necessary to be well-informed about the structure of damage development. It is widely recognized that disasters have a domino effect whereby damage indirectly leads to even further damage. By analysing this particular type of disasters, we might be able to work out an effective system that can serve in damage control efforts.

Especially in a number of developing countries, there is concern about economic repercussions, as well as social unrest in the aftermath of a major disaster. In this context, we should clarify the structure of disaster development and introduce a relevant model of socioeconomic impacts of disasters in order to prevent or mitigate this kind of disaster development .

With the expectation of an active dialogue on this subject, we have invited highly qualified experts in the field and organized two sessions during this seminar. The first session focusing on the socioeconomic consequences of the 1989 Loma Prieta earthquake, will be chaired by Professor Shigeru Itoh of the University of Tokyo. As an excellent example of an earthquake which had major repercussions in a fully developed country, the Loma Prieta earthquake attracted the interest of many experts who conducted studies from all aspects. From the United States, we have invited four experts who will present their reports on the Loma Prieta earthquake at this session from four different aspects, including post-disaster living conditions, the effects of a damaged transportation system, economic impacts, and the insurance industry's response.

The second session, chaired by Professor Michel Lechat of the Catholic University of Louvain, will be devoted to the topic of socioeconomic influences in the reconstruction process. In relation to this topic, four speakers will share their findings on separate major disasters, such as the recent natural disasters that took place in Ecuador and Nicaragua, the case of Mexico City, the 1923 Great Kanto earthquake, and the 1983 Nihonkai-Chubu earthquake in Japan.

The results of the presentations and the succeeding discussions will be edited and published by UNCRD as the report and proceedings of the research and training seminar. I am hopeful that this publication will be able to respond to the needs of researchers on this subject throughout the world and, at the same time, we would like to utilize the results as educational materials for senior level training courses for disaster management planners which are implemented in all parts of the world by international and national organizations and agencies including UNCRD.

This is a brief summary of what we expect for this seminar.

2. **SESSION 1: SOCIOENOMIC CONSEQUENCES OF DISASTERS IN METROPOLITAN AREAS (CASE STUDY OF THE 1989 LOMA PRIETA EARTHQUAKE)**

The first session was chaired by Shigeru Itoh and focused on the theme: Socioeconomic Consequences of Disasters in Metropolitan Areas (Case Studies of the 1989 Loma Prieta Earthquake)

The following four papers were presented for discussion during the session :

1. Post-Disaster Living Conditions in Large Cities: Implications of the Loma Prieta Earthquake
2. Inferences for Infrastructure Planning: Effects of the Loma Prieta Earthquake on Transportation
3. Economic Impacts of the Loma Prieta Earthquake: A Focus on Small Business
4. The Insurance Industry's Response to a Major Earthquake: Lessons from the Past and Suggestions for the Future

A summary of the main discussion resulting from these presentations follows immediately after the papers.

LESSONS FROM THE LOMA PRIETA EARTHQUAKE: CRITERIA FOR INFRASTRUCTURE PLANNING IN EARTHQUAKE COUNTRY, by James K. Mitchell

INTRODUCTION

The primary objectives of this paper are to identify major socioeconomic problems that arose in the wake of the Loma Prieta earthquake and to assess their implications for similar communities elsewhere.

The Loma Prieta earthquake provided an important test of the ability of large urban communities to survive and rebound from major natural disasters. The results of that test are mixed. On the one hand, loss of life and injuries were lighter than expected and emergency services generally responded quickly and effectively. On the other hand, property damage and other economic impacts were severe and protracted, and the recovery process has been plagued by unexpected difficulties. Most important, the Loma Prieta experience shows that human responses to disasters in large cities can be heavily influenced by factors of scale and complexity that are not present when disasters strike smaller towns and rural areas. Such factors should be given special consideration when planning for disasters in the world's rapidly urbanizing areas.

LOSSES AND SOCIOECONOMIC IMPACTS

At 5.04 p.m. on October 17, 1989 a magnitude 7.1 earthquake ruptured a 25 mile segment of the San Andreas fault centred about 30 miles south of San Francisco Bay. Though larger than any onshore California earthquake in the previous 37 years, the Loma Prieta event was much smaller than the 1906 San Francisco earthquake (8.3), and the period of ground shaking was brief (5-7 seconds). This was not the long-predicted "big one"! Considering the earthquake's magnitude and its location near a densely urbanized area of more than five and a half million people, there were relatively few deaths, injuries or major building failures. Sixty two (62) people were killed, 3,757 injured, 367 businesses were destroyed, and 13,000 people left homeless. (Earthquake Engineering Research Institute 1990) It is widely believed that an earthquake of the same magnitude on the Hayward fault - which runs through Berkeley, Oakland and other communities to the east of San Francisco Bay - would produce far heavier losses . (About 200,000 people lived within the area affected by strong shaking during the Loma Prieta earthquake; 3 million occupy a similar sized area along the Hayward fault.)

The earthquake produced a wide range of impacts that affected many aspects of the built environment and many sectors of society. Several broad analyses of the its effects have been published (Earthquake Engineering Research Institute 1990; Federal Emergency Management Agency/California Office of Emergency Services 1989). This paper focuses on three socioeconomic topics - mass media reporting, emergency assistance, and post-disaster recovery.

THE MASS MEDIA: REPORTING THE LOSSES

The Loma Prieta earthquake took place in a setting that was favourable. First, it occurred during intensive media coverage for three reasons. Live television and radio broadcasts of the World Series from the San Francisco baseball stadium. This is one of the premier annual media events in the United States. A sizable proportion of the population in the Bay area and the country as a whole were watching and listening to these broadcasts at the time the earthquake struck. Second, the Bay area is the fourth largest metropolitan region in the United States and is (Rogers 1990) normally well served by its own resident mass media. This, together with the presence of many temporarily-assigned recording crews, much remote and sophisticated outside broadcasting equipment and many out-of-town reporters, facilitated early and continued reporting to a national and international audience. Third, because the Bay area was the site of a catastrophic 1906 earthquake that has become part of the national folk memory, and because the area's landscape and quality of life are a highly valued part of the national heritage, the prospect of a large earthquake in this location elicited very high levels of public interest.

All of these factors favoured quick and complete reporting of the earthquake, but the local media's relatively low level of earthquake preparedness operated against it. A survey out in 1982-83 found that few new organizations were equipped to function effectively during a major earthquake. (Wenger 1990) The situation was not significantly better six years later.

When the earthquake occurred it received intensive news coverage, though initial reporting was often flawed and misleading. Many of the local media were unable to function effectively because they had not developed emergency plans or maintained emergency equipment. The state of California's disaster response organization did not activate its emergency broadcast system, thereby depriving the media of "official" information. Local news organizations had to improvise coverage as best they could to feed a large and strongly interested national audience.

Accurate reporting was hampered in various ways. In the 24 hours following the earthquake, the numbers of human deaths reported were five times the actual tally. Several days elapsed before a final total of approximately 62 deaths was agreed upon. The media also generally overestimated the extent of damage in San Francisco and Oakland, communities that were 70 miles from the epicentre but close to media bases of operations. They were slow to take account of losses in Santa Cruz and other communities near the epicentre that were not only isolated by landslides across access roads but also on the periphery of the metropolitan reporting area. Out-of-town media personnel were primarily sports reporters who possessed no direct experience of earthquakes and lacked knowledge of the local area. For example, when they tried to interpret televised scenes of damage, they often failed to understand what was being shown. Incorrect information had an important effect on people outside the disaster area. Television pictures of collapsed buildings, roads and bridges from relatively few sites of heavy damage, convinced viewers that losses in San Francisco and Oakland were of catastrophic proportions.

There followed an immediate outpouring of private voluntary aid for these communities. The scale of proffered assistance dwarfed the flow of private aid that typically reaches disaster-stricken areas in the United States. By contrast, victims of Hurricane Hugo - a 1989 storm disaster of comparable proportions to the earthquake - received significantly fewer and smaller donations from the US public. Moreover, when the American Red Cross sought to divert surplus donations from its urban earthquake relief activities in California to its rural hurricane activities in South Carolina, public opinion forced the plan to be shelved.

The experience of Loma Prieta clearly illustrates the importance of earthquake preparedness planning for the mass media. However, it also suggests that mass media reporting of disasters can be affected by the size and prominence of the community in which a disaster occurs. A large city or urban area that possesses extensive news and communications media can dominate disaster reporting in ways that distort national and international perceptions of the event. As a result, external aid may flow more readily to that city than to a disaster-stricken hinterland where devastation is less well-publicized. This occurs partly because the city has a numerical advantage over other places in terms of media personnel, equipment and facilities. It is also because large cities are more likely to be familiar to non-residents and information about such cities has a greater chance of engaging public empathy and compassion outside the affected region .

The dominance of big city media perceptions of natural disasters has important implications, particularly for developing countries. Heretofore we have been accustomed to portrayals of Third World disasters as predominantly rural phenomena. Since the number and size of urban centres in less developed countries is growing very rapidly (Johnson 1987; Dogan and Kasarda 1988), not only will the potential for urban disasters increase, but a bias towards reporting urban losses may also develop as these cities acquire their own mass media facilities.

EMERGENCY ASSISTANCE TO VICTIMS

The delivery of emergency assistance to the victims of Loma Prieta was strongly influenced by the heterogeneity of the affected communities. The disaster-impacted area contained many different ethnic, racial, economic and social groups, often in close proximity. As a result, the problems that arose, the range of interests at stake, and the spectrum of agendas for the use of post-disaster assistance, varied widely. Disaster assistance organizations, accustomed to operating among more homogeneous populations in the smaller communities where US disasters have typically occurred, experienced serious difficulties meeting the needs of clients. (Peterson 1990)

Linguistic diversity caused many problems. A large number of victims were recent immigrants and temporary workers who spoke Spanish, or regional dialects from Mexico and Central America, or Asian languages. English is the communications medium of most US public and private disaster relief agencies. For example, the Federal Emergency Management Agency possessed only English-language claim forms for distributing to victims. Few organizations possessed sufficient trained staff to respond effectively to

non-English speaking victims. Language difficulties were not confined to the disaster relief process. In the wake of the earthquake, the safety of non-English speakers who sought to enter unstable buildings was jeopardized because most of the warning signs were in English.

A related problem of illiteracy also hindered the reporting of disaster losses. A large but undetermined number of residents - including some who had been born in the United States - could not write or read the language that they spoke.

Differences between the social norms of the care-givers and the victims also came into play. Many impacted communities contained significant numbers of people whose lifestyles were unconventional from the perspective of the organizations that were deployed to provide disaster relief. Among others, these included: homosexual groups, drug and alcohol-dependant populations, and homeless people. The continuing plight of the poor and the homeless in inner-city neighbourhoods deserves special mention.

Approximately 13,000 people were left homeless by the earthquake. Middle and upper-income residents were re-housed quickly because they could afford hotel rooms or permanent replacement accommodations. But low income residents were not so fortunate. The earthquake destroyed the few houses the elderly could afford in Santa Cruz and the Marina district of San Francisco.

Oakland and other impacted communities contained an undetermined but ~ substantial number of people who were already homeless before the disaster struck. They included a mixture of welfare recipients, transients, j physically or psychologically impaired people, and other marginalized j groups. Personnel in relief organizations experienced difficulties in deciding who was a "victim" of the disaster and, therefore, eligible for assistance. Relief aid was often denied to people who had long been destitute but it was provided to others who lost property during the earthquake. In some places, fights broke out in emergency shelters between members of the "chronic homeless" and those who had been made homeless by the earthquake.

Some of the problems of emergency assistance that have been noted they have occurred in previous disasters. For here, are not new. example, difficulties in providing disaster relief to multi-ethnic, multiracial and multilingual communities have been noted in Hawaii, Utah, (Mitchell 1985; Bolin and Bolton 1986) However, Texas, and California. The Loma Prieta experience suggests that such problems are intensified in Moreover, the record reveals that disaster assistance large cities. organizations in large cities may be affected by social formations which are rarely present in the smaller communities of developed countries. These include - but are not limited to - organized and unorganized groups of homeless people, substance abusers, and practitioners of alternative lifestyles.

The experience of delivering emergency assistance to the victims of Loma Prieta has implications for cities in other countries. Similar problems are likely to emerge in existing large cities. As the process of global urbanization and international migration continues, the potential

for disruption in the wake of disasters will probably increase. Members of groups that are locally dominant and well separated from each other in different rural areas, are likely to find themselves thrown together with unfamiliar neighbours in densely packed urban areas. After disasters occur, the potential for friction among the urban poor will be likely to increase and the delivery of emergency may be hindered.

Some, if not most of the new urban social formations that have appeared in the San Francisco Bay area in recent years already exist in other cities. They may be replicated in Third World mega cities, and others - as yet unknown - may also appear there. Such changes in urban demography and urban ecology will have repercussions for the management of disasters and the provision of disaster assistance.

THE SLOW PACE OF REHABILITATION AND RECONSTRUCTION

Scars of the earthquake were still visible a year later throughout the impacted area because rehabilitation, reconstruction and redevelopment have often been slow to get under way. Based on analyses of previous urban disasters, it has been suggested that the rehabilitation period is typically ten times longer than the emergency response period and that reconstruction lasts ten times longer than rehabilitation. (Haas, Kates and Bowden 1977) In the case of the Loma Prieta earthquake it is widely agreed that emergency response was generally fast and effective. The emergency response period ended within three days. But rehabilitation continued for more than 90 days and reconstruction was correspondingly slow. At many sites that suffered heavy damage, reconstruction had not even begun by September 1990 (Schultz 1990).

Individual homes and businesses that were damaged have generally been repaired, or cleared and replaced. But several older business districts that were devastated by the earthquake had not been rebuilt (e.g. Watsonville) . Nor had the so-called mile-long "Cypress structure" section of Interstate 880 in Oakland been replaced. (Most of the earthquake fatalities were caused by the collapse of that elevated two-tier expressway.) Most of the poor and homeless victims of the earthquake were not adequately housed almost a year after the event. Some occupy temporary accommodations in public buildings or in "tent cities" where racial, ethnic and economic tensions run high. Others have joined the ranks of the homeless, but they now have even less chance of finding permanent shelter than before the earthquake occurred. In the meantime, several of the emergency shelters that house and feed victims cannot be returned to their normal functions. For example, some schools in Oakland continue to house poor residents who have nowhere else to go at present and little prospect of finding alternative accommodation in the future.

Several reasons account for the slow pace of rehabilitation and reconstruction. unresolved policy issues, such as the aforementioned eligibility of homeless people for public assistance, hamper recovery. Some projects have been delayed by lack of capital, by slow reimbursements of losses, or by disputes about the wisdom of rebuilding on sites where there are high risks of ground failures or other physical hazards. Others are delayed for more subtle reasons that are connected with changes in the metropolitan economy and with the re-emergence of long established, but

dormant, controversies about appropriate urban development strategies. For example, there is opposition to rebuilding downtown business districts that were already losing customers to suburban shopping malls before the earthquake struck (e.g. Watsonville). Some business people wish to abandon these sites, while others prefer to introduce urban design innovations such as pedestrian precincts that might lure back the lost elsewhere, (Santa Cruz) the anti-growth sentiments that had customers. previously fuelled successful opposition to the development of city-centre shopping malls, are being reassessed in the wake of damage to downtown. Similarly, many Bay area voters have long opposed commercial properties. the expansion of freeways on aesthetic, environmental, and energy. Proposals to tear down San Francisco's Embarcadero conservation grounds. Freeway, as well as to block the reconstruction of 1-880, probably stem from the fact that in proposed freeway development is controversial debates in the earthquake merely reopened old and rancorous development this region.

The potential for such debates is always present in large metropolitan areas and it increases in proportion to the size and complexity of urban centres. Major natural disasters provide appropriate opportunities for reopening old development debates or initiating new ones because they offer possibilities for adopting new urban forms and functions to replace those that were destroyed, and they hold out prospects for redistributing the benefits and costs of urban living. However, the larger and more complex the urban area, the greater the likelihood that redevelopment decisions will be controversial, costly and slow. Loma Prieta offers evidence that supports these propositions.

In affluent participatory democracies like the United States, the countries of western Europe and Japan, public decision-making about land use and development in metropolitan areas is difficult under normal circumstances. Local leaders and citizens who wish to participate must learn to operate within a multi-tiered and increasingly decentralized system of government. They must also devise ways of reconciling the interests of different municipalities that share common metropolitan regions. The complex socio-spatial patterning of large cities, and changes in urban and regional economies, introduce additional complications that are further exacerbated by rapid growth of population and associated demands for employment, housing and public services.

Natural disasters compound the difficulties of metropolitan decision making. Given the rapid pace of global urbanization, and the spread of decentralized participatory democratic governments from more developed to less developed countries, it is likely that the problems of post-disaster decision making in metropolitan areas will become more important throughout the world.

CONCLUSION

Cities are complex systems that are both vulnerable and resilient to natural disasters. *A priori*, the degree of complexity increases as a city grows. Because the size and number of cities is growing at a rapid rate in most countries it is likely that national patterns of vulnerability and resilience to disaster are also changing. As cities grow it seems

probable- that their vulnerability increases; whether their resilience expands at a comparable pace is open to question. Evidence from the Loma Prieta earthquake offers some clues to the evolving nature of changes in the vulnerability of very large cities. It suggests three possibilities: (1) big city disasters are likely to be better reported than rural counterparts; (2) the socio-spatial structure of big cities is likely to pose unforeseen problems for the delivery of emergency response services and disaster relief; and (3) recovery from disasters may be slower in big cities than in smaller communities because of difficult-to-solve conflicts about redevelopment. If these trends are confirmed by subsequent disasters in other large cities, they may herald a deepening and widening of the gap in opportunities for survival that already separates urban and rural communities throughout the world. However, all of the trends do not point in the same direction. The comparative disaster reporting advantages of large cities may enhance urban chances for survival, whereas the greater social frictions and more complex decision making processes that retard disaster recovery in metropolitan areas, work to the disadvantage of urban populations.

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INFERENCES FOR INFRASTRUCTURE PLANNING: EFFECTS OF THE LOMA PRIETA EARTHQUAKE ON TRANSPORTATION, by Melvin M. Webber

INTRODUCTION

The big news from the 1989 earthquake on the San Andreas Fault is that the transportation disruptions were only inconvenient, not dreadful. The metropolitan area lost the use of some large and critical transport arteries, cutting road capacity along key routes. Nevertheless, the Bay Area transportation system did not break down.

Employers accommodated in diverse ways. Many permitted employees to set their own working hours ("flex-time" they call it). Others shortened the work week, relocated work places close to employees' homes, permitted some employees to work at home, and in other ways tried to adjust to a truncated transportation system. Transport agencies responded quickly to keep undamaged facilities operational and to expand or install mass transit services where roads were closed. As a consequence commuters got to work without intolerable hardship. Trucks got their freight delivered, nearly on time. Some businesses suffered in the short-term, but only a few have not survived. By and large, the effects of the transportation system's failures were not nearly as bad as one might have expected.

DAMAGES TO THE TRANSPORTATION NETWORK

Japanese observers are no doubt aware of the major breaks in the metropolitan transportation system, because the international press and television reported them in graphic detail. Among the most dramatic breaks was the failure on the San Francisco - Oakland Bay Bridge where a supporting steel column slipped on its foundation, causing a section of the roadway to fall out of place. The bridge is the major artery connecting the two sides of San Francisco Bay. It was closed for a month while the broken section was rebuilt.

The Cypress Freeway, a double-decked concrete structure in the East Bay, was an artery that carried heavy traffic onto the bridge. During the 15-second earthquake, it collapsed completely; and it has not yet been replaced. Other double-decked-and-elevated concrete freeways in downtown San Francisco were cracked, and so were closed to traffic. They are now being repaired, but are not yet reopened. A major elevated, double-decked concrete section, the Embarcadero Freeway that borders the Financial District along San Francisco Bay, may soon be demolished in favour of a less-obtrusive surface road or a depressed road.

The Bay Area's topography closely resembles Japan's, with mountains separating sections of the urbanized area from the main mass of settlement. The city of Santa Cruz is in such a location, relatively isolated from the rest of the metropolitan area, lying behind mountains that are crossed by only one major road. Unfortunately, Santa Cruz lay very close to the quake's epicentre; it therefore suffered extreme damage to buildings. Half the buildings in the city centre either collapsed or were damaged

beyond repair. Among its greatest misfortunes was the loss of one main access road, cut off by a landslide and a collapsed bridge, blocking traffic in and out of the city. In the immediate aftermath of the quake, the obstruction on the access road prevented emergency equipment from getting to Santa Cruz when needed.

POST-QUAKE STUDIES OF TRANSPORT EFFECTS

Immediately following the earthquake, several researchers at the University of California in Berkeley and researchers in several governmental transportation agencies undertook a series of quick-response studies. Our aim was to assess the effects of this damage to the metropolitan transportation network.

Some studies sought to discover how the various population groups accommodated by shifting their routes, modes, and times of travel and how other studies traced the alternate arteries handled the added loads. Patronage of the rail rapid transit system (BART) and of the hastily installed ferry services. Another study examined the adjustments made by trucking companies that had to reroute and reschedule freight movements. Still another study monitored the effects on small businesses, while a parallel study examined the adjustments made by a sample of large corporations.

It must be obvious that a 7.1 earthquake with such extensive damage to critical transport arteries must have been extremely costly. Estimates place losses from the Loma Prieta quake at over \$8 billion dollars, making it the costliest natural disaster in American history. That is about twelve-hundred billion (or 12×10^9) Yen. Some additional cost must be assigned to the secondary losses resulting from the breakdown in accessibility. The surprise is that the losses were so low.

Our studies of the effects of major breaks in the metropolitan transportation network reveal three major reasons why traffic disaster did not follow the earthquake disaster:

Self-Adjustment Processes

Traffic systems, like market systems, have self-adjusting processes built into them. Urban travellers are remarkably adaptive. In the short-run, given the chance and given adequate information, they are quick to find ways around bottlenecks by adjusting their travel routes, their travel times, and their travel modes. In the long-run, though the workings of labour markets and land markets, job locations and residential locations become readjusted to accommodate to the constraints in the transportation system.

That is no news to either individual travellers or to transportation planners. Those short-run adjustments were clearly evident during the Los Angeles Olympic Games when dire predictions of horrendous traffic jams proved wrong, mostly because travellers anticipated the congestion and took counter measures to avoid it. The adjustments are observed every day of the year when a road becomes clogged and alert motorists find ways of avoiding the snarl ups. The long-term adjustments are evident in the huge

expansion of jobs and houses in the suburbs everywhere, the visible outcomes of individuals' and corporations' relocation responses to changing levels of accessibility.

We all know that traffic, like rainwater, seeks the easiest route, and that it redistributes itself over whatever space is available to it. So, it should have been no surprise that, when the Bay Bridge was cut off, transbay motorists quickly adapted by moving over to the San Mateo and Dumbarton bridges to the south and the San Rafael and Golden Gate bridges to the north, while many became BART riders or ferry passengers.

When the Cypress Freeway broke down, many motorists spontaneously moved over to parallel freeways and to local streets. When the Embarcadero Freeway was closed, cars soon found that local streets really do connect to the San Francisco Financial District.

It is also clear that transportation agencies are highly adaptive too. Despite all we hear about bureaucratic rigidity, when there was need for quick response last October, they sprang into action with sophisticated diagnoses and damage repair, with effective traffic controls and supplemental transit services, and with informative media campaigns that advised travellers about alternative routes and modes available to them.

Redundancy

The second reason the overall transportation system failed to fail is that the Bay Area is endowed with a fairly redundant transportation network. There is no more important feature of the Bay Area's system than this -- and no more important lesson from the October quake.

Because we had other bridges that could substitute for the Bay Bridge, motorists had several options to select from. Because we had an alternative channel with large and underused capacity in the BART tube along essentially the same alignment, a great many transbay commuters and others could get to their destinations on time by simply changing mode.

It is because we had redundant highway and transit channels that we were able to survive the severe damage to sections of the network without catastrophic loss. It is in part because Santa Cruz lacked such transport redundancy that it suffered unduly.

I wish we could say that the genius of our transport-system lies in the redundancy built into it by design. But it is quite unlikely that redundancy was deliberately planned --that we built parallel routes as an intentional hedge against breakdown in the system. Instead, our standard design criterion calls for just-enough capacity to meet expected traffic. Standard planning requirements call for least means --loads and no more. for minimum inputs in pursuit of maximum efficiency. They are not aimed at maximizing effectiveness.

Indeed, standard public administration doctrine holds that redundancy -- duplication or overcapacity -- is equivalent to wastefulness. However, it was redundancy that saved us in this instance, as in so many others. In other fields where system-wide failure is intolerable, designers require duplication (or triplication or quadruplication) of component parts.

Computers, aircraft, space vehicles, telephones, and other complex systems, including complex institutions, are built that way. Their designers guard against system-wide collapse by installing stand-by components, seemingly superfluous parts that stand-by, ready to take over whenever a component fails.

Urban infrastructural systems are analogous to these less-complex examples, but the costs of urban breakdown can be enormous as compared to even complete failure of one of these. Loss of life from an 8-point earthquake in a place like Tokyo or San Francisco might be thousands of times greater than loss of life in an aircraft crash. Financial losses might be millions of times greater than loss from a bank's computer crash. Stand-by infrastructural components might prove far the most effective, although not the least, means for protecting ourselves from natural disaster.

So I suggest that a first principle of system design should be to install redundant subsystems from the start -- purposefully, with an eye to the probability, if not certainty, that unintended breakdowns will occur, no matter how hard we try to prevent them.

Fortunately, we already have a lot of transportation redundancy in the Bay Area. We have a network of freeways (including parallel freeways) and a ubiquitous network of wide streets and urban highways -- virtually We have a great many transit systems, several directly everywhere competing with each other. There are over twenty local diesel bus operations, plus electric buses, electric trolleys, light rail in subway and light-rail above ground, heavy-rail rapid transit, a suburban railroad, ferries, jitneys, shuttle buses, and taxis, not to mention cable cars. In addition, of course, there are some three million cars and trucks, mainline railways, major seaports, three major commercial airports, and numerous small general-aviation airports. The Bay Area is very well endowed with transport facilities and services.

So when the quake struck down several big highway structures, individual travellers and individual shippers still had many options they could choose among. As independent and autonomous consumers of transport services, they did choose, and pretty effectively. For some it took a little experimentation among the available options during the first week or so; but then, most soon settled into one medium or another, and virtually all of them got to work without catastrophic delay or cost.

As a result of those millions of individual choices, the overall regional transportation system thereby also adapted to the broken links in the networks. Even though some routes were severely overloaded and subjected to as severe a test as they have ever received, self-adjustments of route-timing-and-mode by individual motorists kept even those roads from clogging up entirely. Congestion was bad in some places; but, even there, we never did suffer the dreaded "gridlock".

An unfortunate and major exception lay in the ruins at Santa Cruz, where the lack of redundancy in access roads meant that the city was virtually cut off from help. As a result the losses there were greater than they need have been.

This was not The Big One

Although the October Quake caused severe damage to the transport system in the central Bay Area, it did not shut it down. Only a few routes were closed. Most others remained available to travellers and shippers, leaving other options, such as time and mode shifts, available to them as well.

But that may not be true when The Big One comes, as we are assured it will. The rule holds that the further we are from the last quake, the closer we are to the next one. We are now 84 years from the last big break on the Bay Area sector of the San Andreas Fault and 122 from the last one on the Hayward Fault. Recent revisions of forecasts now set the probabilities of magnitude 7 or larger earthquake in the San Francisco Bay Area at 67 percent between 1990 and 2020. Next time, the present system may be unable to adapt.

LESSONS FROM THE LOMA PRIETA EARTHQUAKE: CRITERIA FOR INFRASTRUCTURE PLANNING IN EARTHQUAKE COUNTRY

The major message from the October quake: It was redundancy that saved us. The major lesson: We should plan now to build in more redundancy, even as we accelerate efforts to retrofit existing facilities to withstand the major shocks that will come.

Of course the first and major effort must be to strengthen existing bridges, overpasses, roadbeds, buildings, and other structures that will be endangered by severe earth shaking. But despite the most valiant efforts, there will inevitably be structural failures, even then. Intelligent planning requires that we recognize the inevitability of failure and plan to accommodate to it.

The October Quake has once again demonstrated that parallel systems provide options permitting the overall transport system to continue to function effectively, even when parts get broken.

Next time, we should be prepared by deliberate installing parallel routes -- and the more the better. For the Bay Area, I suggest that means more parallel bridges, more freeways, and more transit routes.

Bay Area transport capacity is already deficient, especially in the suburbs where growth was earlier spurred by congestion in the metropolitan centre and where congestion levels have been rising lately. But I suggest we need more than just-enough additional capacity to relieve congestion. We also need to build in safeguards.

Public officials will think it wasteful and inefficient to build a lot of capacity in excess of predicted traffic volumes. But the Bay Area's future viability may well hang on the region's ability to continue functioning after The Big One hits -- after the region has been shaken by 7 or 8 Richter points or more. Immediately after an earthquake hits, the ability to move emergency equipment freely can spell the difference between life and death for potentially tens of thousands of persons and the preservation or loss of tens thousands of buildings.

The long-term dislocation of passenger and freight movements that would follow severe damage to the transport system could, in turn, inflict severe and long-term damage to the local economy. By averting some of the horrendous costs that The Big One will generate, investment in future options and additional capacity will surely yield tremendous returns then.

The conclusions we have drawn concerning transportation must be equally applicable to other public services. San Francisco was without j electricity for about a week after the Loma Prieta shock, because several large transformers and circuit breakers were damaged; and it took time to Redundancy in telephone lines and find and install replacements parts. other communication channels, water lines, hospitals, and the large arrays of emergency equipment will all surely increase the chances of surviving a large quakes in the future.

Are the costs of these additional facilities warranted? It depends on the time horizon we assign to our estimates. In the present, any benefits accruing in the long-term future tend to be heavily discounted. However, when the next quake strikes, everyone will be grateful for the foresight that averted future disaster.

And for survivors of The Big One -- for those who live to tell about it -- redundant public facilities systems could well prove to have been a major source of their survival.

ECONOMIC IMPACTS OF THE LOMA PRIETA EARTHQUAKE: A FOCUS ON SMALL BUSINESS

by Cynthia A. Kroll

On 17 October 1989, an earthquake of 7.1 in magnitude shook northern California. Centered in the Santa Cruz mountains, south of the San Francisco Bay Area, the quake caused significant damage not only in nearby cities such as Santa Cruz and Watsonville but also in major urban centres such as Oakland and San Francisco (see Figure 1). For a region long used to earthquake risks, the quake was a sharp reminder of vulnerability. As history has shown, the area could experience an earthquake of ten to fifteen times the magnitude of the October quake, possibly much closer to the most recent major urban centres, any time in the next few decades. The quake, then, has provided an opportunity to examine the region's capacity for coping with earthquake damage and to identify areas of preparedness and response capability that could assist in recovery from a future quake.

This paper focuses on identifying the economic impacts of the October 17th earthquake, for the regional economy as a whole and for small businesses operating in the heart of the impacted areas. We report findings based on an analysis of published aggregate economic data and a survey of small businesses in the cities of Oakland and Santa Cruz. The paper concludes with a discussion of the broader implications for earthquake preparedness and response strategies.

THE DAMAGE IN CONTEXT

Because the Loma Prieta quake occurred in a developed country, it has the distinction of being perhaps the most expensive earthquake in history while having caused relatively few fatalities. Estimated costs of the earthquake, in terms of damage to physical structures, was almost \$6 billion. Close to 4000 people were injured, but there were only 62 fatalities, most caused by the collapse of a freeway structure in Oakland. The connection between cost and number of fatalities is not coincidental --the earthquake resistant structures that protected lives may still be very expensive to repair when they sustain damage.

The extent of damage varied widely by location within the San Francisco and Santa Cruz areas. The bulk of the dollar damage was reported in the San Francisco Bay Area (Table 1), but the largest share of damage to homes occurred in the area including and surrounding Santa Cruz County (Table 2). Region wide, the dollar value of damage was equivalent to about two-thirds of a year's worth of building permit and heavy construction activity. In the City of San Francisco, dollar damage estimates were almost four times the 1989 building and heavy construction activity (partly because building activity in the city is low compared to places of similar size and relative to existing stock); Santa Cruz suffered damage equivalent to almost twice its annual building activity.

In the San Francisco Bay Area, the loss to housing stock was quite minor. Less than 1 per cent of the region's housing stock was damaged and less than 1/10,000 of the stock was lost. The largest amount of damage and loss occurred in Santa Clara County, the Bay Area location closest to the quake's epicentre. In Santa Cruz County, the effects were far more

severe. Nevertheless, while 15 per cent of the county's housing stock was damaged, less than 1 per cent of homes were destroyed (housing vacancy was at 9.3 per cent in Santa Cruz County in January 1989).

The effects on businesses were more severe (Table 2). While modern high-rise structures and wood-framed, bolted, single family homes withstood the earthquake with little damage, some older commercial and industrial buildings (and one modern hotel) proved more vulnerable. More than 1 per cent of San Francisco Bay Area firms were damaged, although only 0.015 per cent were reported destroyed. Of Bay Area counties, San Mateo County had the largest number of firms damaged, while Alameda County had the largest number destroyed. By far the most severe impacts to firms occurred in Santa Cruz County, where more than one fourth of firms experienced damage, and 5 per cent were reported destroyed.

One of the most significant aspects of this earthquake for the region was the large amount of damage to the transportation infrastructure (see Figure 2). Damage to the San Francisco Bay Bridge closed the bridge for a month. Freeway structures leading to and from the bridge on both sides of the bay were also severely damaged or destroyed, and several have not yet been replaced. Damage also caused a one-month closure of the major freeway route linking Santa Cruz to major job centres in Santa Clara County. Any analysis of the impacts of the quake must take into account the extent to which effects were caused by direct damage to firms and facilities and the extent to which they resulted from effects on transportation facilities.

EMPLOYMENT AND UNEMPLOYMENT FOLLOWING THE QUAKE

Aggregate statistics on employment and unemployment suggest that the economy was quite resilient to the effects of the quake, but that impacts were significant for limited time periods and for specific locations and sectors. The duration of some of the impacts suggest that the transportation damage may have been particularly significant in producing of short-term effects on the economy.

Unemployment insurance claims jumped sharply in the week following the quake (see Figure 3). Even the San Francisco Bay Area's northernmost counties had a large increase in unemployment insurance claims for the week immediately following the quake, although these counties experienced little physical damage (see Figure 4). The cities of Oakland and San Francisco reported unusually high numbers of unemployment insurance claims for the entire period of the Bay Bridge closure (Figure 5). Santa Cruz County unemployment claims followed a similar pattern, returning to close to normal levels within a month (Figure 6).

A long enough trend for the period following the quake is not yet available to allow reliable statistical tests on the employment impacts of the quake. Instead, we used a simple descriptive comparison of employment level in the current year compared to the previous year to assess apparent effects. For example, a measure of 1.044 for the Oakland Metropolitan Statistical Area (MSA) for October 1989 indicates that employment in the Oakland MSA in 1989 was 4.4 per cent above (or 1.044 times) the 1988 level. We compared relative employment levels by location and sector before and after the October 1989 quake.

Effects on total (non-agricultural) employment appear minor for most Employment parts of the San Francisco Bay Area, as shown in Figure 7. growth had begun to slow in California in the third quarter of 1989, apart In the fourth quarter of 1989 and from any impacts of the earthquake. early 1990, the San Francisco and Oakland MSAS Show no worse a slowdown in growth than was experienced for the state as a whole. In fact, employment trends in the East Bay (Oakland MSA) suggest that the earthquake may have induced a mini-boom for the end of October and the month of Santa Clara County had already begun to November in some sectors. experience a slowdown due to conditions in the electronics industry prior to the earthquake, but by January 1990 showed recovery from both any earthquake effects and from the broader economic slowdown. Santa Cruz County showed the most evidence of employment effects as a result of the October quake. Total employment dropped from a level 2.6 per cent above the previous year in September 1989 to a level just below that of the previous year in November 1989. However, by February 1990, even Santa Cruz County appeared to have returned to its pre-quake rate of growth.

Impacts on employment varied considerably by sector as well as by location. Manufacturing sectors throughout the Bay Area showed no sign of impacts on employment levels as a result of the earthquake. Employment in general merchandise stores (a major retail category) dropped slightly in the Oakland MSA and more sharply in Santa Cruz and the San Francisco MSA following the quake (see Figure 8). Employment levels in general merchandise had largely recovered in the Oakland and San Francisco MSAS by early 1990 but remained below the previous year's level in Santa Cruz throughout the first four months of 1990. Hotel employment dropped sharply in Santa Cruz and slightly in San Francisco for a few months following the quake, but drops were mirrored by increases in hotel employment in the Oakland and San Jose MSAS for the same period (Figure 9). The quake boosted construction employment throughout the affected area.

In sum, the effects of the earthquake on aggregate employment were for the most part small and temporary. Longer term effects are most evident for the retail sector in the Santa Cruz area.

TOURISM AND RETAIL TRADE -- SOME OTHER ECONOMIC MEASURES

The Loma Prieta earthquake has been blamed for slowdowns in tourism and retail sales activity, especially in the City of San Francisco. Data available to date suggest that some short-term effects occurred. These impacts may have lasted only a few months in most areas, however.

As noted above, employment drops in hotel employment appear to have been temporary and limited to the San Francisco and Santa Cruz areas. Data available on hotel occupancy supports this finding. Hotel occupancy was down relative to the previous year in San Francisco and Santa Cruz for four or five months following the Loma Prieta quake. The Oakland/East Bay area showed an unusually high level of occupancy in November of 1989, and Santa Clara County had unusually high occupancy levels in October, November and December 1989 (see Figure 10). All four areas have had occupancy at or below the previous year's level in March and April 1990. However, it is not clear that the 1990 slowdown is a result of the quake. Similar drops have occurred in major Southern California markets, such as Orange County and Los Angeles.

Taxable sales data have only recently become available for the fourth quarter of 1989, and information on 1990 activity will not be available for several months. Some earthquake impacts are suggested by a comparison of taxable sales levels in 1989 to 1988 levels, but the impacts appear to be confined to local areas affected by damage. Of the major Bay Area and Santa Cruz area counties affected by the quake, only San Francisco shows relatively weak fourth quarter 1989 sales activity (see Table 3). Alameda County shows fourth quarter sales at 5 per cent above 1988 levels, while Santa Cruz County as a whole reported taxable sales at 6 per cent above 1988 levels. In addition to lower

At the city level, greater effects appear. sales for the City of San Francisco, Oakland had weaker sales in fourth quarter 1989 compared to the previous two quarters. Sales in Oakland in fourth quarter 1989 were equivalent to their 1988 levels, while second and The cities of Santa Cruz third quarter sales were well above 1988 levels. and Watsonville (also in Santa Cruz County) show the most severe effects. Santa Cruz sales dropped from a level 3 per cent above 1988 sales in the third quarter to a level 4 per cent below 1988 sales in the fourth quarter. The Watsonville area saw sales drop from 21 per cent above 1988 sales in the third quarter to 4 per cent below in the fourth quarter. Each of these three cities appears to have lost the benefit of higher sales levels normally experienced by merchants in the fourth quarter (holiday-related sales) .

While more recent data is not available on sales level, it is likely that the impacts on retail activity lasted well into the 1990s in the areas most heavily affected by the earthquake. The City of Oakland, for example, lost its major department store for a 10-month period, while the entire downtown area of Santa Cruz was destroyed. At the county level, however, many of the sales losses appear to have become gains for businesses in areas that escaped significant damage.

SMALL BUSINESSES IN OAKLAND AND SANTA CRUZ

The data reported above is useful in understanding how well the economy fared in aggregate but is less useful for understanding how individual businesses responded, the role that preparedness played in the response, how rapidly businesses recovered from damage, which businesses gained rather than lost from the quake, and how transportation system damage versus building damage affected operations. In the immediate days following the earthquake, little funding was available to launch a survey of firms in affected areas. However, with cooperation of the Oakland Chamber of Commerce and the Santa Cruz Downtown Association, we were able to distribute surveys to approximately 1200 Oakland firms and 600 Santa Cruz firms in January 1990. The Oakland area response rate was 23 per cent, and the Santa Cruz response rate was just below 10 per cent. -I

Survey Coverage and Biases

The surveys were directed at firms with 100 employees or fewer. Firms in this size category represent 99.85 per cent of the Alameda County firm population and 99.88 per cent of the Santa Cruz County firm population. They represent an estimated 45 per cent of employment in

Alameda County and 60 per cent of employment in Santa Cruz County. Because the surveys were mailed out through Chamber-type organizations, they tended to reach retail and service firms in greater proportions than are present in the population. This was particularly true for the Santa Cruz sample. As a result, the aggregate findings are somewhat biased. In addition, no attempt was made to track down firms that may have closed and were no longer receiving mail sent to their original address. Thus, the number of destroyed firms may be underestimated in the sample. Nevertheless, with careful interpretation, the timeliness of the sample offers a useful snapshot of perceptions of impacts in the period immediately following the earthquake.

Incident of Damage among Small Businesses

One of the most striking features of the earthquake was the localized incidence of impacts. Heavily damaged areas could be separated from areas showing no visible damage by only a few city blocks. In the City of Oakland, where the downtown area was badly damaged, almost 41 per cent of firms reported no damage at all while an additional 47 per cent reported only minor damage (see Figure 11). Even in the City of Santa Cruz, very close to the epicentre of the earthquake, where the downtown area was destroyed, 27 per cent of firms experienced no building damage and 35 percent experienced only minor damage. Almost one fourth of Santa Cruz firms, however, were in buildings that were uninhabitable following the earthquake, while only 5 per cent of Oakland firms were in uninhabitable buildings .

Business Losses -- Days Lost and Inventory and Income Losses

The differential impact of the earthquake is apparent in business days lost. The limited building damage to firms in Oakland translated into relatively minor disruptions in business. Over 90 per cent of firms in Oakland reopened for business less than one week following the quake and all but 1.5 per cent were back in business within a month following the quake. Over 40 per cent of firms in Oakland lost no working days at all. In Santa Cruz, more than half of firms were back in business in less than a week, but 18.5 per cent remained closed a month following the earthquake, and only 4 per cent reported no loss in working days. In both cities, the number of business days lost increased sharply with the amount of building damage incurred.

Impacts to business stemmed from more than building damage. Over one fifth of Oakland firms and half of Santa Cruz firms lost some of their inventory due to the quake. The size of losses ranged from less than \$100 up to \$1,000,000, with an average for businesses experiencing inventory losses of about \$40,000 in Oakland and \$30,000 in Santa Cruz. This level of loss is approximately 3 per cent of average gross income in both cities -- a significant but not devastating level of loss, for most firms.

Changes in the surrounding business environment also present problems for small businesses. We asked respondents to rank the severity of several types of problems on a scale from 1 (no problem) to 5 (very severe problem). Not surprisingly, Santa Cruz firms reported more severe problems than did Oakland firms (see Figure 12). Many Oakland firms found few problems in operating their business, even in the first week following

the earthquake. Customer and employee access had the highest average rankings for Oakland, of 2.4 and 2.1. Santa Cruz firms, in contrast, encountered a wide range of problems, especially in the first week following the earthquake. As in Oakland, customer and employee access received the highest (most problematic) rating -- an average of 3.7 for both factors in Santa Cruz. Building damage and shipping delays also averaged between 2.5 and 3.5. Within a month, the mean ranking had dropped below 2 for all factors in both Oakland and Santa Cruz.

The firms that remained open or reopened felt some impacts to their level of business, as shown in Table 4. In Oakland, 26 per cent of firms experienced a decrease in business of over 20 per cent in the first week following the quake. Losses at this level continued for 13 percent of 1 businesses during the first month and for 6 per cent for more than a month after the earthquake. Two thirds of Santa Cruz firms experienced a loss greater than 20 per cent for the first week following the quake, 40 percent reported a loss of this size for at least a month following the quake, and 18 per cent continued to have losses greater than 20 per cent more than 1 a month following the quake.

In Oakland, trade and service firms were particularly vulnerable to larger, longer lasting business losses, while the greatest share of losses were incurred by trade firms in Santa Cruz. Not surprisingly, those in damaged buildings had substantially larger losses, for longer durations than other firms. In Oakland, smaller firms were more likely to experience larger, longer lasting losses than were larger firms. (This did not appear to be the case in Santa Cruz, although the small size of the sample makes generalizations difficult).

While the earthquake was a disaster for some firms, it proved a stimulus for other firms. Construction firms, in particular, reported increases in business following the earthquake. A significant number of trade firms also reported business gains following the earthquake, as business shifted from damaged firms to those still in operation.

Accommodation to Changing Business Conditions

Businesses found means of coping with physical damage to buildings and roadways (Table 5). More than one third of Oakland firms and over one fifth of Santa Cruz firms allowed employees to work more flexible hours. About 10 per cent of Oakland firms also introduced car-pooling, expanded business hours, new shipping schedules and/or working at home as means of coping with the immediate problems from the quake. In Santa Cruz, car-pooling was quite unimportant as a response to quake impacts, in contrast to other roadway-related responses. About one fifth of Santa Cruz firms moved to a new location, changed shipping hours, and/or encouraged employees to work at home. Large firms overall appeared more likely to make specific adjustments to keep the business in operation, while manufacturing firms in Oakland were the most likely to concentrate particularly on transport related responses (car-pooling and shipping schedules).

Use of Public and Private Assistance

Assistance came to the earthquake stricken areas from all levels of government and from the private sector as well (see Figure 13). Overall, Federal (national government) assistance showed the lowest level of usage and generated the least amount of satisfaction among businesses. In Oakland, less than 5 per cent of firms received assistance from the Small Business Administration (SBA) or from the Federal Emergency Management Administration (FEMA). In Santa Cruz, 10 per cent of firms used SBA programmes and one third of firms worked with FEMA. Both Oakland and Santa Cruz firms expressed dissatisfaction with FEMA services in particular. In contrast, businesses had generally favourable comments to offer on the response of state and local agencies.

Local government programs were used more heavily than Federal programs. In Oakland, 6 per cent of firms used state or local government emergency services, but almost half of firms profited from extended service on the Bay Area Rapid Transit system (BART) and 30 per cent felt they benefited from expanded ferry services. In Santa Cruz, 47 per cent of firms used local and state emergency services. An even larger number -- 56 per cent -- used the recovery services offered by public and private local business programs, such as the Downtown Association.

Although not covered specifically in the survey, other local government programmes appeared less well prepared to respond to the quake. In Oakland, many government offices were displaced because of damage to public buildings. In Santa Cruz, offices such as the building and planning departments faced new issues with no backing policy framework. The city had to address issues such as whether permits should be issued in places that had proven to be geologically unsound. As a result, issuance of building permits was down sharply in the city following the earthquake.

Small Business Perspective on the Earthquake

The immediate and longer term experience of small businesses following the Loma Prieta earthquake depended very much on where the business was located and how much damage occurred to the building housing the business and to the firm's inventory. Outside the areas of most intense shaking, firms were able to resume operations quickly and within a month were back to pre-quake levels of business. In the area where physical damage was most intense, however, recovery has been slower. While over 80 per cent of Santa Cruz firms had returned to normal levels of operations within a month of the earthquake, close to 20 per cent have faced a longer and more costly recovery period.

INTERPRETATION AND IMPLICATIONS

An evaluation of the economic impacts of the Loma Prieta quake is both encouraging and informative. The economy showed a great deal of resilience in the face of a significant natural disaster, and where impacts were severe they were also confined to limited geographic areas. Some of the major reasons for the region's ability to recover quickly economically from the quake are:

- 1) The fact that the earthquake was centred away from the most populous portions of Northern California.
- 2) The economic diversity and geographic dispersal of the region's economy -- the region relies on no single industrial sector (such as tourism in San Francisco), and there are many economic activity centres throughout the San Francisco and Santa Cruz areas.
- 3) The strong performance of communications and utilities systems, which functioned again very quickly following the quake.
- 4) Redundancy in the transportation system. Many were surprised by the degree of impact to major transportation facilities from an earthquake of this magnitude and location, but the existence of alternative routes and facilities made it possible for many businesses to continue to operate quite normally.

These factors enabled a quick recovery for most firms.

Preparedness was a major element in the factors mentioned above as well as in the overall level of impact of the earthquake. While some structures failed, the very great majority of structures designed to survive a major quake came through with little damage. Communications and utility systems became operational again quickly because of basic design and planning for emergency response.

The weaknesses that appeared were in the preparedness level of individual small businesses and to some extent of the general purpose public agencies (as opposed to emergency related services). Small businesses in general had few resources to prepare for an earthquake. Large firms implemented a greater number of responses quickly in part. Firms such as Bank of America, for example, had diverse locations throughout the region to which Single location retail they could relocate operations as necessary. businesses and some FIRE and service businesses were particularly vulnerable not only to the immediate impacts of building damage but also to the access effects of surrounding damage and disrupted transportation Assistance from Federal agencies was problematic. At the least, routes there was a great deal of confusion among potential recipients as to the type of aid available and eligibility requirements.

Concern for the future should also focus on the greater vulnerability of the economy to a quake centred closer to San Francisco or Oakland. While many businesses would again be largely unharmed, the proportion experiencing severe damage could be much greater than that experienced on 17 October 1989. In addition, disruption to the transportation system; could be much worse than that experienced last fall. Small businesses generally do not have the resources to prepare for the recovery period to a major natural disaster. Thus, for the Bay Area economy to be able to operate again quickly after another major earthquake, some attention is needed in advance to the likely needs of small business.

Figure 1
Area Affected by the Loma Prieta Earthquake

Table 1: Dollar of Physical Damage to Structures from the Loma Prieta Quake by County

County	Damage Assessment (1,000 of \$s)				Building Permit & Heavy Constr Value, 1989	Damage as % of Permit Value
	Private	Public	Undermined	Total		
<i>San Francisco Metropolitan Area</i>						
Alameda	\$1,164,813	331,673		1,476,486	1,537,839	96.0
Contra Costa	5,290	19,549		24,839	1,252,675	2.0
Marin	687	977		1,664	330,264	0.5
Napa	0	0		0	228,018	0.0
San Francisco	1,500,000	1,259,000		2,759,000	727,604	379.2
San Mateo	284,889	8,042	1,336	294,267	821,922	35.8
Santa Clara	695,300	32,400		727,700	1,661,918	43.8
Solano	203	3,557		3,760	923,687	0.4
Sonoma	0	0		0	648,858	0.0
Total (9-county)	3,651,182	1,635,198	1,336	5,287,716	8,132,785	65.0
<i>Santa Cruz / Monterey Area</i>						
Monterey	750	6	116,980	117,736	363,668	32.4
San Benito	101,330	175		101,505	75,449	134.5
Santa Cruz	328,907	66,339	37,551	432,797	249,453	173.5
Total (3-county)	430,987	66,520	154,531	652,038	688,570	94.7
Overall Total 12-County	4,082,169	1,701,718	155,867	5,939,754	8,821,355	67.3
<i>Source: California Office of Emergency Services, Summary of the Current Situation, December 18, 1989; Construction Industry Research Board</i>						

Table 2: Housing and Business Impacts of the Loma Prieta Earthquake by County

County	Housing Stocks Effects					Business Effects				
	Number of Housing Units			Percentage		Number of Businesses			Percentage	
	Total	Damaged	Destroyed	Damaged	Destroyed	Total	Damaged	Destroyed	Damaged	Destroyed
<i>San Francisco Metropolitan Area</i>										
Alameda	500620	2763	17	0.55	0.003	31288	414	17	1.32	0.054
Contra Costa	306458	485	0	0.16	0.000	18610	124	0	0.67	0.000
Marin	100088	24	0	0.02	0.000	8895	20	0	0.22	0.000
Napa	44825	0	0	0.00	0.000	2927	0	0	0.00	0.000
San Francisco	327274	382	11	0.12	0.003	31670	134	0	0.42	0.000
San Mateo	250530	782	1	0.31	0.000	17906	793	1	4.43	0.006
Santa Clara	531534	5124	131	0.96	0.025	37371	364	6	0.97	0.016
Solano	112223	2	0	0.00	0.000	5318	0	0	0.00	0.000
Sonoma	154948	0	0	0.00	0.000	10740	0	0	0.00	0.000
Total (9-county)	2328500	9562	160	0.41	0.007	164725	1849	24	1.12	0.015
<i>Santa Cruz / Monterey Area</i>										
Monterey	118809	341	19	0.29	0.016	7792	48	11	0.62	0.14
San Benito	12068	174	62	1.44	0.514	664	35	22	5.27	3.313
Santa Cruz	91439	13329	774	14.58	0.846	6224	1615	310	25.95	4.981
Total (3-county)	222316	13844	855	6.23	0.385	14680	1698	343	11.57	2.33
<i>Source: California Department of Finance, California Office of Emergency Services, U.S. Bureau of the Census, County Business Patterns, and CREUE calculations</i>										

Figure 2
Major Road Closures Resulting From the Loma Prieta Earthquake

COMPARISON OF UNEMPLOYMENT CLAIMS
SAN FRANCISCO BAY AREA

COMPARISON OF UNEMPLOYMENT CLAIMS
NORTHERN BAY AREA COUNTIES

COMPARISON OF UNEMPLOYMENT CLAIMS
OAKLAND AND SAN FRANCISCO

COMPARISON OF UNEMPLOYMENT CLAIMS
SANTA CRUZ COUNTY

TOTAL NON AGRICULTURAL EMPLOYMENT

EMPLOYMENT IN GENERAL MERCHANDISE

EMPLOYMENT IN HOTELS

CHANGE IN HOTEL OCCUPANCY

Table 3 Taxable Sales Activity, 1988 and 1989
Areas Affected by the Loma Prieta Earthquake

**BUILDING DAMAGE AND BUSINESS DAYS LOST IN THE LOMA PRIETA EARTHQUAKE
OAKLAND AND SANTA CRUZ FIRMS**

**MAJOR PROBLEMS FOLLOWING THE EARTHQUAKE FIRST WEEK COMPARED TO ONE MONTH
LATER OAKLAND AND SANTA CRUZ SMALL BUSINESSES**

Table 4: Business Losses and Gains after the Loma Prieta Earthquake: Oakland and Santa Cruz Firms

	First Week: Business Losses and Gains						After November 18: Business Losses and Gains					
	TOTAL #	21+% Loss	1-20% Loss	No Change	1-20% Gain	21+% Gain	TOTAL #	21+% Loss	1-20% Loss	No Change	1-20% Gain	21+% Gain
OAKLAND RESPONDENTS												
ALL RESPONSES	279	26	18	47	8	2	279	6	13	72	6	3
BY ECONOMIC Sector												
<i>Construction</i>	9	11	0	56	33	0	9	0	0	78	22	0
<i>Manufacturing</i>	22	23	9	68	0	0	21	5	19	71	5	0
<i>Trade</i>	78	27	27	33	10	3	78	14	17	58	8	4
<i>Fire</i>	34	9	21	65	3	3	35	3	11	77	6	3
<i>Services</i>	130	32	15	45	7	1	130	4	11	78	5	3
<i>Other</i>	6	17	17	50	0	17	6	0	0	100	0	0
BY BUSINESS Size												
<i>1-5 employees</i>	87	31	14	46	7	2	87	11	11	70	5	2
<i>6-10 employees</i>	54	30	24	41	4	2	54	6	17	74	2	2
<i>11-20 employees</i>	41	20	12	54	15	0	41	5	2	78	10	5
<i>21-50 employees</i>	52	31	19	38	12	0	52	2	17	65	13	2
<i>50+ employees</i>	30	10	10	73	0	7	30	3	17	77	0	3
<i>Other</i>	9	11	67	22	0	0	9	0	11	78	0	11
BY BUILDING DAMAGE												
<i>None</i>	114	18	17	53	12	0	114	4	9	79	7	2
<i>Minor</i>	130	25	22	45	5	4	130	7	13	71	5	5
<i>Severe</i>	15	67	13	20	0	0	15	27	27	47	0	0
<i>Unoccupiable</i>	14	71	14	14	0	0	14	7	14	71	7	0
<i>Other</i>	6	67	17	17	0	0	6	0	33	33	33	0
SANTA CRUZ RESPONDENTS												
ALL RESPONSES	55	67	7	24	0	2	55	18	9	47	15	11
BY ECONOMIC Sector												
<i>Trade</i>	30	80	3	13	0	3	30	23	10	23	27	17
<i>Fire</i>	8	38	25	0	38	0	8	13	0	75	0	13
<i>Services</i>	17	59	6	35	0	0	17	12	12	76	0	0
BY BUSINESS Size							56	18	11	46	14	11
<i>1-5 employees</i>	30	57	10	30	0	3	30	17	7	50	13	13
<i>6-10 employees</i>	5	100	0	0	0	0	5	0	40	20	0	40
<i>11-20 employees</i>	6	67	0	33	0	0	6	17	0	50	33	0
<i>21-50 employees</i>	6	83	0	17	0	0	6	33	0	33	33	0
<i>50+ employees</i>	3	67	33	0	0	0	3	67	33	0	0	0
<i>Other</i>	5	80	0	20	0	0	6	0	17	83	0	0
BY BUILDING DAMAGE							55	18	9	47	15	11
<i>None</i>	15	67	0	33	0	0	15	7	7	53	27	7
<i>Minor</i>	19	47	21	26	0	5	19	11	16	58	5	11
<i>Severe</i>	6	83	0	17	0	0	6	17	0	67	0	17
<i>Unoccupiable</i>	13	85	0	15	0	0	13	46	0	23	15	0
<i>Other</i>	2	100	0	0	0	0	2	0	50	0	50	0

Source: Survey of Oakland and Santa Cruz small businesses, January 1990

Table 5: Oakland and Sta. Cruz Business Adjustments to the Earthquake (p45)

	Type of Business Adjustments									
	TOTAL Responses	Encourage Carpooling	Adopt Employee Flexitime	Encourage Working at Home	Expanded Business Hours	Change Receiving Hours	Change Shipping Hours	Special Sales	Consolidate Operate	Move Location
OAKLAND										
ALL	264	9.1	35.2	8.7	10.2	5.3	12.5	6.1	4.5	4.5
BY ECONOMIC Sector										
<i>Construction</i>	9	11.1	22.2	0.0	22.2	0.0	22.2	11.1	11.1	11.1
<i>Manufacturing</i>	22	13.6	45.5	4.5	4.5	18.2	31.8	9.1	0.0	0.0
<i>Trade</i>	74	1.4	24.3	8.1	8.1	5.4	17.6	10.8	5.4	5.4
<i>Fire</i>	32	15.6	40.6	9.4	12.5	0.0	0.0	0.0	6.3	9.4
<i>Services</i>	121	10.7	33.1	9.9	9.9	5.0	8.3	4.1	3.3	3.3
<i>Other</i>	6	0.0	0.0	16.7	33.3	0.0	16.7	0.0	16.7	0.0
BY BUSINESS Size										
<i>1-5 employees</i>	81	6.2	34.6	7.4	13.6	6.2	9.9	8.6	7.4	7.4
<i>6-10 employees</i>	53	7.5	28.3	7.5	5.7	3.8	15.1	5.7	1.9	0.0
<i>11-20 employees</i>	40	5.0	27.5	10.0	2.5	7.5	10.0	7.5	5.0	7.5
<i>21-50 employees</i>	51	17.6	47.1	11.8	15.7	5.9	17.6	3.9	3.9	2.0
<i>50+ employees</i>	29	13.8	41.4	3.4	6.9	3.4	10.3	3.4	0.0	3.4
<i>Other</i>	8	0.0	25.0	25.0	12.5	0.0	12.5	0.0	12.5	12.5
SANTA CRUZ										
ALL	51	2	22	18	8	10	20	10	12	20
BY ECONOMIC Sector										
<i>Trade</i>	29	0	17	14	7	10	24	10	10	24
<i>Fire</i>	6	0	0	17	0	17	33	17	33	17
<i>Services</i>	16	6	38	25	13	6	6	6	6	13
BY BUSINESS Size										
<i>1-5 employees</i>	28	0	25	25	11	14	11	14	11	21
<i>6-10 employees</i>	5	0	0	0	0	0	20	0	0	0
<i>11-20 employees</i>	5	0	20	20	0	20	60	0	0	20
<i>21-50 employees</i>	6	17	33	17	0	0	17	17	50	17
<i>50+ employees</i>	3	0	33	0	33	0	33	33	0	67
<i>Other</i>	4	0	0	0	0	0	25	0	0	0
<i>Source: Survey of Oakland and San Francisco small businesses, January 1990</i>										

USE OF PUBLIC AND PRIVATE PROGRAMS IN RECOVERING FROM THE EARTHQUAKE
OAKLAND AND SANTA CRUZ SMALL BUSINESSES

THE INSURANCE INDUSTRY'S RESPONSE TO A MAJOR EARTHQUAKE: LESSONS FROM THE PAST AND SUGGESTIONS FOR THE FUTURE, by Debra T. Ballen

INTRODUCTION

1990 marks the beginning of the International Decade for Natural Disaster Reduction. It is, unfortunately, a decade that already has experienced too many graphic examples of the devastation wrought by a massive earthquake. Since the October 17, 1989, Loma Prieta earthquake -- the case study for this seminar--significant earthquakes have occurred in Australia (Richter magnitude 5.5), Iran (Richter magnitude 7.1-7.7), and the Philippines (Richter magnitude 7.7). Thus, it is clear that the socioeconomic impacts of earthquakes are indeed global in scope.

Using information from the Loma Prieta earthquake where possible, this paper examines a number of central issues relating to insurance for earthquake damage. First, it explains the role of the U.S. property/casualty insurance industry in responding to a major earthquake, including the types of coverage potentially affected and the challenges involved in loss adjustment. Second, it examines the current limitations on the insurance industry's role, from the perspectives of both insurers and insured. Third, it considers the central dilemma surrounding earthquake insurance. The crux of the dilemma is that there are serious obstacles to the provision of earthquake insurance on both the supply (*i.e.*, insurer) side and the demand (*i.e.*, insured) side -- yet, more individuals and businesses should be adequately protected against the risk of a major earthquake. Finally, the paper suggests a solution for solving this dilemma and preparing for future earthquakes.

Background on the Loma Prieta Earthquake

The Loma Prieta earthquake, which occurred on California's San Andreas Fault, had its epicentre approximately seventy miles southeast of San Francisco. The earthquake registered 7.1 on the Richter scale. It took 63 lives, caused about 3,000 injuries, and left some 14,000 people homeless. It damaged more than 100,000 buildings, and caused more than \$8 billion in direct damage to buildings, roadways, vehicles, and other property. Economic dislocation suffered by individuals and businesses added further to the total loss. All in all, some six million people were affected.

While these numbers are certainly impressive, there are several reasons why the Loma Prieta earthquake was not as devastating as other recent earthquakes. Although strong, the Loma Prieta earthquake was not as severe as the earthquakes in Armenia, Iran, or the Philippines. Moreover, experts believe that the Loma Prieta earthquake's damage was much less serious than it might have been, due to the Northern California region's excellent loss control and emergency preparedness measures. Thus, while the Loma Prieta earthquake provides an excellent case study for understanding various insurance issues, the loss estimates -- and resulting dislocation to the insurance industry and general economy--are less severe than might be expected if the circumstances had been different.

Background on the U.S. Insurance Industry

The insurance industry in the United States can be divided into three broad categories: Life insurance, health insurance, and property/casualty insurance. While all types of insurance play a role in helping society to recover from the financial effects of an earthquake, this paper concentrates exclusively on property/casualty insurance, because this is the segment of the industry for which earthquake losses would be greatest.

The U.S. property/casualty insurance industry is comprised of approximately 3800 companies. About 900 operate in all or most states and provide a range of different types of insurance, such as automobile, homeowners, workers' compensation, commercial liability, and medical malpractice. The remaining companies are smaller firms that operate in a single state or region.

In contrast to some countries, the insurance industry in the United States is regulated primarily by state, rather than federal, government. Insurance regulation encompasses nearly all aspects of insurance companies' operation and interaction with the public, including the formation of companies; rate regulation; protection against insolvency; and liquidation. Because insurance is considered to be a business "affected with the public interest", public policymakers have a strong incentive in assuring that the industry serves society. However, insurance companies in the U.S. are private corporations which also must satisfy the expectations of their owners and investors.

ROLE OF INSURANCE IN RESPONDING TO AN EARTHQUAKE

When an earthquake strikes an urban centre, the direct and indirect damage can be widespread and severe. Buildings may be destroyed. Gas pipelines, electrical systems, Transportation systems may collapse. telecommunications facilities, water mains, and sewer lines may fall. "Secondary" disasters such as fires, dam failures, avalanches, and tsunamis Blood supplies may be tainted, and hazardous chemicals may occur. Offices, factories, and stores may be forced to shut down, and spill. Businesses whose jobs depend on sales to the employees may be laid off. Indeed, Tai revenues may decline. affected area may similarly suffer. because of the integrated financial relationships that exist in most countries, an entire national economy may suffer the effects of a Although the insurance industry does not devastating earthquake. alleviate all financial losses resulting from an earthquake, it plays an important role in the recovery and risk management process.

Coverage Affected

Many observers assume that the property/casualty insurance industry's claims responsibility following an earthquake primarily involves structural damage by ground shaking. However, experts believe that "shake" damage payments generally account for less than one quarter of the industry's ! total claims payments. This is due, in part, to the fact that in the ! United States, "shake damage" is excluded from residential and commercial property policies unless it is covered by a special endorsement. (Certain other countries, such as Australia, do not utilize such exclusions.)

Another reason is that a myriad of other types of insurance are also called upon following an earthquake, as discussed below.

Fire Insurance: Although actual fire losses attributable to the Loma Prieta earthquake were modest, it has been estimated that approximately one half of insured losses following a major earthquake potentially could be attributable to fire damage. Ground shaking itself is not usually the cause of a major fire following an earthquake. Gas mains break and industrial spills may provide the spark for a fire; and telephone failures, broken water mains, and disrupted transportation systems may prevent fire fighters from acting quickly enough to control a conflagration. There is also a risk of arson, particularly in structures that may not be covered by earthquake insurance.

In California, the risk of fire damage is particularly great, since many dwellings are of wooden construction. Compared to masonry (more popular in the eastern United States), wooden structures are less apt to experience shake damage, but they pose a greater fire risk. In addition, there are special hazards associated with industrial facilities, such as oil refineries and chemical plants. Fortunately, although the Loma Prieta earthquake caused a spectacular conflagration in San Francisco's Marina District (a residential area), overall fire damage was not extensive. This was probably due to favourable winds, and to the fact that fire fighters did not lose emergency services and were able to concentrate their resources on a single area of the city.

Automobile Insurance: An earthquake can also cause automobile accidents and other vehicle damage, due to ground movement, lack of driver concentration or the failure of traffic signals. The Loma Prieta earthquake, for example, caused the collapse of a major elevated highway and a span of the San Francisco-Oakland Bay Bridge. As a result of these two incidents, forty-two people were killed, and hundreds more were injured or experienced vehicle damage.

In the United States, the typical automobile insurance policy contains a number of different types of coverages, several of which may be triggered bodily injury liability policies provide the by an earthquake. Policyholder with protection in the event he or she causes an accident which harms other people; property damage liability policies provide the same protection in the event of damage to other vehicles. Both of these coverages would come into play if, as the direct or indirect effect of an earthquake, a driver swerves and hits another person or car. Collision coverage protects the policyholder from damage to his or her own vehicle in Comprehensive the event of an accident, regardless of who is at fault. coverage protects a policyholder from losses to his or her own vehicle that if an earthquake causes a building are not caused by a traffic accident. or other structure to collapse, thus damaging an automobile, the owner could recover under the comprehensive coverage portion of his or her automobile insurance policy.

Although there are no estimates of total automobile insurance losses from the Loma Prieta earthquake, State Farm Insurance, the largest automobile insurance writer in the state of California (insuring about one-tenth of the drivers), has estimated that the company incurred about \$1.5 million in automobile insurance losses as a result of the earthquake.

Most of this total is attributable to claims brought under the comprehensive coverage part of the automobile insurance policy.

Workers' Compensation Insurance: Workers' compensation is a system which provides benefits to individuals (or their survivors) who are killed or injured while on the job. Benefits are paid without regard to the cause of the incident, or whose fault it might be. If an earthquake occurs during working hours, deaths and injuries to employees caused by building collapse, falling debris, or other accidents would be covered by workers' compensation.

The Loma Prieta earthquake struck at 5:04 p.m. local time. There were at least two factors which limited the number and severity of workers compensation losses. First, many people had already left their workplace, in order to be able to watch a World Series Baseball game at about 5:15 p.m. Second, commercial buildings in the San Francisco area are built to withstand earthquake damage better than those in many other urban areas, thus minimizing the potential for worker injuries. As a result of these factors, workers' compensation losses from the Loma Prieta earthquake are believed to be relatively modest.

This would not necessarily be the cause for a stronger earthquake, occurring at a different time in a different place. Recently, the All-Industry Research Advisory Council (AIRAC), an insurance industry research organization, estimated the insurance losses under workers' compensation resulting from a Richter magnitude 7.5 earthquake at 2:00 p.m. on the Newport-Inglewood fault, which runs beneath Los Angeles, California. While there are many uncertainties in making such estimates, the study developed a range of possible outcomes, from \$3.2 billion to \$5.5 billion. The "most likely" loss figure was \$4.5 billion.

General Liability: There is also a possibility that, following an earthquake, a large number of liability claims and lawsuits will be brought against building contractors, architects, engineers, municipalities, and others whose negligence can be alleged to have contributed to deaths. For example, plaintiffs may allege that the injuries, or property damage, defendant knew of geological or structural hazards and failed to reduce or eliminate the hazard, develop a response plan, or warn others of the potential danger. In responding to a survey by the Association of Bay Area Governments, one business executive predicted that "If we ever had a major earthquake of the size predicted for California, the judicial system could not physically handle the potential damage suits."

Because liability suits take a long time to be processed by the courts, it will take several years following the Loma Prieta earthquake before an evaluation can be made of the number of successful claims, the average amount awarded, and whether any new theories of recovery will be developed by the courts. The costs of such claims--both damage awards and legal expenses--would in many instances be covered by liability insurance. AIRAC has estimated that general liability claims following a magnitude 7.5 earthquake on the Newport-Inglewood fault would result in insured losses under general liability coverages in the range of \$9.5 - \$19.7 billion, with the most likely value being \$14.6 billion. (This includes claims for bodily injury and property damage.)

Business Interruption Insurance: As noted an earthquake can cause many types of indirect damage. It may shut down offices, factories, and stores--not only because of physical destruction but also because of power outages, loss of sales due to transportation system failures, unavailability of workers, and other indirect causes. Businesses in other areas of the country might also suffer if their sources of supply or demand are located in the stricken region.

Some, but not all, indirect economic losses would be covered by insurance. Business interruption insurance covers lost profits and fixed expenses during the period a damaged business must be closed. The San Francisco-Oakland Bay Bridge, which was closed for about a month in order to repair structural damage, was covered by a business interruption policy for lost income from tolls. However, business interruption insurance probably would not cover businesses which remain open but experience revenue declines due to the earthquake.

Individuals might also suffer if businesses were forced to close or curtail their services. In the United States, however, private insurance is generally not available for individuals to protect themselves against financial loss due to unemployment or underemployment. Rather, unemployment insurance is provided through public programmes. Such insurance is, however, limited in terms of the amount and the duration of benefits paid.

The Loss-Adjustment Process

Insurance loss-adjustment is the process by which claims are investigated, losses are calculated, and the coverages checked. The goals of insurance loss adjustment include quickly evaluating the loss, mitigating additional damage, and paying claims (consistent with policy provisions) as quickly as possible. An earthquake poses special challenges to the loss-adjustment process.

Because of the magnitude of the challenge posed by an earthquake or other catastrophes, insurance companies usually dispatch "catastrophe teams"--often equipped with cellular telephones, laptop computers, and blank checks--from around the country to handle claims. Mobilization of insurance claims adjusters poses a number of logistical problems. Unlike hurricanes or other storms which can be tracked, there is no prior warning. Once the earthquake has occurred, adjusters may confront the destruction of airports and highways; the breakdown of communications and power facilities; and lack of adequate food and lodging. Insurance companies need to utilize every available resource to get adjusters to loss sites, where they can begin to evaluate losses and pay claims. Many have developed special mobilization plans which can be adopted for the circumstances surrounding each individual catastrophe.

There are also special technical problems associated with an earthquake. Much of the structural damage may be invisible, rendering quick evaluation difficult. Often, structural engineers are needed, yet the limited number of experts will be in extremely high demand throughout the region. While awaiting the arrival of the experts, adjusters must preliminarily assess the damage, estimate the loss, and attempt to mitigate further damage.

Finally, because of power failures and other demands on the local media, there may be problems notifying policyholders as to how to report claims. Insurance companies must respond creatively to the communications challenge. Following the Loma Prieta earthquake, for example, many companies established special hotlines and placed full page advertisements in the newspapers to alert policyholders where to call for help.

LIMITATIONS ON THE INSURANCE INDUSTRY RESPONSES

Any recitation of the role of the insurance industry in responding to a major earthquake would be incomplete without a discussion of the limitations of that role. These include the inherent limitations of the insurance mechanism, coverage gaps, and deductible provisions. It is also important to understand some of the reasons insurance companies have difficulty underwriting earthquake insurance.

Inherent Limitations of the Insurance Mechanism

The purpose of insurance is to shift the financial burden of loss from one party (the insured) to another (the insurer). Insurance is not designed to stop losses from happening; it merely redistributes the resulting financial burden. The insurance industry cannot prevent earthquakes or the damage they cause. However, insurers can and do play a positive role in helping to mitigate potential losses, as discussed in the final section of this paper.

In addition, it must be recognized that insurance does not always make the insured "whole". Certain costs and expenses are not likely to be covered, nor does insurance provide payments for loss of time or items of purely sentimental value.

Coverage Gaps

Coverage gaps may also exist for those who are uninsured or underinsured, or who fail to meet deductible requirements. The issues surrounding coverage gaps for residential and commercial earthquake insurance are, however, somewhat different.

Since 1985, California law has required every insurance company writing residential insurance in the state to offer earthquake insurance. (California is the only state with such a requirement.) Nonetheless, prior to the Loma Prieta earthquake, it was estimated that only 20-25 percent of California residents carried "shake" coverage. A study sponsored by the National Science Foundation provided considerable insight into the reasons many people do not purchase earthquake insurance. These include: (1) the belief that rates and deductibles are high, compared to the damage that is likely to be sustained; (2) the belief that the federal government will provide adequate assistance following an earthquake; (3) the fact that many individuals have little equity invested in their homes and, thus, little directly at risk; and (4) reluctance to worry about low probability, high severity losses such as earthquakes. Not surprisingly, demand for residential earthquake coverage tends to increase dramatically following a major earthquake.

Because of the relatively high deductible requirements in most residential policies (typically 10 percent), many individuals who carry earthquake insurance will not be eligible for insurance payments. A sponsor of a California bill to require homeowners to buy earthquake insurance has estimated that, of the approximately 25,000 homes that sustained shake damage from the Loma Prieta earthquake, only about 1,000 were damaged enough to meet the deductible requirements.

With respect to demand for commercial earthquake insurance, there is a great disparity between large and small businesses. According to a 1980 national study conducted for the Federal Emergency Management Association, more than one-half of businesses responding to a survey--mostly large firms who employed professional risk managers--had some form of earthquake insurance. By contrast, according to a nationwide survey conducted by AIRAC of small businesses, only 3 percent reported having earthquake insurance.

Businesses are much more likely than homeowners to meet their deductible requirements. In most commercial policies, deductibles are lower (2 per cent compared to 10 per cent). More significantly, commercial structures are likely to sustain more damage than residences (averaging up to 75 percent of insured value).

Problems from Insurance Industry's perspective

Uninsurability of the Earthquake Risk

While it is convenient to "blame" the insurance industry for not providing enough earthquake coverage, such charges ignore the reasons why insurance companies have difficulty underwriting earthquake insurance. Earthquakes undermine the basic concepts of the insurance system--the ability to predict losses, and the opportunity to spread risks. First, There are many reasons why earthquakes are uninsurable. earthquakes have the potential for catastrophic loss that can jeopardize an insurance company's financial stability. Second, there are too many unknowns regarding where and when an earthquake will occur, and how much damage it will cause. Because earthquakes occur so infrequently at any given location there are no reliable statistics upon which to base these calculations. ~/ Third, insurers cannot spread their risk over a sufficiently large pool of policyholders because only those who are most at risk are likely to purchase coverage. (This problem is known to the insurance industry as "adverse selection.") Fourth, United States tax policy prohibits insurance companies from accumulating reserves for unknown losses, such as a future earthquake. While these concerns apply to of the risks posed by earthquakes, only "shake" damage is specifically excluded from insurance policies (unless covered by a special endorsement) .

Deductibles

From the insurance industry's perspective, relatively large deductible requirements help alleviate some of the practical problems inherent in post-earthquake loss adjustment. Deductible requirements allow insurance companies to direct their attention to the worst damage and to issue payments more quickly to those most in need. If deductibles were eliminated, each loss would have to be adjusted at a time when the demand for adjusters is already overwhelming.

CONSEQUENCES OF A MAJOR EARTHQUAKE

Estimates of Potential Insured Loss

The Loma Prieta earthquake, while significant, did not seriously impair the financial condition of the insurance industry as a whole. This would not necessarily be the case if a stronger earthquake were to strike closer to a major city, particularly if that city were not as well prepared as San Francisco.

It is extremely difficult to predict total losses from an earthquake, due to the high degree of variability among locations, soil conditions, construction techniques, and the many other factors which make each earthquake unique. Losses will also vary widely, depending on property values in the affected area. Mindful of these difficulties, the "Earthquake Project", a consortium of U.S. insurance and reinsurance companies, has estimated total insured losses from a devastating earthquake .

The Earthquake Project's efforts are not limited to losses due to ground shaking, but also include losses arising from fire following an earthquake, workers' compensation, and general liability. (Other coverages, such as automobile and business interruption, are not included.)

The study is based on a reoccurrence of the 1906 San Francisco earthquake along the Northern San Andreas Fault and a 7.5 magnitude earthquake along the Newport-Inglewood Fault below Los Angeles. It postulates that total insured losses from the two earthquakes studied could amount to \$31 billion for the northern California earthquake and \$52 billion for the Southern California earthquake. Losses of such a magnitude would threaten the health of the insurance industry and the economy as a whole. These economic impacts were the focus of a recent study by Stewart Economics, Inc.

Effects on the Insurance Industry and the Economy as a Whole

According to the Stewart Economics report, efforts by the insurance industry to pay the billions of dollars needed to respond to a major earthquake would have three major negative effects: (1) insurers would be forced to liquidate assets to pay the claims and, in doing so, would disrupt financial markets for stocks, bonds, and other investment instruments; (2) a number of insurance companies would become insolvent, causing ripple effects on the rest of the insurance industry; and (3) insurers would find it more difficult to renew existing business and write new business on a sound financial footing. Each of these is discussed below.

Effect on Financial Markets

Like most other businesses, insurance companies do not keep large cash balances on hand. They are also limited in their ability to sell new

stock or borrow to obtain cash. Thus, in order to quickly raise the cash needed to pay earthquake-related claims, insurers would have to sell many of the stocks and bonds in their investment portfolios. This, in turn, would depress prices and cause serious disruption throughout the financial markets. This disruption would be felt by many non-insurance interests (such as municipalities wishing to sell bonds) needing to raise funds through the financial markets.

Threat of Insolvencies

While a major earthquake would probably not destroy the U.S. property/casualty insurance industry, it most likely would force some companies, particularly those with a heavy concentration of business in the affected region, into insolvency. To deal with insolvencies, all fifty states have established "guaranty associations" which protect policyholders and claimants when an insolvent insurance company is unable to meet its obligations. The guaranty associations are funded by insurers who remain solvent (even those whose financial condition may be somewhat impaired due to an earthquake). The guaranty fund obligations, in turn, would impose an even greater burden on the industry as a whole following an earthquake.

Limitation on Capacity to Assume Risks Generally

To assure that the funds necessary to pay claimants are available, regulators limit the amount of coverage that an insurer can write, in relation to how much capital and surplus the company has available to assume loss. Extraordinarily large losses caused by an earthquake would weaken capacity which, in turn, would limit an insurer's ability to write new business. Some buyers would be more affected than others. It is believed, for example, that coverages which require a higher capital to surplus ratio (for example, liability insurance for manufacturers and other businesses, doctors, and municipal governments) would be most difficult to obtain whereas automobile insurance and workers' compensation insurance (which are mandatory in most states) would be more easily available.

CENTRAL DILEMMA AND PROPOSED SOLUTIONS

The Central Dilemma

The central dilemma involving earthquake insurance is that there are serious obstacles to the provision of earthquake insurance on both the supply side and the demand side--yet, more individuals and businesses should be adequately protected against the risk of a major earthquake. The solution to this dilemma lies in the enactment of a programme to ensure that the public receives affordable, reliable, and adequate coverage; that the basic economic fabric of society is preserved; and that insurance companies are financially able to pay claims and continue to serve society's broad insurance needs. The key is to prepare now, not to wait until after the next devastating earthquake.

A Proposed Solution

The U.S. insurance industry, through the Earthquake Project, has attempted to develop such proposal. The proposal, called the Federal Earthquake Insurance and Reinsurance Act, is now pending before the U.S. Congress. The bill would establish two separate programmes to ensure that the public is protected in the event of a major earthquake, without destabilizing the insurance industry and the economy as a whole.

The first programme, for residential property owners, establishes a special government fund. Under this programme, earthquake insurance is mandatory for all homeowners with mortgages backed by the U.S. government or a government-insured bank. Premiums collected by private insurers are to be paid into this fund. In the event of an earthquake, private insurance companies would process claims submitted by their policyholders, and the fund would provide reimbursement for losses and expenses. If there is not enough money in the fund to cover all payments, the deficit would be financed through loans and contributions from the U.S. Treasury and the participating insurance companies.

The second programme creates a special mechanism to respond to a truly catastrophic earthquake. (It would not, for example, have been triggered by the Loma Prieta earthquake.) Through this mechanism, insurance companies can purchase "reinsurance" (that is, insurance for insurance companies). This reinsurance would be made available for many types of coverage, including shake damage, fire, workers' compensation, general liability, burglary, and theft. In order for the reinsurance to be activated, an earthquake would have to cause losses of sufficient severity to threaten the financial viability of the industry--as determined by a specific threshold that is built into the programme.

Because it addresses insurance supply and demand problems posed by earthquakes, a proposal such as that developed by the Earthquake Project is the best way to solve the central earthquake insurance dilemma. It is mandatory for all homeowners with federally-backed mortgages; therefore, the programme will greatly increase the number who are insured. The mandatory aspect of the programme also assures that homeowners throughout the country will participate, thus solving the current problem of "adverse selection." Moreover, by pre-funding the two component programme, the proposal will help accumulate the money necessary to prevent economic dislocation and save the federal government money in terms of disaster relief after the earthquake.

The Earthquake Project's proposal is still being debated in the U.S. Congress, and it is likely to undergo many changes before it is eventually. In its current or revised forms, it may not be adopted or rejected. Earthquake insurance systems already in place in countries such as Japan and New Zealand, for example, may provide more suitable models. Regardless of the programme's applicability outside the United States, however, it provides an important example of how the insurance industry can work with others to manage earthquake risks. Irrespective of the specific details of the programme, the key is to begin as soon as possible to accumulate funds that may be needed to respond to a future earthquake.

Enactment of a comprehensive policy solution is the only meaningful way to solve the earthquake insurance dilemma. However, support for such legislation is not the only way the insurance industry can and does get involved in efforts to manage earthquake risks.

Although the insurance industry cannot serve as a surrogate for regulation of the construction industry, insurers play a positive role in the mitigation of future damages. Insurers support efforts by local governments to develop and enforce strong building codes, upgrade existing structures, and enact land-use controls. Through technical seminars, insurers help educate government officials, architects, and engineers about the effects of various construction techniques on claim costs. Policyholder communications, particularly for homeowners and small businesses, also assist in earthquake preparedness education. And, to the extent feasible, the rating mechanism is used as an incentive for safe construction.

As was evident following the Loma Prieta earthquake, a number of insurance companies have already developed comprehensive earthquake response plans. Other companies are currently in the process of developing such programmes. In addition to these individual company efforts, cooperative industry programmes can help solve potential technical and communications challenges. For example, specially designed "how to" manuals and media kits can enhance individual companies' existing capabilities .

CONCLUSION

Earthquakes are one of the most devastating natural disasters, and In many different ways, their socioeconomic impacts are global in scope. the property/casualty insurance industry plays an important role in the There are, however, serious limitations to the extent recovery process. The central dilemma is to which insurance can make policyholders "whole". that there are a number of obstacles to the provision of earthquake The insurance, yet more individuals and businesses should be protected. United States insurance industry believes that a comprehensive programme is needed to solve this dilemma and is working to enact federal legislation to In the meantime, insurers can and do work authorize such a programme. with local, state, and federal governments--as well as citizens of all types--to manage the earthquake risk.

Notes

1. W.W. Hayes, "The October 17, 1989. Loma Prieta Earthquake," Reston VA: United States Geological Survey, 1989, p. 1. , photocopied.
- 2 . Ibid.
3. German Alliance Insurance Co. v. Lewis 233 U S 389 (1914)
4. Stewart Economics, Inc. , "The Impact of a Major Earthquake," appendix in Catastrophic Earthquakes: The Need to Insure Against Economic Disaster, by the Earthquake Project of the National Committee on Property Insurance Boston: The Earthquake Project of the National Committee on Property Insurance, 1989, Appendix D, p. 45. One estimate postulates that insured losses for "shake" damage (residential and commercial) would amount to approximately \$13.5 billion (out of total insured losses of \$52 billion) for a 7.5 magnitude earthquake along the Newport-Inglewood Fault and \$11.5 billion (out of total insured losses of \$31 billion) for a reoccurrence of the 1906 San Francisco earthquake. The Earthquake Project of the National Committee on Property Insurance. Catastrophic The Need to Insure Against Economic Disaster. Boston: Earthquakes: The Earthquake Project of the National Committee on Property For a more complete description of the Insurance, 1989, pp. 53-56. Earthquake Project's estimates of total insured losses, see note 30 and accompanying text. "The Impact of a Stewart Economics, Inc., Major Earthquake," appendix in Catastrophic Earthquakes: The Need to Insure Against Economic Disaster, by the Earthquake Project of the National Committee on Property Insurance Boston: The Earthquake Project of the National Committee on Property Insurance, 1989, Appendix D, p. 45.
- 5 . Ibid .
6. By contrast, fire losses following the 1906 San Francisco earthquake totalled about \$500,000,000 in 1906 dollars. It has been estimated that a repeat of the 1906 earthquake would cause fire damage of \$2 to \$5 billion today. Ibid.
7. Other types of coverage provided by automobile insurance policies include uninsured motorist coverage, underinsured motorist coverage, personal injury protection, and medical payments coverage. While these, too, may be triggered by an earthquake, insured losses would not be as large as those under the coverages described in the text.
8. Wayne Sorenson telephone Interview by author 19 July 1990
9. Don G. Friedman. Earthquake Losses Under Workers Compensation and General Liability: Estimates for a "Worst Case" Event in Greater Los Angeles Oak Brook. IL: All-Industry Research Advisory Council (AIRAC), October, 1988, p. 13.

10. Association of Bay Area Governments, Liability of Private Business and Industries for Earthquake Hazards and Losses, Oakland, CA: Association of Bay Area Governments, 1984.
11. Ibid., p 48
12. Friedman, pp 14 15
13. Stewart Economics, Inc., p. 15
14. Kathleen Pender, "Special Insurance Lessens Quake Toll". Ban Francisco Chronicle, 23 October 1989, p. D1.
15. Stewart Economics, Inc., p. 16.
16. "Deductibles" are provisions in insurance contracts that eliminate coverage for small losses--i.e., those below a fixed dollar amount or percentage of policy limits.
17. California Department of Insurance. California Earthquake Zoning and Probable Maximum Loss Evaluation Program Los Angeles: California Department of Insurance, 1989 p. 13.
18. Howard Kunreuther, et al., Disaster Insurance Protection: Public Policy Lessons : John Wiley & Sons, 1978. . New York
19. Although there are not yet any statistics regarding effect of the Loma Prieta earthquake on consumer demand, following the 1987 Whittier (southern California) earthquake, insurance premiums in California rose 33 percent, due to higher demand, higher real estate values, and higher insurance rates. California Department of Insurance, p. 2.
20. Daniel M. Weintraub, "Senate Approves Plan Requiring Homeowners to Buy Quake Insurance," Los Angeles Times, 7 July 1990, p. A26. (statement of Senator Frank Hill).
21. Federal Emergency Management Agency (FEMA) , Earthquake Insurance: A Public Polio Dilemma, Washington: Federal Emergency Management Agency, May 1985, p. 18. FEMA 68.
22. All-Industry Research Advisory Council (AIRAC), Business Attitude A Survey on Insurance Coverages Held by Small Businesses Monitor: Availability and Cost of Business Insurance Claims Satisfaction All-Industry Shopping Patterns and Other Topics, Oak Brook, IL: Research Advisory Council, April 1989, p. 1.
- 23 California Department of Insurance p. 13.
24. Congressional Research Service. Earthquake Insurance: Problems and Options. Senate Print No. 220, 99th Congress, Washington: Congressional Research Service. Library of Congress, 1987, p. 23.
- 25 . Ibid .
- 26 . Ibid

27 . Ibid

28 California Department of Insurance p. 12.

29. Because of the large differences in property values, the potential magnitude of insurance losses is much higher in San Francisco and other major U.S. cities than in many rural regions of the world.

30. The Earthquake Project of the National Committee on Property This estimate includes additional losses that Insurance, pp. 49-58. would be incurred if currently uninsured losses (for shake damage) were to be covered. Property damage estimates have been adjusted upward by 30 percent to account for insurer payments such as homeowners' additional living expenses and increased replacement costs under post-earthquake conditions. All loss estimates are adjusted downward to reflect applicable deductibles.

31 Ibid pp. 50-65.

32 Ibid pp. 51-54.

33. Ibid., pp 54 59

34 Stewart Economics Inc. , pp. 59-65.

35. House, U.S. Congress. Federal Earthquake Insurance and Reinsurance Act, 101st Cong. 2d Session, H.R. 4480 (4 April 1990).

36. Ibid.. Section 9.

37. Ibid Section 10

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DISCUSSION

Following the four presentations which, using the Lonja Prieta earthquake experience from California, had focused on "Socioeconomic Impacts of Disasters" the chairman requested the discussants to voice their views .

Kunihiko Hirai, Secretary General of the Urban Safety Research Institute, noted the group-oriented nature of Japanese society. This meant that in companies, neighbourhoods, schools, etc., group response to disasters would be good, facilitating efficient local-level planning. But what of outside elements? There seemed to be no concern for people who did not belong to any particular group. In Tokyo, in particular, where a big earthquake was expected, planning needs to take account of this. What type of planning should be in place? He suggested that an international organization should be set up to oversee various national/urban disaster preparedness plans.

Japan's "Special Basic Law" had the government as guarantor for local damage nationwide but Tokyo was a special case. Here, the private sector had a large role to play, he thought. In a major earthquake effecting the Kanto plain the effects would be very unequal - recovery process could lead to unequal restructuring. He looked at insurance, covering the period from the Zenkoji earthquake of 1885 and noted that there would be no way to cope in the event of a series of major earthquakes. Government - imposed insurance claims' limit was 1.5 trillion yen. Many damage studies have been carried out in Tokyo. With a 100-year margin, preparation for a big earthquake would be possible, but scientists say time is shorter than that.

The second discussant, Anand S. Arya, from the Earthquake Engineering Department at the University of Roorkee, India began by observing the importance of the American contribution to earthquake studies; but he went on to note that the contexts of the developing countries are different. Preparations are meagre at best, generally nonexistent. In the Indian context, the two earthquakes of 1988 in the rural areas of the India/Nepal borderland (measuring 7-8 on the Richter scale) had the effect of improving the public infrastructure as the government responded with more investment. He observed that following the Yugoslavian earthquake, the city of Skopje, which had been largely destroyed, received huge grants-in-aid and became ultimately better off, as did Tashkent in the USSR. (In a wry aside he stated that maybe earthquakes are the key to prosperity!) In the developing countries earthquake insurance was not developed at all; mandatory insurance was far off, however, tax-based funds could be set up for disaster preparation. He then moved on to some slides to highlight his comments. In 1897 a large earthquake hit N.E. India destroying the only bridge in the region -across the Brahmaputra river resulting in massive dislocation. (He drew a stark contrast with the San Francisco area which had numerous alternative methods of bay transportation). The statistical chances of an earthquake in India affecting Delhi were high. In 1988, 150,000 were made homeless and 1,000 killed as a result of an earthquake . Hazard zoning maps were being drawn up and micro-zoning systems were identifying areas for building retrofitting. Communications/radio needs were being identified. A disaster fund was being established and heightened preparedness was being fostered among business and industries. A tax relief system for disaster mitigation measures was also being instituted.

Following Arya's discussion the chairman opened the proceedings to the floor:

To commence the floor discussion, chairman Shigeru Itoh called upon NHK commentator Yanagawa to voice his views on media responsibility. He agreed that biased reporting had occurred, largely because unusual or extreme items generate more public interest; but the media now also informed as well as entertained; information transportation was seen as an important function. Referring to the praise for Japanese expertise which had been voiced in an aside during Mitchell's presentation, he cautioned strongly for circumspection - was it really that good? He voiced concern for structural foundations and requested no further praise for Japan.

M. Erdik questioned the Californian presenters regarding the collapsed bridges which were known to be vulnerable. Could the government be sued? Webber responded that currently retrofitting was in such a case? progress, formerly the money had not been available. No record of government being sued existed. Kaji complimented Kroll on her presentation and wondered aloud as to how much damage would occur today should the Tokyo earthquake of 1923 repeat itself. Kroll's paper had focused on damage estimation following an earthquake with reference to Loma Prieta. Kaji was particularly interested in business losses. Experience from Loma Prieta showed that initially after the quake, employment went up, sales business shifted to those businesses which were able to remain. Temporary tent facilities enabled some business to continue. Actual resale figures were not yet available. Many Oakland stores were quick in reopening.

Kuroiwa asked what factors determined the recovery speeds of specific areas, observing that the Marina area was soon normal whereas Watsonville remained tent-bound. Responses to this question ranged from Kroll's, who noted the difference in socioeconomic background, and the greater degree of damage in Watsonville to Mitchell's, who emphasized the greater political clout of Marina inhabitants, vis a vis Watsonville's residents, to Webber's, who agreed that Watsonville inhabitants generally had a more difficult job to recover their community.

Eibenschutz contributed an interesting point on the subject of recovery speeds. Was it not possible to attempt to recover too quickly from a disaster. His question was directed at Mitchell. His response was that there was no virtue in speed, but in the US, emphasis was upon regaining prosperity. Slower rates of recovery indicated growing decision-making problems. In the case of Mexico city, perhaps reconstruction was a little too hasty. Kaji remarked upon the slowness of re-opening the Bay Bridge. Great disruptions were caused by its closure and undoubted economic losses. As the bridge was insured, surely, it could have been re-opened sooner? Webber's response was to state that he was impressed by the speed at which recovery work was completed.

Kintanar wanted to know, with reference to the Philippines earthquake, why so many new buildings were damaged, but older ones survived. Was their poor building code enforcement? Who was responsible for checking?

Arya was requested to respond. He outlined some technical reasons for building collapse, but allowed that there was no universal agreements on standards. The anchoring of steel was a frequent deficiency, and codes. The detailed aspects provided in the building were sometimes inadequate. The chairman, S. Itoh, was of codes require close and constant scrutiny. the opinion that architects were to blame. A member of the audience suggested faulty quality control and spoke of the need to share If this Close supervision was essential, at all levels. If this was the case, there was a higher probability of the job being done properly .

Kaji responded to the chairman's request for comment. He agreed that strong supervision is essential to ensure that building codes are enforced. Standards were being continually upgraded, and being closely followed.

Kuroiwa noted the Peruvian context of good structural conception, intelligent structural codes. Lechat observed that despite good codes, they are really only experiments which are continually being tested against experience and updated accordingly.

Yamada, of the National Land Agency, noted that standards are developed and bureaucrats are blamed. Many politicians had civil engineering in their backgrounds. The final responsibility was with Government. Private contractors were responsible in many cases. He noted the poor design of buildings in the earthquake affected area of the Philippines, which he had visited. He described one four-story structure to which two further floors had been added. Both extra floors had collapsed. In terms of seismic resistance, standards lagged. He noted the apparent fragility of many dams in the Philippines.

Webber voiced concern over whether the lessons of failure are internationally disseminated. Are the seismological/ engineering/ architectural professions mixing together, sharing knowledge?

Arya was confident that this was taking place, through numerous meetings and international fora. There was a great deal of activity in this area.

Sazanami made a comment concerning risk management which was a growing area. For developing countries, ideas such as the Grameen bank of Bangladesh seemed excellent. This type of bank catered to the rural poor enabling them to cope with problems. Could not similar institutions be set up to extend loans for earthquake resistant housing provision?

With time almost up, the chairman added his own thoughts to the session. Noting that vulnerability of certain areas was known, hence when large-scale loss of life and damage to property resulted from an earthquake occurring in such areas takes place, they could not be called natural disasters. They are man-made. There should be more information exchange; this was an area in which UNCRD could play an active role. There was an urgent need for more English publications on this matter.

3. SESSION 2: SOCIOECONOMIC INFLUENCES IN THE RECONSTRUCTION PROCESS

The second session was chaired by Michel F. Lechat and focused on the theme: Socioeconomic Influences in the Reconstruction Process.

The following four papers were presented for discussion during the session:

1. The Economic and Social Effects of Recent Natural Disasters in Ecuador and Nicaragua
2. Post Disaster Planning: The Case of Mexico City
3. Socioeconomic Consequences of the 1923 Great Kanto Earthquake
4. Evaluation of Indirect Damages Caused by the 1983 Nihonkai-Chubu, Japan. Earthquake

A summary of the main discussion resulting from these presentations follows immediately after the papers.

INTRODUCTION

Scope of the Paper

The type and intensity of the effects of natural disasters in Latin America and the Caribbean are influenced, among other factors, by the social and economic development patterns prevailing in the region. Thus, it becomes of particular relevance to evaluate the damage caused by such disasters from a social and economic perspective, that is, as part of the development process .

The present paper presents a brief overview of two natural disasters that affected the Latin American and Caribbean region in recent years: the earthquake that struck Ecuador in 1987; and Hurricane Joan that ravaged An insight into the social and the Caribbean coast of Nicaragua in 1988. economic conditions in these countries allows a reasonably acceptable identification of the sectors that could be more affected by natural ECLAC's post-disaster evaluations of the damages caused by disasters. both natural events tend to confirm such conclusion.

The evaluation of damages carried out by ECLAC serves as an instrument for both the mobilization of resources and planning of the reconstruction, and for development planning through the projection of the post-disaster evolution of social and economic conditions in the affected country. The paper presents a comparison between some economic trends estimated by the post-disaster evaluation and those that actually took place in Ecuador and Nicaragua .

ECLAC's Work on Natural Disaster Damage Management

ECLAC's activities on natural disasters are directed to attend government requests for the execution of independent evaluations of the damages caused by natural phenomena. Such evaluations focus on the quantification of the direct and indirect effects of the natural event, as well as on determining the medium-term secondary effects on the economy and quality of life of the population. They also normally include the identification of priority rehabilitation and reconstruction projects.

The objective of the evaluation is to assist governments in planning reconstruction activities and in seeking international cooperation. To meet this objective, the criteria for damage assessment cannot be based exclusively on economic considerations. They must reflect the financial effort to be made by the countries in replacing losses in capital stock and social infrastructure, and other additional costs suffered or to be incurred as a result of such losses.

Overview of Social and Economic Effects of Natural Disasters in Latin America and the Caribbean

Latin America and the Caribbean region are exposed to the periodic occurrence of natural phenomena which cause disasters of variable

Magnitude. The characteristics and intensity of the most important disasters have already been presented elsewhere. 1/ Table 1 gives a summary of the main economic losses due to some disasters of geological and meteorological origin in the region in the last two decades.

A comparison of such losses with the Gross Domestic Product (GDP) of the affected countries can give an idea of the relative impact of the disaster on the overall national economies. In Table 2 it is possible to appreciate that most of the evaluated disasters have caused losses with a value which exceeded 5 per cent of GDP. It is also possible to see that the weaker the economic base of the country the greater will be the relative impact of the damages on the national economy. Thus, the losses caused by the earthquake that struck Mexico City in 1985, represented only 2.8 per cent of the national GDP for that year; however, they are the largest in absolute terms of those shown in table 2. On the other hand, smaller losses such as those produced by the earthquake that affected San Salvador (1986), or by Hurricanes David and Frederick (Dominican Republic, 1979), represented over 23 percent of the GDP of the respective countries.

Natural disasters can also affect key sectors of a country's economy creating, in addition to the economic losses, restrictions for the evolution of economic growth. The floods and drought of 1982-1983 found Bolivia in the middle of a severe economic crisis. GDP grew by 0.9 per cent in 1981; it fell by -4.4 per cent and -6.5 per cent in the years 1982 and 1983; and then recovered slightly in the following years (-0.3 in 1984 and -0.4 in 1985). At least part of the dramatic fall of the Bolivian GDP in 1982-1983 can be attributed to the effects of the disaster. This affected the agricultural sector with particular intensity which contributes on average over 20 percent of the GDP. The fall of agricultural production in 1983 was of 16.4 per cent. The earthquake of 1987 in Ecuador is another example of the effects of a disaster focusing in a particular productive sector. The damages to the oil exploitation and transportation infrastructure disrupted the flow of exports by this sector. Crude oil represents over 50 per cent of the total exports of Ecuador. More details in the case of Ecuador will be presented in section 2 of this paper .

The composition of the economic losses presented in table 2 also provides an insight into possible causal relations (not a firm correlation) between the type of natural disaster and its effect on certain social and economic sectors. It is observed that earthquakes have mainly affected the infrastructure of the social sectors (housing, education, and health) and to a lesser extent transport and communications. However, the effects of hurricanes and other meteorological events have focused on the agricultural sector and also in a significant manner on the infrastructure of transport and communications.

Finally, it is necessary to point out that overall deterioration of social conditions in the whole country (through economic losses) is compounded by the worsening of the living conditions of the population directly affected by the disaster. The largest part of the direct victims of natural disasters in the region are composed by the lower income sectors of the population. Thus, disasters tend to exacerbate existing social problems and to restrict the capacity of the governments to attend such needs .

Table 1 Economic Losses Caused by Recent Natural Disasters of Geological and Meteorological Origin in Latin America and the Caribbean
(In millions of 1987 US dollars) *a/*

Losses and Effects	Hurricane			El Nino	Earthquakes					Volcanic Eruption Nevado del Ruiz 1985
	Fifi 1974 <i>b/</i>	David 6 Frederick 1979 <i>c/</i>	Joan 1988 <i>d/</i>	El Nino floods & drought 1982-1983 <i>e/</i>	Managua 1972	Guatemala 1976	Mexico City 1985 <i>j/</i>	San Salvador 1986 <i>j/</i>	Ecuador 1987 <i>k/</i>	
Total Losses	588	1.057	840	3.970	1.967	1.437	4.337	937	1.001	224
Direct losses	388	842	745	1.311	1.580	1.402	3.793	710	186	154
Capital Stock	329	506	668	1.060	1.412	1.381	3.777	694	184	150
Inventories	14	230	18	251	168	21	16	16	2	4
Others	45	106	59	-						
Indirect losses	200	215	95	2.659	387	35	544	227	815	70
Production	175	185	15	1.284	-	35	154	71	704	17
Services <i>f/</i>	25	30	80	1.375	387	-	390	156	111	53
Secondary effects										
Public sector finances	224	303	605	- <i>g/</i>	687	368	1.899	935	397	-
Increased Expenditures	214	264	605	-	673	368	2.025	974	55	-
Decrease in revenues	10	39	-	-	14	-	(126)	(39)	342	-
External Sector	362	464	241	621	186	419	8.579	350	781	-
Reduction of Exports	48	167	27	547	-	-	1.650	-	635	-
Increase in Imports	314	296	223	74	186	419	9.075	447	155	-
Disaster-related income <i>h/</i>	-	-	(9)	-	-	-	(2.146)	(97)	(9)	

Source: ECLAC

- a) All figures adjusted for inflation through 1987 in order to enhance comparability
b) Damages refer to Honduras only, even though other countries were affected as well
c) Damages refer to Dominican Republic only, even though other countries were affected as well
d) These figures are in 1988 US dollars. Secondary effects have been projected through 1993
e) Damages refer to Bolivia, Ecuador, and Peru only, although other countries were affected as well
f) Losses of income due to reduction or disruption of services, and/or higher expenditures for the provision of services
g) Sizeable increase in fiscal deficit occurred, but to accurate estimates are available
h) From emergency relief aid and reinsurance payments from abroad
i) Secondary effects estimated for 1985 to 1987, and projected thereafter through 1990
j) Secondary effects estimated for 1986 and 1987, and projected thereafter through 1991
k) Include damages caused by ensuing floods and mudflows which represent a very high percentage of the total

Table 2: Damage by Sector as a Percentage of the Total Losses and in relation to the National Gross Domestic Product for the Year of the Disaster

Natural Disaster	Damage by sector as % of total losses					
	Social a/	Agriculture	Industry	Transport & Communications	Energy	Total Losses (as % of GDP)
Earthquakes						
<i>Guatemala (1976)</i>	76	1	3	9	0.1	22.0
<i>Mexico City (1985)</i>	67b/	-c/	11	8	0.5	2.8
<i>San Salvador (1986)</i>	44	-c/	3	6	2.0	23.0
<i>Ecuador (1987)</i>	3	1	-c/	4	89.0h/	8.3
Hurricanes						
<i>Fifi (Honduras) (1974)d/</i>	16	45	5	16	3.0	17.0
<i>David & Frederick (Dom. Rep) 1979</i>	9	43	19	10	6.0	26.0
<i>Joan (Nicaragua) (1988)</i>	41	10	4	18	1.0	40.0
Floods/Drought (El Nino)						
<i>Bolivia (1982-1983)</i>	3	86	-c/	10	-c/	19.0g/
<i>Ecuador (1982-1983)</i>	4	54	8	32	-c/	5.0g/
<i>Peru (1982-1983)</i>	7	38e/	24f/	15	1	9.0g/
a) Includes: housing, education, and health b) Includes 30% for public buildings c) Negligible d) Only direct losses e) Includes reduction in fishing effectiveness (resources) f) Includes lower production levels (oil, mining, fish-meal, agro-industries, etc.) g) In related to GDP for year 1982 only h) Hydrocarbons						

THE MARCH 1987 EARTHQUAKE IN ECUADOR 2/

Prevailing Conditions before the Disaster

Ecuador, like most Latin American countries, has been subject to the most serious economic crisis suffered by the region in recent years. Despite being an oil-exporting country, Ecuador has had problems to modernize its productive sector and provide substantial improvements in its social and productive infrastructure. Also, Ecuador is, together with Bolivia, Panama and Nicaragua, one of the country's with the highest ratio of external indebtedness to GDP, over 100 percent, while the average for the region is 54 per cent. The following paragraphs provide some indication of the evolution of the economic and social conditions in Ecuador in the years previous to earthquake of 1987.

The two main productive sectors in Ecuador are agriculture and the oil industry, which represent approximately 12 per cent and 21 per cent respectively of GDP. The economy grew modestly in the years 1984 to 1986 (3.4 to 4.8 per cent), and showed positive rates of growth of its per capita GDP in spite of the 50 per cent drop in oil prices experienced in 1986. Agriculture (including fisheries) was one of the most dynamic sectors having annual rates of growth of nearly 10 percent.

Other activities showed little dynamism in that period. The manufacturing sector remained virtually stagnant in recent years due to financing problems and domestic market restrictions. Similar problems were experienced by the construction sector. The services sector showed modest growth.

About half of Ecuador's nine million inhabitants live in urban areas. Over the past decade, urban population growth averaged 4.5 per cent, compared to under 2 percent in rural areas. Quito and Guayaquil--the two main cities--account for about 55 per cent of the urban population. Oil reserves and exploitation facilities are located in the Amazon region which has only precarious communication links with Ecuador's administrative centre in the highlands (Quito), and with the location of industry and refining activities in the Pacific coast (Guayaquil and Esmeralda harbour).

Despite the increased oil revenues, significant poverty remains in the It is estimated that about 23 per cent of the families in the country. This figure was large urban centres have incomes below the poverty level. estimated at nearly 35 percent for rural areas and small cities. It is estimated that in 1987 about 40 percent of the housing units in the country had some type of deficiency, such as lack of drinking water, sanitation services, electricity, overcrowding or poor state of constructions. The illiteracy rate was near 17 percent in 1985. Daily per capita calorie consumption is estimated at 2040, as compared to over 3100 for countries like Mexico or Argentina.

Description of the Natural Disaster

The natural disaster that struck Ecuador on 5 March, 1987 began with a first earthquake which occurred at 8.45 P.M. and measured 6.1 on the Richter scale. A Second earthquake took place at 11.10 P.M. and measured 6.8. In both cases, the focal point was located less than 10 km deep and

the epicentre lay some 90 km northeast of Quito. A succession of aftershocks of decreasing intensity occurred thereafter but only some of them were felt without the aid of instruments. The scientific information gathered on this event tends to indicate that it can be attributed to the release of energy which had accumulated over a long period of time through interaction of the Nazca and South America plates.

The movement of the South American plate, upon which Ecuador is located, in opposite direction to the Nazca plate generates strong compression forces on the continental land mass and subsidence of the Nazca. The resulting formation of a volcanic arch under the continent is plate. manifest in the presence of the Andes mountain range. The above phenomenon is responsible for the raising of magma which feeds the activity of 27 volcanoes that are considered potentially active, and generates the presence of several geological faults in the Inter-Andean corridor. The epicentres of the earthquakes mentioned above are located in this area.

The earthquakes of 5 March form part of a series of similar events that have affected this area through the years. There have been 58 recorded earthquakes in the present century of which one of the most important occurred in 1949. The epicentre was located in the central highlands (Pelileo) and it had an intensity of II on the modified Mercalli scale which destroyed the city of Ambato. In 1955 an earthquake which registered 6.7 on the Richter scale whose origin could have been identical to that of 5 March 1987 occurred in the same area; as at the time the area was scarcely populated, damage was not significant.

The earthquakes of 5 March 1987 triggered huge landslides from the steep Andean hillsides in an area of about 100 km around the epicentre. Unconsolidated material which had been saturated by the previous days' rains were rapidly swept away to the lower reaches of the area, eroding the hillsides and depositing the materials in the riverbeds of the Amazon cantonment area and damming up some of the rivers.

In the Amazonian region lying east of the epicentre, the landslides and the swell of the rivers caused by the giving away of the dams created by deposited materials, wrecked roads, bridges, the trans-Ecuadorian oil pipeline, a gas pipeline to Quito, and some scattered rural settlements. It also affected crops and livestock and isolated a great part of the region, creating the need for temporary supply by air of essential provisions.

In the highlands region located west of the epicentre, the earthquakes affected not only the scattered rural population, by damaging or destroying their houses and some services and production and infrastructure works, but also several large urban centres such as Quito and Ibarra. In these cities there was damage to housing, educational and health infrastructure, water supply and sewage services, and even the historical and cultural heritage. It should be remembered that Quito's city centre is a part of mankind's heritage.

Although the direct damage to houses, services, infrastructure and means of production of a rural and urban population of about 65,000 people seriously affected their living conditions and income, the physical repercussions at the national level were very limited. The natural

phenomenon, however, had other consequences which--although they were due to localized damage in a very small area--affected the whole country and its entire population, that is, the destruction of the trans-Ecuadorian pipeline.

Social and Economic Effects

Official estimates put the number of victims of the earthquakes at close to 1,000, including an undetermined number of missing persons. The living conditions of approximately 65,000 people were severely affected due to direct damages to their property and services. The greatest proportion of them were located in rural areas of the highlands. In addition, about 75,000 people, composed mainly of settlers and workers of the oil industry in the Amazon basin provinces, were temporarily cut off from the supply of provisions by land due to the destruction of several sections of the road linking eastern Ecuador with the rest of the country.

The people directly affected by the event could thus be classified in four broad categories: a) a majority of peasants and a minority of generally poor inhabitants of urban areas in the Andean region whose dwellings (mainly of rammed earth or mud-blocks) were seriously damaged; b) settlers and self-employed people in the Amazonian region, who suffered the consequences of the destruction of access roads, crop and livestock losses and the interruption of trade; c) scattered groups of settlers and native tribes in the rural areas of the Amazonian region who had seen trade and commerce activities interrupted; and d) people living outside the areas where the earthquakes were felt with the greatest intensity, who temporarily suffered difficulties due to secondary effects, for example the labourers and contractors of the oil industry.

Damage to the social and productive infrastructure are summarized in table 3. It is possible to note that despite the relatively large number of housing units and other installations that were damaged or destroyed, the greatest losses are concentrated in the hydrocarbons (energy) sector. A first reason for this is that most of the affected housing units were located in low-income areas corresponding to cheap or deteriorated edifications with a low replacement or repair cost. Also, only a few health and education facilities, as well as public buildings, required total replacement and the cost of repairs was relatively small. The exception was the transport sector where it was necessary to repair large portions and ancillary structures of the road to the oil fields.

A second reason is that, although direct damage to the oil and gas pipelines and pumping stations were of great magnitude (US\$ 122 million), the indirect losses were even greater (US\$ 766 million). It was calculated at the time of the disaster that the oil exports would fall by half during 1987, assuming an interruption of 4 months in the operation of the This loss alone represented US\$ 643 million. pipeline . The other losses, or additional costs were due to aspects such as the additional transport cost to return to its point of origin the crude oil lent by Venezuela and Nigeria to cover part of Ecuador's export commitments and internal demand; to construct a pipeline linking the Colombian lines in order to pump crude for domestic consumption; and higher transport costs of liquid gas to Quito and of oil products to the eastern region.

Table 3 Damages Caused by Earthquake of 5 March 1987, Ecuador (p73)

Sector/ Subsector	Type of Losses	Damages I(in Million dollars) a/		
		Total	Direct	Indirect
TOTAL		1.001	186	815
Social Infrastructure		30	30	--
Health	23 Health centers/hospitals damaged, urban water supply	2	2	-
Education	200 schools damaged/destroyed	7	7	-
Housing	15,500 houses damaged/destroyed	21	21	-
Economic Infrastructure		42	22	20
Transport/Communication	45 km roads and ancillary structures destroyed	38	18	20
Electricity	Generation plants/transmission lines damaged	4	4	-
Productivity Sector		900	124	776
Agriculture	400 ha. Eroded/silted Crops, livestock, irrigation destroyed	12	2	10
Hydrocarbons	33 km. Oil/gas pipelines destroyed. Oil losses, additional transport cost plus emergency works	888	122	766
Other Sectors		29	10	19
Private/public buildings	In Quito and Ibarra	3	3	-
Historical heritage	15 national monuments (buildings) damaged	8	7	1
Emergency expenses	Health and transport	18	-	18
Environment b/	Spill 100,000 barrels oil, plus soil losses	-	-	-
a) US dollars 1987 (based on a rate of 150 sucres per US dollar)				
b) Not costed				

ECLAC's estimation of the evolution of the main macroeconomic variables of the country after the disaster can be summarized as follows:

- Fall of 2.7 per cent in GDP instead of a growth of 2.8 per cent as expected before the disaster;
- A deficit of US\$ 440 million in the trade balance instead of a superavit as expected before the disaster;
- In view of the lower income and increased expenditure of the government, a rise to US\$ 500 million of the fiscal deficit instead of US\$ 93 million which had been estimated prior to 5 March.

HURRICANE JOAN IN NICARAGUA IN 1988 ^{3/}

Prevailing Conditions before the Disaster

The evolution of the social and economic conditions in Nicaragua is a special case in the regional context. In addition to suffering the impact of the economic crisis common to all Latin American countries. Nicaragua has suffered pronounced disruptions in its productive activities and trade since the late 1970s. This has been the result of the internal war experienced in this period, a commercial embargo imposed by Nicaragua's previous main trade partner, and the closing of credit lines by multilateral lending agencies. To the above should be added the costs resulting from the political process on which the country had embarked, including the implementation of ambitious social programmes and reforms to the public sector and administrative structures. All these factors have combined to make of Nicaragua the country with the highest ratio of external indebtedness to GDP in the region, i.e. , 300 per cent.

The two main productive sectors in Nicaragua are agriculture and manufacturing, each of them representing over 23 percent of GDP. Agriculture, which is also the main exporting sector of Nicaragua, depends on three principal crops: coffee, cotton and sugar cane, thus, becoming very vulnerable to external factors (prices), meteorological conditions, and government credit and promotion policies. The manufacturing sector is extremely weak, and over 50 per cent of the sectoral production is concentrated in three productive activities: food, drinks and tobacco.

The average annual rate of growth of GDP in the 1970-1980 decade was a modest 0.3 per cent. GDP experienced a continuous decline in the 1980s with the exception of three years at the beginning of the decade. Agriculture has shown a pattern of continuous deterioration in this period. j The production of cotton decreased by 10.5 per cent in 1987 after two years of decline at rates of over 20 per cent. Coffee production increased by 12 per cent in that year, but only after a fall of 21 per cent in 1986. Finally, the production of sugar cane in recent years has been falling at rates of over 5 per cent. Manufacturing and other sectors of the economy have remained stagnant or shown signs of deterioration.

Nicaragua has over 3.6 million inhabitants of which 43 percent are in rural areas. The capital city, Managua, has about 20 per cent of the total population and has been growing at annual rates of over 6.5 per cent.

The rapid process of urbanization has been partly caused by the relocation of population due to the war and decreasing agricultural activity. Although there are no detailed statistics in this regard, it is estimated that over 35 percent of the families in the country are living below the poverty level. The illiteracy rate is near 13 percent. Approximately 35 percent of the urban population counts with adequate sanitation services, and despite that 75 percent of the urban dwellers have easy access to drinking water, the supply services are irregular and in a state of disrepair.

Description of the Natural Disaster

The natural disaster which occurred in Nicaragua was caused by the tenth hurricane of the Caribbean season. The storm formed as a low-pressure area off the north-western coast of Africa. It moved in the direction of the American continent at a speed of nearly 15 km per hour; it continued to build up to the point where, on 13 October 1988, it was designated as a tropical storm and given the name of Joan.

Shortly before 4.00 AM on 22 October (local time), it touched land in Nicaragua at Bluefields, after having crossed over Corn Island, with a maximum sustained wind velocity of 217 km per hour and gusts of up to 250. The hurricane then continued westward along the 12th parallel, with a wind intensity diminishing as it moved away from the ocean and came up against the Amerrisque mountain range. It crossed the continental divide after having subsided to the intensity of a tropical storm once again (re-baptized as Myriam), moved over lake Nicaragua and then passed to the south east of Managua, moving out into the Pacific in the early morning of 23 October.

The hurricane had different types of effects on Nicaragua. Firstly, its strong winds destroyed the localities of Corn Island and Bluefields, as well as vast stretches of the forests located inland on the Atlantic slope. Although they slowed gradually, the winds also severely eroded the soil of In addition, the heavy rains (which in some places the Amerrisque range. amounted to over 400 mm in 24 hours) caused by the hurricane mixed with sediments and felled trees, causing rivers to overflow their banks and flooding a number of cities (such as El Rama) and extensive tracts of farmland, which resulted in the destruction of infrastructure, crops and housing.

On the Pacific slope, most of the damage was caused by flash floods, although the winds also occasioned some minor losses. Moreover, high tides combined with the rise in river levels to increase the flooding in some coastal areas.

Social and Economic Effects

Thanks to the preventive measures taken by the government, the population began to prepare for the hurricane several days before it hit Nicaragua. This doubtlessly helped to ensure that the number of victims (148 dead, 100 missing and near 200 injured) was much lower than what might have been expected of an event of such intensity.

Official figures indicated that over 300.000 persons were evacuated from their homes and transported to secure shelters. It is estimated that 230.000 people lost their homes, household goods and working tools. The population group which sustained the greatest amount of damage was the peasantry of the Atlantic zone, who suffered losses of housing, capital stock and their means of livelihood. Self-employed fishermen and small-scale merchants in the Atlantic coastal areas (for example Bluefields) and along the river Rama (El Rama) were also affected.

The losses suffered by the social and productive sectors are summarized in Table 4. The sectors that suffered the most were housing, transport, and natural resources through the destruction of native forests in the Atlantic coast. The losses in infrastructure and housing reflect the extensive physical damage suffered by those sectors, but also the high unit costs for public works and housing repair and replacement. The main construction materials (cement, timber, steel, and fittings) are imported or require imported inputs for their production, which were scarce and expensive at the time of the disaster. Thus, despite the fact that most of the damaged houses corresponded to deteriorated wooden structures, the cost of providing equivalent design shelters was much higher than the actual value of the destroyed units.

The export crops (coffee, cotton and sugar cane) were less seriously affected than were those for domestic consumption since these production areas were not in the direct path of the hurricane. Products for domestic consumption were affected in various ways. Peasants who produce basic grains for their own consumption lost their crops of beans, maize and sorghum, which were on the point of being harvested. Commercial grain producers, who had already harvested their crops lost a portion of the products they had in storage. The coconut and banana plantations located on Corn Island and in other areas of the Atlantic zone were totally destroyed. Finally, peasant stock-raising activities were severely affected, and about 16,000 head of cattle, 20,000 pigs and nearly half-a-million poultry were killed.

ECLAC's estimate for the evolution of the main macroeconomic variables of the country (1988) after the hurricane can be summarized as follows:

- Fall of 9 per cent in GDP instead of a fall of nearly 7 per cent as expected before the disaster;
- The deficit in the trade balance was expected to remain at a similar level as that estimated before the disaster, since the major part of the exports for that year had already taken place and the additional imports for reconstruction to materialize in 1988 were expected to be relatively small. The full impact of the disaster was expected to be felt in 1989, with a US\$27 million fall in exports and increased imports for reconstruction of approximately US\$ 74 million;
- It was calculated that emergency expenditures would increase by 13 percent the previously expected central government deficit of US\$ 210 million.

Table 4 Damages Caused by Hurricane Joan, Nicaragua, October 1988 (p77)

Sector/ Subsector	Type of Losses	Damages I(in Million dollars) a/		
		Total	Direct	Indirect
TOTAL		840	745	95
Social Infrastructure		348	305	43
Health	Health centers/hospitals (216 beds), urban water supply	45	15	30
Education	279 schools damaged/destroyed (700 classrooms)	6	6	-
Housing	46,500 houses damaged/destroyed	297	284	13
Economic Infrastructure		158	152	6
Transport/Communication	Over 70km main/secondary roads damaged	150	148	2
Electricity b/	Telephone & transmission lines, generation plants destroyed	8	4	2
Productivity Sector		134	119	15
Agriculture	Spoilt crops (coconut, banana, staples), infrastructure	81	79	2
Industry/Commerce	Fishing, sugar, agro-industry, timber	53	40	13
Other Sectors		200	169	31
Buildings/urban	Mainly bluefields and El Rama	7	7	-
Land	Erosion (10,000 ha.) and sitting (80,000 ha)	56	56	-
Forests	500,000 ha. Totally or partially destroyed	106	106	-
Emergency expenses	Relocation, health, food	31	-	31
a/ US dollars 1988 (based on a rate of 320 cordobas per US dollar)				
b/ Include damages to fuel storage facilities in Atlantic coast				

CONCLUSIONS

Social and Economic Conditions as a Contributing Factor to the Intensity of the Disaster's Effects

In both of the described natural disasters, many of the losses suffered by housing, infrastructure and services have been due to the poor state of the structures or their precarious location. Most of the damaged houses in Bluefields, Nicaragua, were dilapidated wooden structures. The few, well kept, wooden houses or those built using concrete and clay bricks, supported the hurricane without major damages. A similar situation was present in Ecuador, where the destroyed houses corresponded to poorly built earth structures or to houses inadequately located in the Andean eastern slopes.

Similar conclusions could be drawn from the analysis of the extensive damages to the trans-Ecuadorian oil pipeline or to the roads' network in both countries. Quick construction without exhaustive planning and design, as well as poor maintenance, has increased the vulnerability of these structures to the effects of natural phenomena.

The common factor in these cases is the insufficient capacity of society to provide, in an adequate manner and to maintain, its basic social infrastructure and services. Thus, the experience is that natural disasters compound existing problems rather than create new ones.

A preliminary conclusion of the above would be that, the mere improvement of the economic conditions and quality of life of the population, and the capacity of governments to properly discharge its basic obligations, could have a substantial effect in reducing the vulnerability of the countries to natural disasters. If to the above could be added the introduction of appropriate measures for settlements planning and disaster prevention, many of the losses currently suffered by the region could be avoided.

The Effects Viewed Within the Context of the Prevailing Economic Crisis in the Region

The economic crisis affecting the Latin American and Caribbean region acquired dramatic proportions in 1988. The per capita GDP fell to the level of 1978. The overall inflation for the region increased fourfold in relation to the previous year reaching an average of 760 per cent, and the real income of the people decreased in most countries. Despite a continuous increase in the volume of exports, GDP for the region only grew. This was due to a marked increase in the transfer of at 0.5 per cent. resources out of the region caused by the higher interest rates on the external debt, the fall in the prices of export products, and especially a sharp reduction in the flow of financial resources into the region.

As the above problems demanded more and more attention from the governments, their capacity to tackle structural obstacles for long-term improvement of the productive and social conditions diminished. Thus, there are still pending essential reforms to, among others, the educational systems, agricultural productivity, technology development, industrial transformation, and the modernization of financial and tax systems. Also,

the deterioration of salaries and social services has increased the social inequalities prevailing in the region.

In these conditions, a fall of 8.7 per cent in the GDP of Ecuador (1987), or 8.0 per cent in Nicaragua (1988) (actual figures obtained at the end of the respective years, in the case of Ecuador the fall is higher than the estimate at the time of the disaster), which were due in part to the effects of the natural disasters, represent a serious setback in the efforts of those governments to return to the path of economic growth and social development.

Presently, the governments have serious limitations in designing and implementing the basic measures for development planning in any sectors, including settlements and regional development. ^{4/} In this context, it will be a task almost beyond their capacities to ask them to apply disaster prevention planning instruments, if it is not an effort that is also geared toward improving their overall planning and implementation capacity. Thus, the actions for disaster prevention should add up and complement overall social and economic planning activities, rather than being isolated efforts in a particular compartment of the national administration.

NOTE

1. Roberto Jovel, "Natural disasters and their economic and social impact," ECLAC Review 38 (Santiago, Chile: 1989).
2. See ECLAC, "The natural disaster of March 1987 in Ecuador and its impact on social and economic development" (LC/G.1465) (Santiago, Chile: 1987).
3. See ECLAC, "Damage caused by Hurricane Joan in Nicaragua: its effects on economic development and living conditions and requirements for rehabilitation and reconstruction," Note by the Secretariat (LC/G.1544) (Santiago, Chile: 1988).
4. Jorge Gavidia, "Evaluation of the effects of natural disasters and human settlements planning," [Final report of the regional meeting on Natural Disasters and Human Settlements Planning, Quito. Ecuador, 1988] .

POST-DISASTER PLANNING: THE CASE OF MEXICO CITY

by Roberto Elbenschutz Hartman

Four years ago I had the opportunity to attend the International Seminar on Regional Development Planning for Disaster Prevention here in Japan .

On that occasion I reported, from the viewpoint of a planner, the measures which urban planners had outlined after the 19th September 1985 earthquake struck Mexico City, and which, in my opinion, would be expedient to take in the event of a disaster.

I would refer you to Volume II of the memoir of this Seminar ^{1/} where I presented a broad overview of the country, its geological characteristics, the types of disasters to which it is susceptible, and the major damage that it suffered in the 1985 'quake. While I am aware that the information which I provided at that time may vary to a slight degree from the more accurate data now available, the panorama is basically the same, and there is no need to repeat it.

Now four years later, it might prove interesting to make a survey of the proposals which were submitted at that time of desirable or necessary measures to be taken, some of which had been launched as government programmes and are now more defined and consolidated, others of which ceased to play a prominent role and were relegated to a position of unimportance and ultimately forgotten, with the serious consequences that this implies.

Although the intention of this paper is to discuss the activities which grew out of the aftermath of the earthquake from the standpoint of urban planning concerns and to compare them with those that can be preventive measures or organized responses to similar situations, it should be pointed out that this is not in the strict sense of the word a meticulous evaluation, which by the way, should be undertaken.

FOLLOW-UP OF THE INTERMEDIATE AFTER-EFFECTS AND THE MAIN GOVERNMENTAL ACTIONS

After-effects

Outwardly, the city returned to its former self and, except for the prescribed modifications in construction regulations which clearly will have an effect upon the overall structure in the long run, the rest of urban functioning is virtually the same as it was before the 'quake.

A closer look, however, will allow us to appreciate certain qualitative and quantitative changes.

Several million new inhabitants have been added to the population since then, many of them settling in high-risk zones.

The face of the historic downtown district has changed due to modifications in the land use. The presence of offices, notably those

belonging to the numerous federal government agencies, has been considerably reduced. On the other hand, offices have altered the appearance of the southern part of the city, where several government ministries were relocated.

The high concentration of commercial activity in the historic downtown district has diminished somewhat with the relocation of a number of A typical example of business establishments to nearby residential areas. this took place in the Polanco neighbourhood, which used to be a high-level In the different neighbourhood communities affected by residential area. the earthquake, two opposite tendencies can be observed at this some have fully recovered their traditional life-intermediate point; style owing to the housing renewal programme, while others show a marked decline, deterioration is plainly visible, even though there are no overt signs of earthquake damage.

Housing Reconstruction

The Reconstruction Commission acted energetically after the disaster. It became the central point of convergence for information and provided guidance to the public sector in its decisions concerning the effects of the earthquake. The first significant and systematic action was carried out by the Housing Renewal office, a transitory agency created to provide solutions to the housing problems brought on by the quake in the downtown area, through a programme of intensive attention to these problems.

The programme basically consisted of replacing the dwellings which were destroyed on the same lots for those families who were affected. While the new buildings were under construction, emergency shelters were set up in nearby parks or streets to provide lodging to these families, without uprooting them from the neighbourhoods where they had their jobs and social networks. Once the construction had been completed, these people returned to their normal places and spheres of activity.

This programme proved enormously successful. More than 40,000 dwellings were built in a period of two years, a record number if one considers that they were spread out over a relatively wide area, and that the lots involved were fairly small, accommodating groups of between 7 and 25 families.

With this in mind, the agency produced some models of houses having areas of 40 m² and organized a massive building programme, contracting private construction firms.

Along with its unquestionable accomplishments, the Housing Renewal Programme had some shortcomings which should be pointed out in order to overcome them in similar programmes.

Many community groups which had been left homeless presented their own proposals for reconstructing their buildings, and expressed their willingness to cooperate by contributing their own labour. It was difficult to get financial institutions to permit this participation if the programmes did not conform exactly to the established norms and procedures of these institutions.

Given the magnitude and the volume of the project, perhaps it is understandable that this might have occurred. Nevertheless, a committee was formed to review the plans submitted by these organizations and it was able to obtain authorization for some of them. The results of this experience were positive on the whole, yet it would have been important to have allowed greater participation on the part of these community groups, which at lower cost may provide more adequate solutions.

Another limitation in the programme from the urban point of view was that it focused exclusively on restoring the damaged buildings. Certainly, replacing the houses of the same families was a praiseworthy enterprise, in the sense that the families were not uprooted and the social configuration of the neighbourhood was preserved. However, in urban terms, this did not necessarily imply an improvement. In some cases the housing density was increased, but the programme did not include additional infrastructure, common areas, or parking areas. Nor did it revise the respective layout or land-use guidelines for the zone. Basically, it concentrated on restoring things to normality under the same conditions.

Although the families found places to live, they also found themselves obliged to obtain loans that they are still paying back. Many had benefited previously from the rent-control system, and their former rent was very low in comparison with their present monthly payments, significantly higher, even when adjustments are made to allow for their limited economic possibilities. Yet there is no information about residents' mobility, who could be looking for an economic benefit selling their dwellings obtained through high subsidy, or simply because they could not afford the amortization payments.

The Building Code

The earthquakes made the authorities face the touchy problem of how to rule, in accordance with the regulations still in force at that time, in the cases of applications for building permits which were then being processed. Clearly, these projects could not be approved without changes. By means of a major technical undertaking, an emergency modification was made in the building code to adapt the norms for the structural characteristics of buildings to the requirements prescribed by the earthquake.

This allowed the normal life of the city to be resumed and new construction to be undertaken for the time being. However, in parallel, more meditative and consistent activities were being undertaken, among them, a technical analysis of seismic risks and the issuance in 1987 of a new Building code for the Federal District, which took into careful consideration the particular characteristics or the subsoil in the valley of Mexico.

The old Building Code dated back to 1976. The new one was issued in 1987. The major modifications grew out of the emergency regulations passed in 1985. At the present time, no new building may be constructed unless it complies with the strict regulations and preventive measures concerning earthquakes. A system of designating competent personnel to be in charge of structural design and maintenance supervision of buildings was also set up.

Civil Safety Programme

One of the most consequential tasks carried out by the National Reconstruction Commission was to determine the bases for a National Plan of City Safety, in a document published in 1986. This document proposed a series of measures relating to the safety of the urban population and the way in which this should be organized at the national level, as well as how the different areas of planning should implement such measures.

After this document was published, the Secretary of the Interior was empowered to coordinate a Civil Safety programme. A new undersecretariat was added to the existing structure of the secretariat for this purpose, formally denoting the importance of this issue.

To take the first steps, the new undersecretariat made use of the Urban Emergency plan, devised six years earlier by the Secretary of Human Settlements and Public Works, and initiated a programme to coordinate activities relating to natural disasters on the national level.

The new undersecretariat has a general operational area which is in charge of taking direct action and coordinating resources in the event of a disaster, as well as being the liaison with other institutions and agencies established to aid people who are left homeless.

In addition, it also includes the National Center for Disaster Prevention, an institution set up with funds donated by the government of Japan. Its functions are geared toward research, technology development, and in general, toward learning more about disasters and how to plan for, and mitigate, their effects.

Other activities undertaken by this agency are the training of personnel to carry out specific roles in the event of a disaster, and providing information about new ways for handling this kind of situation.

Preventive Measures in Planning

In the Urban Planning System of the Federal District the general and partial plans were rewritten. Density in the downtown district of the city was reduced and the degree of land-use intensity in that area went from 10 to 7.5. Any further expansion was limited to natural growth.

The specifications provided for in the plans ensure that land use will be concordant with the structural features of the buildings, as regulated by the Building Code.

In 1987 also the Zoning Ordinance was passed, identifying three important zones within the city, that of highest risk, corresponding to the low-lying area of the old lake bed, a transition zone, and a third zone, having better conditions of support, made up of the area surrounding the lake bed.

These elements constitute an important basis for reducing risks.

INFRASTRUCTURE OF SOCIAL ORGANIZATION

There are other factors that should complete the bases for guaranteeing the coordination and participation of society in the event of a disaster, to a large extent based on the foregoing ones, and these are elements which have not yet been worked out.

In the area of planning, where one would expect to find preventive measures and careful studies, plans for what measures to take and where, in response to an earthquake, not much which might prepare the city for such an event has come forth.

Parallel water and power networks have not been established. Emergency routes to be used in the event of a disaster have not been determined. Underground shelters, storehouses of provisions, medicines, information or any other kind of help in acting more efficiently in such emergencies, have not been built.

In this respect, one of the few preventive measures taken consisted of dividing the central telephone system into several operational centres, since the earthquake of 1985 made evident the vulnerability implied by having only one central telephone exchange. When it collapsed, the city was left without communications with the rest of the world.

In the province of urban and regional planning for earthquake prevention, nothing has been done regarding the training of specialists.

There is no doubt that we need people trained in physical planning, who understand the complexities of urban-metropolitan space and the functioning of cities, so that they can acquire additional rudimentary knowledge about how disasters affect urban functioning in order to know how to react should a disaster occur -- an event which has a high probability.

As far as I know, not even one course has been conducted on this subject, nor have there been any training programmes about less ambitious technical topics, necessary at the operational level, concerning matters of communication, transport, movement of people, etc. , in the event of a disaster. No university in the country, as yet, offers specialized courses or graduate programmes in the treatment or prevention of the effects of disasters.

Lack of preventive measures of this type reflect the insufficient follow-up efforts we have made in regard to the prescribed programme of action. The formal aspect is taken care of but the operational factor remains almost untouched.

In the area of civil safety, we projected a centre for disaster prevention on the highest organizational level possible in the federal government, and the formation of ad hoc committees in the different boroughs of the Federal District and at the municipalities in the whole country is mandatory, but this has not yet been implemented.

Considering the need for a broad-based dissemination of information about the vulnerability of the city and the courses of action which are decisive in the event of a disaster, another major inadequacy has been diffusion. The information exists, but is only available to the experts.

Neither is there any doubt about the importance of developing a social conscience concerning this issue. It is true that there are frequent talks and lectures, some television and radio programmes, as well as posters with schematic instructions, but such messages do not make either an organic nor sufficiently broad programme so as to guarantee reaching the entire population.

The effort made by Mexico City after the earthquake was immense and of great importance. Having an exceedingly high economic price, it was focused almost exclusively on restoring previous conditions, prevailing over the earthquake, and seeing that the city overcame the after-effects. The fact that this should have been the priority in political decision making, without sufficient guidelines established by planners, constitutes, in my view, another error.

Without taking away any credit due for having erased from the face of the city in only a few short months the psychological effect produced by the sight of rubble, destroyed buildings, broken pipes, cracked and uneven pavement, it is necessary to point out that this same effort lulled the traumatized population into feeling that, once the damage was repaired, the question of continued vulnerability was also resolved. A sense of security was produced by the fact that only the buildings standing erect were left, in effect blotting out any evidence of the earthquake. This also reduced the state of alert and the consciousness of the need to take preventive measures against similar disasters.

The restoration of prior conditions was so effective that vulnerability was also restored, producing a kind of therapeutic amnesia about an experience that people preferred not to recall. It is indicative of this situation that books giving personal accounts of the earthquake have utterly failed to sell in any noticeable quantities.

Organizing society is not an easy task. In recent years, Mexico has experienced very serious economic problems affecting the majority of the population, those with fewest possibilities and who are, moreover, most vulnerable in the event of a disaster. So great has been the absorption in solving the economic situation that the great concern about possible future earthquakes, social mobilization and the demands of 1985, have been put to one side.

However, the organization still exists. The people of the country have matured and have learned the efficacy of organizing themselves into community action groups, which promote an ever more active involvement and a forceful political presence in relation to the public authorities. This qualitative change offers a basis that could foster more efficient means of training and conscientization for disaster prevention. However, this has not been accomplished up until now.

Clearly, the task of training the population far exceeds the possibilities of the recently created National Center for Disaster Prevention, and should focus on mass means of communication and the educational system. The textbooks used in the schools do not yet address the issue of developing a consciousness of this problem, nor do we have the staff adequately prepared to start a nationwide programme on disaster prevention.

NOTE

1/ United Nations Centre for Regional Development. Planning for crisis relief. Towards comprehensive resource management and planning for natural disaster prevention. Papers at the International Seminar. 21-30 September, 1986. Vol.2, p.157.

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SOCIAL CONSEQUENCES OF MAJOR DISASTERS - MODERN LESSONS TO BE LEARNED FROM THE GREAT KANTO EARTHQUAKE - Hiroaki Yoshii

INTRODUCTION

Major disasters not only result in a large number of casualties, but also destroy the basis of human existence, including housing, equipment, lifelines such as energy supply and telecommunications, transportation facilities, as well as manufacturing and commodities facilities. This causes a temporary change of social goals and a decrease in resources which may be possibly used for relief and recovery, and presses society towards quickly building up an emergency system.

Another characteristic of major disasters is that damages are concentrated within a particular district. Especially in the case of earthquakes, distance from the epicentre affects the scale of damage. Therefore, differing social systems for emergency situations are required for each area. This also means that differing social systems are needed with time after the occurrence of an earthquake. As indicated in figure 1, in the central district of disaster areas the social goal for the first one to two weeks after disasters is the sustenance of life (measures dealing with casualties and fatalities and the provision of the minimal amount of food and water to sustain life). Hereafter, the social goal changes from the minimal sustenance of life to the recovery of minimum standard of living. In relation to this, in the surrounding areas of disasters, recovery of minimum standard of living is the goal immediately after disaster strikes. As for areas which have not been affected by disasters, the recovery of a normal standard of living is taken for granted from the very beginning. In this manner, depending on the area, and depending on the period, different social goals are designated.

Figure 1 Changes in Social Goals depending on Period and Distance from Epicentre

The focus of this paper is not the social phenomena during the period when sustenance of life is the social goal after disasters, but rather the various social phenomena during the period when the recovery of a minimum] and normal standard of living are goals in the central area of disasters (boxed off area in figure 1). Emphasis is placed on the following three items in this paper.

1. The emergence of a large number of long-term evacuees and "sokai" ^{1/} population: An examination will be made of the after-effects caused by the emergence of mass immigrants from the central area of disasters.
2. Reconstruction of housing in a short period: Time required for reconstruction of housing after the destruction of a large number of housing and forming a seismic structure of the areas.
3. Emergence of a large number of unemployed: Analysis of unemployment issue arising from damages of manufacturing and commodities facilities and the disruption of lifelines.

EMERGENCY OF LARGE NUMBER OF EVACUEES AND "SOKAI" POPULATION -- LARGE-SCALE IMMIGRATION

The Emergence of Large Number of Evacuees and "Sokai" Population During the Great Kanto Earthquake of 1923 and Its Social Impact

Approximately 2.5 million people lost their homes from fires during the Great Kanto Earthquake but it is not clear how many victims evacuated to distant areas. Within two months after the earthquake, 30 per cent of the total population --670,000 people -- had evacuated from the downtown Tokyo. ^{2/} Even one year later, 500,000 people had not yet returned to the area .

We find that the number of migrating people who were transported during the one month after the earthquake was 880,000 by train and 150,000 by ship or military transport. ^{3/} As shown in table 1 which is taken from the records ^{4/} of prefectures receiving evacuees, we learn 1 million people migrated to areas surrounding the disaster area, and 700,000 fled to distant areas immediately after the earthquake.

Based on these statistics, it can be supposed that after the earthquake, about 1.7 million victims evacuated to remote areas and then gradually returned to their homes. However, after one year, 700,000 of that number had failed to return. There are three probable reasons for such a long-term evacuation.

1. Destruction and loss of homes
2. Inadequate drinking water supply due to destruction of water lines.
3. Unemployment due to destruction of business premises and facilities.

Temporary destinations of evacuees were mainly the uptown and suburbs of Tokyo, rural areas of Tokyo-fu, Saitama and Kanagawa Prefectures.

Table 1 Destination of Evacuees after the Earthquake

Area	Number
Chiba Prefecture	115,000
Saitama Prefecture	297,000
Kanagawa Prefecture (farming community)	79,000 families
Tokyo-fu (farming community)	481,000
Shizuoka Prefecture (transit evacuees)	119,000
Aichi Prefecture	150,000
Tochigi Prefecture	42,000
Gunma Prefecture	43,000
Nagano Prefecture	28,000
Fukushima Prefecture	40,000 (approximate)
Niigata Prefecture	70,000 (approximate)
Osaka-fu	48,000
Hokkaido	16,000
Other Prefectures	130,000

A detailed examination reveals that as indicated in figure 2, prior to the earthquake 130,000 people resided in the Nihonbashi ward which had the highest ratio of destruction by fire. After the earthquake, this number decreased to less than 40,000 and in 1930, seven years after the earthquake, the total population of the ward had only returned to 110,000. On the other hand, Koishikawa ward which had the lowest ratio of destruction by fire in the City of Tokyo had a population of 150,000 prior to the earthquake but this number increased by 20,000 people, bringing the total to 170,000. By 1930, the population again returned to 150,000. As shown in figure 3, the population of the City of Tokyo was 260,000 less than before the earthquake even in 1927, whereas surrounding areas saw an increase of their population by 85 per cent for the five years between 1922 to 1927. Now adding the Tokyo City area and its surroundings (1-3 districts), we find a 25 per cent rise in the population (3.92 million in 1922; 3.25 million in 1923; 4.85 million in 1927) which indicates that there is no great change in the long-term trend of population concentration in Tokyo.

This means that the Great Kanto Earthquake did not bring changes to the long-term trend of population concentration in Tokyo, but the reallocation of population and industry in the Tokyo metropolitan area. In other words, it brought about the formation of the Greater Tokyo Metropolitan Area and the creation of the second uptown, "Yamate."

The Emergence of a Large Number of Evacuees and "Sokai Population During the Next Great Kanto Earthquake

What would happen in society if the next Great Kanto Earthquake occurs sometime in the future? According to the survey conducted, about 30 percent of residents whose homes are destroyed plan to evacuate to their hometown or parents' home. Approximately 25 per cent would seek refuge at

Figure. 2 Changes in Population within Tokyo (Koishikawa and Nihonbashi population wards)

Figure. 3 Changes in Population in the City of Tokyo and its surrounding areas

the home of relatives or acquaintances near their homes and 10 to 20 percent would seek refuge at the evacuation site of the city or district, or remain at the site of the burnt down home to protect their land. Using the damage estimation ^{5/} by the National Land Agency, the amount of population immigration may be discerned to be as shown in figure 4.

Figure 4. Estimated Population Movement after the Next Great Kanto

The following serious questions will accompany the problems arising from the large number of long-term evacuees or "sokai" population.

1. How to provide transportation (railway, bus, etc.).
2. How to provide clothing, water, food, and shelter.
3. How to assist evacuees in finding employment at the evacuation site.
4. Educational support: Permission for enrolment of child disaster victims, and assistance in educational costs.
5. Management of private land owned by victims located in the disaster area and provision of information on the rehabilitation activities at disaster areas.

Ironically, the area which is expected to burn down extensively is the area developed just after the Great Kanto Earthquake. If history repeats itself, the next major earthquake will also be unable to change the trend of population concentration towards the Tokyo metropolitan area. It is probable that an even greater Tokyo metropolitan area will be created and the reallocation of the population and industry in the Greater Tokyo area will be accomplished.

RECONSTRUCTION OF HOUSING

Housing Reconstruction after the Great Kanto Earthquake of 1923

The reconstruction of housing after the Great Kanto Earthquake was carried out in two stages. The first stage involved building barracks (temporary housing) on the site of the burned down homes, and the second stage entailed the reconstruction of proper housing. The central and local governments built approximately 140,000 houses in one year. However, on an individual basis, 110,000 houses were built within 3 months after the earthquake which was more substantial in number. Following this, due to the drastic rise in prices of construction material, construction projects failed to show a marked increase and after three years, the number finally reached 240,000 houses. It took an even longer time to accomplish total reconstruction.

On the occasion of the housing reconstruction, much active discussion took place regarding the creation of a city that is well-prepared for disasters, and succeeded to build fifty-two new main streets, fifty-two parks (including large ones), and the establishment of land-use planning. But in the final consequence efforts failed to build up a genuine "earthquake resistant city." The reasons for this failure are generally believed to be the limitations regarding funding and an absence in needed political leadership. But the fundamental reason for this is prevalent the attitude that the occurrence of major disasters is an act of fate and is punishment from heaven to those persons who have behaved. With such an attitude toward disasters, 6/ people accepted them as fate or they acknowledged it to be "heaven's punishment" and proceeded to lend their every effort to restore the standards of living. It was very rare for the public to find out the real reason for the disaster in scientific terms and consider what steps should be taken so that it never occurred again. Moreover, for the general public who hardly possessed any property, disasters might give them the opportunity to make money rather than to lose it. Also, entrepreneurs such as shop owners had the clever custom of quickly responding to the situation after the disaster by taking orders for lumber in preparation of another forthcoming disaster due to past experience of frequent large fires in the Edo era. It was due to the above reasons that building a city well-prepared for disasters was not vigorously promoted at the expense of a delay in reconstruction suffering from the burden of providing necessary funding.

Housing Reconstruction After the Next Great Kanto Earthquake

It is estimated that in the worst situation approximately 3.77 million families will lose their homes when the next Great Kanto Earthquake occurs. Reconstruction of these homes will be possible only if the following

conditions are met: The intention of the owner to reconstruct, ability of the owner to obtain funds for reconstruction, ability of the construction companies, and ability to provide building materials. According to the survey, 8/ the intention to reconstruct by owners is rather high and 80 per cent of the respondents had the intention and replied that they would like to reconstruct as soon as possible. Next, as to the ability of the owner (family) to provide funds for reconstruction, the average family savings for 1988 was 11.2 million yen, and the percentage of owners who bear debts is approximately 30 per cent which is not considered very high. So, funding is highly possible.

In consideration of the ability of construction companies, the actual record for 1988 in Tokyo and its surrounding three prefectures was 560,000 houses, and in five peripheral prefectures the number is 90,000 homes and the national total is 1.68 million homes. Construction ability has almost reached its limits and can only be increased up to 20 to 30 percent. Therefore, even if builders were gathered from throughout the nation, housing that can be built in the metropolitan area is at the most 900,000 to 1 million homes per year.

Regarding building equipment and materials, the following have been pointed out:

1. Since the use of electric powered equipment has increased greatly, efficiency of construction would depend on the time when electricity is restored.
2. In the case of prefabricated buildings or condominiums, shortage of large cranes etc. would present a problem.
3. Construction materials such as steel, iron, and lumber could be imported, and their shortage would not be a major problem. Problems would arise when the road transportation system is restored.

The greatest problem would be the shortage of necessary manpower.

From the above analysis, the restoration of housing after the earthquake is expected to take the following scenario:

1. Three to four months will be required for the restoration of ports and harbors, roadways, electricity, telecommunications and so forth after the earthquake. There will be a shortage in construction material and housing construction will see little or no progress. Construction of barracks will be put forward.
2. Thereafter, general builders, prefabricated housing companies, and condominium builders will have reorganized themselves and the administrative sector will be ready to give advice and financial support. Then 900,000 to 1 million houses may be built in a year.
3. However, demand will exceed supply, and there will be a marked rise in the price of building material and labour, as well as in the price of housing. This will lead to many victims building only small huts instead of permanent housing.

4. Three to four years after the disaster, the peak of housing construction will have passed, which will put the price of housing down to a reasonable level.
5. Later, a period of excess housing supply will arrive.

In the process of housing reconstruction as mentioned, whether governments could form a long-term strategy for building a city well-prepared for disasters depends on the victims' attitude toward disasters. It is hoped that efforts would be made to scientifically analyse the reason for the disaster with the desire that the next generation is saved from the same kind of suffering.

THE OCCURRENCE OF UNEMPLOYMENT

Unemployment accompanying earthquake disasters result not only from direct damage such as the destruction and burning down of factories, stores, and offices but also from the halt of electricity supplies, gas, telecommunications, and transportation, and the dramatic changes in consumers demand.

Unemployment Resulting from the Great Kanto Earthquake of 1923

In the case of damaged factories, 17.4 percent of the workers were laid off and the workers engaged in commerce also saw a decrease of 10 to 20 percent. Conversely, the number of agricultural workers increased. This is because the long-term evacuees returned to their hometowns and helped out with the family business of farming.

Estimates for Number of Unemployed in the Case of the Next Great Kanto Earthquake

The estimates for potential unemployment in the manufacturing sector is 1.3 million. For the ratio of unemployed persons in proportional to the decrease in production is expected to be approximately 35 percent. ^{8/} Among them, considering that those who actually lost their jobs during the great Kanto Earthquake was 17.4 per cent, the unemployed in the manufacturing sector (3.63 million persons: 1985) are estimated as $3.63 \text{ million} * 0.35 * 0.174 = 220,000$.

The following survey results are available in the case of the service and retail industries. ^{9/}

1. In the case of damage to the building or facilities only, 10 to 20 percent of small-scale businesses are basically of the intention to suspend their business.
2. About 50 per cent of businesses will be forced to close down if electricity is stopped. If transportation systems are affected, about 50 percent of companies would scale down their business rather than close it. Only a portion of the workers would be layed off as a result of this.

Taking into consideration that the damage to businesses is the same as general housing at 39 percent, and the ratio of those laid off is expected to be 25 percent (The ratio of shutdowns was 25 percent in the case of the service industry and retail industries in the area which had their stores buried by the lava flow from the Miyakejima eruption of Tokyo), the number of those employed in the service and retail industries was 7 million in 1985), the number laid off would be $7 \text{ million} * 0.39 * 0.25 = 680,000$.

Aside from this, those who lose their jobs because of long-term evacuation resulting from destruction or burning of their residences will be added, and the total number of unemployed is expected to exceed 1 million.

CONCLUSION

A major disaster not only destroys many lives and possessions, but also forces victims to live their lives as refugees which is inconvenient and can lack privacy for long periods of time. It also brings suffering of unemployment and economic burden accompanying reconstruction of their housing and brings a big impact to their entire lives. However, it is often the case that in society in general, existing social trends are such as the trend toward population accelerated even more as a result --concentration in metropolitan areas and the out-migration of population to the suburbs, moving of factories and universities to the suburbs and the Also if appropriate : mergers of small-scale companies with large ones. assistance is not provided by the government, this leads to the collapse of the middle class which serves as the central support of the nation.

As to whether or not an all-out effort will be made for the creation of a city well-prepared for disasters after the occurrence of a major disaster depends on the leadership of the government, but needless to say, this is basically affected by people's attitude towards disasters.

NOTES

- 1/ "Sokai" is a Japanese word which means that victims of disasters return to their hometown when they are pressed to evacuate for a long period of time.
- 2/ Yoshimasa Kurabayashi, "A System of Social and Demographic Statistics in the Case of the Great Kanto Earthquake," Keizai Kenkyo 34: (2, 1983).
- 3/ Ministry of Internal Affairs, "Great Kanto Earthquake," (1926)
- 4/ Kyochokai Division of Rural Area, "Consequences of Earthquake Damage in Rural Areas," (1923)
- 5/ National Land Agency, Disaster Prevention Section, "Estimation of Damage Caused by the Next Great Kanto Earthquake," (1988)
- 6/ Osamu Hiroi, "Disaster and the Japanese," Jiji Tsushinsha, (1986)

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7/ Institute for Future Technology, "Study on the Plan to Build a Safe Country", (1985)

8/ Ibid.

8/ Hideki Kaji, Private Communication

EVALUATION OF INDIRECT DAMAGES CAUSED BY THE 1983 NIHONKAI-CHUBU, JAPAN, EARTHQUAKE, by Kazuhiko Kawashima and Takashi Kanoh

ABSTRACT

The effects of an earthquake are not necessarily restricted to damage of structures, but extend much further. This paper presents a method for estimating indirect losses caused by an earthquake. Loss of production, damage of transportation facilities, and damage of materials and goods. Based on direct loss associated with production loss, a secondary "ripple" effect was estimated through an inter-industry relation analysis (input-output analysis). The procedure was applied to the Nihonkai-chubu, Japan, Earthquake of 1983. Estimated gross products at the damaged region agreed fairly well with those actually observed after the earthquake.

INTRODUCTION

Damage due to earthquakes has been evaluated mostly in terms of damages associated with failure of facilities and structures. However, effects of an earthquake are not necessarily restricted to such physical damages but may include much wider aspects, such as loss of production due to suspension of production, decrease of consumption due to decreased social activities, etc. Losses associated with such effects would be much greater and more widespread than those counted only from physical failures. However, mechanism of economic losses induced by an earthquake is so complicated that little is known about the effects.

This paper presents and evaluation of indirect losses caused by the Nihonkai-chubu, Japan. Earthquake of 1983, based on an inter-industry relation analysis (input-output analysis) .

EFFECTS OF AN EARTHQUAKE ON ECONOMIC LOSSES

Economic losses associated with an earthquake may be evaluated based on a decrease of products within a region. An amount of products $G_o(t)$ within a region after an earthquake may be defined, and evaluated as

$$G_o(t) = G(t) - GD(t) + GR(t) \quad (1)$$

in which $G_N(t)$: Products which were supposedly achieved in t fiscal year in a region if an earthquake had not taken place, $GD(t)$: a decrease of products in a region due to the earthquake damages, $GR(t)$: an increase of products in a region due to investments for restoration.

Consequently, it may be possible to evaluate $G_o(t)$ if $G_N(t)$ and $G_R(t)$ are appropriately evaluated. If one prefecture is regarded as a region for evaluating the economic losses, the products $G_o(t)$ can be obtained in a form of gross Prefectural products. Because Japan Consists of 47 prefecture, prefecture may be an appropriate unit to express local activities. However, because the gross Prefectural products describe only final products achieved in a given prefecture, detailed economic effects caused by an earthquake cannot be traced. Therefore, it is required to develop an analytical method for clarifying economic effects of an earthquake.

There are a number of aspects which may be regarded as effects induced by an earthquake. They are classified as shown in table-1, in which losses i of facilities, properties, goods and materials are generally evaluated through damage surveys conducted by industries and regional governments following an earthquake. As an effect of earthquake damage, the following decreases of products are considered: Decrease of products due to damage of facilities for production; decrease of products due to damage of transportation facilities; and decrease of products due to damage of materials and goods.

Considering the three types of damage, the economic effects of an earthquake may be evaluated in accordance with a flow chart shown in Figure 1. A reduction factor which represents a degree of reduction of products of i -th industry due to an earthquake is defined here as

$$\alpha_i = \frac{\Delta X_i}{X_{iN}} \quad (2)$$

in which ΔX_i and X_{iN} represent a decrease of yearly products of i -th industry due to an earthquake and yearly products supposedly developed in i -th industry if the earthquake had not taken place, respectively.

EVALUATION OF ECONOMIC LOSSES CAUSED BY AN EARTHQUAKE

Although the reduction factor of products can be estimated independently for the three types of damage, interrelations between the three types of damage have to be taken into account. Because the products for i -th industry are likely to be affected by the most critical damage among the three types of damages, the decrease of products for i -th industry ΔX_i is assumed here to be evaluated as

$$\Delta X_i = X_{iN} (\alpha_{\max}) \quad (3)$$

Table 1 Classification of Earthquake Effects

Classification	Objective and/or Form of Damage	Effects of Loss and/or Damage
Human Life	Dead, Injury	Loss of manpower, mental effects
Facilities for Living	House, education facilities, hospitals, etc.	Functional loss for daily human activities
Facilities for Production	Cultivate field, non-residential house (factory, shops) etc.	Decrease of production, loss of production
Lifeline Facilities	Electricity, telecommunication, gas, water, and sewage, trash	Decrease and/or capability for production
Transportation Facilities	Roads, bridges, ports, railways	Decrease of production due to decrease of transportation capability for material and products, Decrease of production due to decrease of capability for passengers
Public Works (excluding transportation facilities)	River, Sabo-works, slope failure	Damage associated with failure
Transportation Media	Trucks, bus, trains, ships	Decrease of production due to decrease of transportation capability
Manufactured goods, partially manufactured goods	Loss of manufactured and/or partially manufactured goods	Decrease and/or loss of value goods; decrease of products due to loss of manufactured and/or partially manufactured goods

in which α_{max} represents the maximum reduction factor among the three reduction factors which are evaluated independently for the damage of facilities for production, for the damage of transportation facilities, and for the damage of materials and goods. X_iN represents the products supposedly developed in i -th industry if an earthquake had not occurred.

Besides such decrease of products in i -th industry, productions of other industries which depend on the products of i -th industry would also decrease, even if their facilities suffered no direct damages by the earthquake. This effect is designated in this study as a first effect, and is analysed through an inter-industry relation analysis.

Table 2 Inter-industry Relation Table (Input-Output Table)

Sell	Purchase	Intermediate Demand	Final Demand	Products
		$l_1 l_2 \dots l_i \dots l_j \dots$		
Intermediate sales				
	l_1			
	l_2			
	\cdot			
	\cdot			
	l_i	$\dots X_{ij} \dots X_{ij} \dots$	f_i	X_i
	\cdot			
	\cdot			
	l_j	$\dots X_{ji} \dots X_{ji} \dots$	f_j	X_j
	\cdot			
	\cdot			
Gross Value Added		$\dots V_i \dots V_j \dots$		
Products		$\dots X_i \dots X_j \dots$		

An inter-industry relation table has a form of table-2 in which l_i represents i -th industry. The relation may be written as

$$\underline{A} \underline{X} + \underline{E} = \underline{X} \quad (4)$$

where

\underline{A} : input coefficient matrix

\underline{X} : Products vector, and

$$\underline{X} = \{X_1, X_2, \dots, X_n\}^T$$

\underline{E} : final demand vector, and

$$\underline{E} = \{f_1, f_2, \dots, f_n\}^T$$

Coefficient X_{ij} of a matrix A X of Equation (4) represents products used from l_i to l_j , or an amount paid from l_i to l_j and X_i and f_i represent the products and final demand of l_i , respectively.

When an amount of α_i ($0 < \alpha_i < 1$) of the products X_{iN} of i -th industry becomes unusable due to an earthquake, such an effect may be considered in the analysis by substituting X_{ij} and f_i on i -th line of the inter-industry relation table with $(1 - \alpha_i) X_{ij}$ and $(1 - \alpha_i) f_i$, respectively. It should be noted here that even if j -th industry did not suffer damages from the earthquake, the products of j -th industry decreases from X_{jN} to $(1 - \alpha_i) X_{jN}$. Similarly, when an amount of α_k ($0 < \alpha_k < 1$) of the products in k -th industry suffered damage, it also makes the products of j -th industry decrease from X_{jN} to $(1 - \alpha_k) X_{jN}$.

Therefore, when products decrease in industries i and k simultaneously, both would influence the production of j -th industry. Although interactions of the decrease of products between various industries are quite complex, it is assumed here that the decrease of products in j -th industry is affected by either l_i or l_k which gives a larger reduction factor. Decrease of products ΔX_j in j -th industry is assumed as

$$\Delta X_j = X_{jN} \cdot \max(\alpha_i, \alpha_k : X_{ij}, X_{kj}) \quad (5)$$

Decrease of product $\Delta \underline{X} = \{\Delta X_1, \Delta X_2, \dots, \Delta X_n\}^T$ is referred to here as a first effect.

To represent a decrease of income and consumption, a decrease of products on a gross value added basis is often used. Decrease of products on gross value added basis ΔV is generally obtained from ΔX by

$$\Delta V = \Delta X T \cdot v \quad (6)$$

in which v represents a gross value added ratio matrix, which is generally assumed as a diagonal matrix consisting of gross value added ratios. The gross value added ratios are generally evaluated for each industry by prefectures. To distinguish ΔX from ΔV , ΔX is referred hereinafter as a decrease of products on a product basis.

Decrease of income and operating profit in the gross value added ΔV , given by Eq. (6) would cause a further decrease of products, because they were to be used to produce products in a form of consumption and formation of fixed assets. Such an effect is defined here as a second ripple effect. To evaluate the second ripple effect, the decrease of final demand vector FS associated with the decrease of income and operating profit has to be obtained. Empirical formulae based on relations between consumption vs. income and operating profit are assumed for computing the final demand. The second ripple effects may then be evaluated from Eq. (4) as

$$\Delta XS = (I - A)^{-1} \Delta FS \quad (7)$$

$$\Delta VS = \Delta X S T \cdot v \quad (8)$$

in which, ΔXS : second ripple decrease of products on product basis, ΔVS : second ripple decrease of product on the gross value added basis, and Y : the gross value added ratio matrix.

One point to be noted in the application of the inter-industry relation analysis for evaluating the economic effect of an earthquake is that the inter-industry relation defined by Eq. (4) is assumed constant during the year considered in the analysis. Although the confusion of economic activities would be gradually recovered with time after an earthquake, the process of recovery cannot be considered in this analysis.

Repair and restoration after an earthquake may consist of expenditures for purchasing materials and goods for restoration. Such expenditures give a positive impact on various industries, which, in turn, develops a ripple effect. The ripple effects caused by such a positive impact may be analysed by the standard inter-industry table analysis by introducing the investment for restoration to the final demand vector. Analytical procedure is the same as described above.

Figure Here

Figure 1. Evaluation of Economic Effects of Earthquake

APPLICATION TO THE NIHONKAI-CHUBU EARTHQUAKE OF 1983

Brief Description of The Nihonkai-Chubu Earthquake

The Nihonkai-chubu earthquake occurred approximately 90km offshore from Akita prefecture at 12:00 noon on May 26, 1983. It had an earthquake magnitude of 7.7 and a focal depth of 5km. Figure 2 shows a distribution of JMA (Japan Meteorological Agency) seismic intensity scale as well as the approximate aftershock area, 60km by 120km in east-west and north-south directions, respectively. The JMA intensity of III, IV and V is generally referred as the peak ground acceleration of 0.008G -0.025G, 0.025G -0.08G, and 0.08G - 0.25G, respectively. Figure 3 shows peak accelerations measured with strong motion accelerographs installed on ground surface and on structures. The largest peak ground acceleration was about 0.4G recorded at a site near the Nanamine Bridge at the Hokkaido.

Figure 2 Distribution of Seismic Intensity (Japan Meteorological Agency's Scale)

Figure 3 Peak Accelerations Measured with Strong Motion Accelerographs

Table 3 Damage Statistics by the Nihonkai-chubu Earthquake

	Category	Unit	Hokkaido	Aomori	Akita	Others	Total
<u>Human</u>	Fatality	Person	4	17	83	-	104
	Injury	Person	24	25	265	10	324
<i>Damage of facilities</i>	Highway	Site	3	702	670	4	1,379
	Bridge	Bridge	-	48	84	1	133
	River	Site	3	243	196	3	445
	School	School	70	370	272	44	756
	Ship	Ship	637	853	681	480	2,651
	Water Supply	Household	770	17,399	22,187	46	40,402
	Electricity	Household	2,200	19,840	17,563	563	40,166
<i>Damages of residential houses</i>	Complete failure	House	8	447	1,132	-	1,584
	Partial failure	House	85	3,883	5,489	2	9,457

Table 4 Direct Damage in Akita Prefecture (Billion Yen)

Type	Classification	Damage
Damage of Facilities	Agricultural facilities	24.48
	Fishery Port facilities	1.49
	Marine facilities	4.20
	Forestry facilities	5.56
	Commercial facilities	2.93
	Industrial facilities	4.92
	Other commerce and industrial facilities	2.26
	Public Works	59.25
	Other public works	3.96
	House	26.7
	Educational facilities	1.73
Damage of Materials and Goods	Agriculture	2.41
	Livestock	0.01
	Forestry	0.40
	Commerce	1.34
	Industry	3.44
	Other commerce and industry	0.71
TOTAL		145.74

Extensive damage resulted from the earthquake. Table-3 summarizes the damage statistics in the Hokkaido, Aomori, Akita and other Prefectures. The most Extensive damage occurred in the Akita prefecture, where 83 persons were killed and 265 were injured.

Table-4 shows the direct damage in the Akita prefecture. Total amount of the damage is 148.2 billion yen in the 1983 price (1 U.S. dollar = 235 Yen in 1983 exchange rate). This corresponds to 6.5 percent of the gross prefectural products of the Akita prefecture (2,272.8 billion yen). Because of the significance of the damage, the economic losses in the Akita prefecture due to the Nihonkai-Chubu Earthquake is analysed in the following.

Decrease of Products due to Damage of Facilities for Production

Direct damage of facilities and properties for production was surveyed by private and regional government bodies in Akita prefecture, and the data for agriculture, forestry, fisheries, manufacturing industries, whole-sale and retail are available) Among these damages, only the decrease in products associated with forestry damage is disregarded in this analysis because of the difficulty in evaluating products vs. properties relations.

A reduction factor for agricultural products was estimated through a unit product model. Agricultural products per unit cultivated area was estimated by regressing the data between 1970 and 1981 as

$$U = 14.1 - 0.217 \times (t - 1925) \quad (R = 0.95) \quad (9)$$

in which U: agricultural products per unit cultivated area (million yen /ha), t: year (1970 < t < 1981), and R: a regression coefficient. The agricultural products per unit cultivated area U in 1983 are estimated by an extrapolation of Eq. (9) as 1.56 million yen/ha.

On the other hand, the total cultivated area in 1983 in the Akita prefecture is estimated at 162,329 ha, and a cultivated area of 3,139 ha is reported damaged by the earthquake. Therefore assuming that the damaged area could not be used for agricultural production in 1983, agricultural products at this year XAE may be estimated as

$$XAE = U \times (162,329 - 3,139) = 248\,687 \text{ (million yen)} \quad (10)$$

Similarly, the agricultural products XAN, which would be possibly developed in 1983 if the Nihonkai-chubu Earthquake had not occurred, are estimated as $1.56 \times 162,329 = 253,591$ million yen.

Therefore substituting XAE and XAN into Eq (2), one obtains the reduction factor A for agriculture as

$$\alpha A = \frac{XAN - XAE}{XAN} = 1.9 \% \quad (11)$$

Fisheries facilities suffered severe damage by tsunami, in the amount of 4,195 million yen. Based on fisheries products per unit fisheries capital stock, the reduction factor F for fisheries is estimated as 26.5 per cent.

For manufacturing industries, total products of goods are estimated by a production function model which is formulated by regressing the data of 1982 as

$$Y = 8.03K^{0.519}L^{0.481} (R=0.87) \quad (12)$$

in which Y: products of goods in million yen, K: fixed assets for production in million yen, and L: number of employees. Because a separate regression analysis predicts K as 179,939 million yen and L as 87,700 persons in 1983, the product of manufacturing industries XMN, which would be supposedly developed in 1983 if the earthquake had not take place, may be estimated as

$$XMN = 8.03 \times 179,939^{0.519} \times 87,700^{0.481} = 1,022,741 \text{ (million yen)} \quad (13)$$

On the other hand, damage of facilities in manufacturing industries is reported as 2,925 million yen. Therefore, the products of manufacturing industries XME in 1983 may be estimated as

$$\begin{aligned} XME &= 8.03 \times (179,939 - 2,925)^{0.519} \times 87,700^{0.481} \\ &= 1,014,081 \text{ (million yen)} \end{aligned} \quad (14)$$

It should be noted in Eq. (14) that the loss of number of employees due to death and/or injuries is disregard due to the limited effect. The reduction factor M for the manufacturing industries is, then, estimated from Eq. (2) as

$$\alpha M = \frac{XMN - XME}{XMN} = 0.85 \% \quad (15)$$

Table 5 Reduction Factor of Products (%)

Classification		(1) Due to Damage of facilities for production	(2) Due to damage of transportation facilities	(3) Due to damage of materials and goods	(4) Most critical reduction factor between (1), (2), and (3)
Agriculture		1.93	0	0.79	1.93
Forestry		0	0	0.48	0.48
Fisheries		26.27	0	0	26.27
Mining		0	0	0	0
Manufacturing		0.85	0	0.12	0.85
Construction		0	0	0	0
Electricity, Gas, Water		0	0	0	0
Commercial		0.01	0	0.75	0.75
Finance and Insurance		0	0	0	0
Landed Estate		0	0	0	0
Transportation and Communication	Road	0	0	0	0
	Railway	0	1.7 ¹⁾	0	1.7 ¹⁾
	Ship	0	45.0 ²⁾	0	45.0 ²⁾
	Communication	0	0	0	0
Service		0	0	0	0
Official Businesses		0	0	0	0
Unclassifiable		0	0	0	0

Note: 1) Reduction factor only for products for third industry
2) Reduction factor only for products for electricity

Reduction factor for wholesale and retail is similarly estimated by formulating a production function model between the products and capital for wholesale and retail.

The reduction factors of products for the damage of facilities and properties for production were thus estimated as shown in table-5. Reduction factors of products for damage of transportation facilities, and for materials and goods, which will be described later, are also presented in table-5.

Decrease of Products due to Damage of Transportation Facilities

Because damage of roads was limited and restoration was carried out promptly after the earthquake, the effect of road damage is disregarded in this analysis. Reduction of products is considered here only for railways and sea transportation.

On the railways, service was suspended at the Oh-u Main-Line, Oga Line, and Gonoh Line for between 10 and 20 days, Number of passengers affected by the suspension is reported at approximately 1.7 percent of the annual

number of passengers. However because freight transportation was made alternatively by truck, the effect of the suspension of the railways for freight transportation was limited. Therefore the effect of railway damage is taken into account only for the tertiary industry by disregarding their effects for primary and secondary industries. The reduction factor for railway is assumed from the number of passengers as 1.7 percent.

Port and harbour facilities suffered severe damage. It took one year and five months for their full restoration. Handling volume of the materials which depend on ship transportation such as crude oil, cement, heavy oil and petroleum goods substantially decreased in Akita prefecture. However, the decrease of landing volume did not directly bring a decrease of products. Most cement was landed at ports located in adjacent prefectures and transported to Akita prefecture by trucks. Heavy oil and petroleum goods were landed with use of exclusive wharves which survived the earthquake, etc. Crude oil for use at the Tohoku Electrical Power Station was the only case where alternative transportation could not be made. Figure 4 shows the landing volume of the crude oil in Akita port. The landing volume was only 450,000 tf in 1983. It corresponds to approximately 45 per cent decrease in the volume of 820,000 of which would be supposedly made if the earthquake had taken place. Therefore, it is assumed here that damage to ports sustained a decrease of electricity by an amount of 45 per cent. It should, however, be noted that because shortage of electricity in Akita prefecture was supplied from surrounding prefectures, it is assumed that the decrease of production due to the shortage of electricity was negligible. This means that the reduction factor of 45 percent is considered only for production of the electricity. The reduction factor of products due to damage of transportation facilities thus estimated is shown in table-5.

Decrease of Products due to Damage of Materials and Goods

Decrease of Products due to damage of materials and goods is evaluated for agriculture, livestock, forestry, commerce and industry (refer to table-4). Dividing the decreases of products by the products (output) of the inter-industry relation table, the reduction factors of the products are evaluated for each industry as shown in table-5. The reduction factors associated with the damage of materials and goods are generally small.

Decrease of Products due to Seismic Damage

Based on the reduction factors which have been estimated in the preceding sections for the damage of facilities for production, for the damage of transportation facilities, and for the damage of materials and

include in part of the decrease of products from the earthquake. Although the drop in production resulting from dependence upon materials damaged in the earthquake was taken into account in the analysis in table-5, the materials could have been sold had the earthquake not taken place.

Table 6 Predicted Decrease of Products (Billion Yen)

Classification	(1) Original Products	(2) Reduction of Products
Cultivated Agriculture	253.6	4.9
Livestock	52.9	1.02
Forestry	82.8	1.04
Fisheries	11.5	3.02
Mining	91.6	0.78
Food	181.7	18.55
Texture and Clothes	100.5	1.81
Wood and Wooden Products	236.8	2.36
Pulp and Paper	48.4	0.7
Printing and Publishing	20.2	0.17
Leather and Rubber Goods	1.3	0.02
Chemical Products	35.1	0.3
Petroleum and Coal	43.5	0.42
Ceramics	47.6	0.4
Iron and Steel	13.9	0.12
Iron and Non-iron goods	146.5	1.24
General machinery	44.3	0.38
Electric machinery	149.6	1.27
Transportation machinery	62.9	0.53
Precision machinery	14.8	0.13
Other manufactures	12.6	3.31
Construction of Buildings	356.3	5.28
Construction of Public Works	246.9	4.77
Electricity, Gas, Water	193.0	73.02
Commerce	460.2	7.82
Finance and Insurance	114.5	1.95
Landed Estate	264.1	4.22
Transportation and Communication	307.5	5.23
Services	641.4	95.4
Official Business	145.2	7.32
Unclassifiable	34.4	0.66
Total	4,415.6	248.14

Table 7 Effect of the Nihonkai-Chubu Earthquake of 1983 on Economy of Akita Prefecture (Billion Yen)

(a) Direct Damage and Decrease of Products (First Effect and Second Ripple Effect)

Damage and Decrease in Production		Products Basis	Gross Value Added Basis
Direct Damage		145.7	72.1
Decrease of products by the earthquake	Damage of Materials and Goods	8.3	4.1
	Direct decrease associated with decrease of products (first effect)	248.1	121.8
	Decrease of consumption (second ripple effect)	114.6	40.7
	Total	371.0	166.6

(b) Increase of Products due to Investment for Restoration

Increase of Products		Products Basis	Gross Value Added Basis
Restoration of Public Works	First Effect	66.9	29.2
	Second Ripple Effect	33.1	11.7
	Sub-total	100.0	40.9
Restoration of Housing	First Effect	18.4	6.7
	Second Ripple Effect	6.4	2.3
	Sub-total	24.9	9.0
Increase of Products due to Restoration			

This could develop incomes for the industries and shops. However because the damaged materials and goods could not be sold, it would be considered as a part of the decrease in production resulting from the earthquake .

The total decrease of products resulting from the earthquake, which consists of the first effect, second ripple effect, and the damage of materials and goods, is predicted as 371.0 billion yen on the production basis and 166.6 billion yen on the gross value added basis. This is 2.5 times and 2.3 times larger than the direct damage on the products basis and gross value added basis, respectively.

Increase of Production due to Investment for Restoration

After the earthquake, 44.3 billion yen and 11.9 billion yen were invested for restoration of public works and housing, respectively. An increase of products due to the investments for retraction is evaluated separately. It is assumed in the inter-industry relation analysis that 22 billion yen of the total restoration of 44.3 billion yen for public works was paid to the industries, and that the rest (22.3 billion yen) was spent for the gross value added. Due to the original investments, products worth 66.9 billion yen were produced including the original investments, which, in turn, caused the second ripple effects of 33.1 billion yen on the products basis shown in table-7(b). Including all these effects, it is found that the investment for restoration of public works developed products of 100.0 billion yen on the products basis and 40.9 billion yen on the gross value added basis.

The same analysis was made for investments for housing restoration as shown in table-7(b). It is found that the investments developed products of 24.9 billion yen and 9.0 billion yen based on the product basis and the gross value added basis, respectively. Therefore, by adding the increase in production due to investment for restoration of public works, the increase due to investment for restoration is predicted as 124.9 billion yen on the products basis and 49.9 billion yen on the gross value added basis .

EFFECT OF THE NIHONKAI-CHUBU EARTHQUAKE ON THE ECONOMY IN AKITA PREFECTURE

Table-8 summarizes the direct damage, the decrease of products, resulting from the earthquake and the increase in production due to restoration works. The direct damage of 145.7 billion yen plus the decrease of products of 371 billion yen is 516.7 billion yen, which

represents the damage predicted on the products basis. Therefore if the restoration works had not been made, this amount of damage would be caused in Akita prefecture.

Because the restoration works are predicted to lead to an increase in production of 124.9 billion yen, an actual decrease of the products is predicted by substituting it from the decrease of products by the earthquake as 246.1 billion yen on the products basis and 116.7 billion yen on the gross value added basis.

Table 8 Summary of Decrease Products Predicted (Billion Yen)

Damage and Products	Products Basis	Gross Value Added Basis
Direct Damage	145.7	72.1
Decrease of Productivity by Earthquake	371.0	166.6
Increase of Products due to Restoration	124.9	49.9
Total	391.8	188.8

Figure 5. Variation of Gross Prefectural Products of Akita Prefecture Between 1975 and 1982

Table 9 Comparison of Predicted and Actual Products Developed in Akita Prefecture in 1983 on Gross Value Added Basis (Billion Yen)

Classification	Prediction of Products of Akita Prefecture in 1983 Fiscal Year						(7) Actual Products Developed in 1983	Ratio (6)/(7)
	Reduction of Products				(5) Products supposedly developed in the earthquake had not occurred	(6) Predicted Products (5) - (4)		
	(1) Decreased of Products	(2) Increase of Products due to Investment of Restoration of Public Works	(3) Increase of products due to investment for restoration of housings	(4) Subtotal of (1), (2), (3)				
Agriculture	5.4	0.2	0.03	5.2	205.0	199.8	201.6	0.99
Forestry	1.8	0.4	0.3	1.1	34.7	33.7	30.9	1.09
Fisheries	1.9	0.03	0.01	1.9	6.8	4.9	5.2	0.95
Mining	1.4	1.5	0.2	- 0.2	36.1	36.4	41.0	0.89
Manufacturing	10.5	2.9	0.7	6.9	331.4	324.5	322.2	1.01
Construction	7.9	23.4	5.1	- 20.6	268.5	289.1	244.5	1.18
Electricity, Gas, Water	26.2	0.5	0.1	25.6	77.9	52.3	78.3	0.67
Commercial	14.6	2.7	0.6	11.3	351.3	340.0	334.1	1.02
Finance and Insurance	4.5	1.5	0.3	2.7	96.8	94.1	91.7	1.03
Landed Estate	4.5	0.6	0.1	3.7	231.5	227.8	226.2	1.01
Transportation and Communication	5.1	1.7	0.4	3.0	112.1	109.1	105.0	1.04
Service	82.8	5.6	1.2	76.0	595.8	519.7	592.2	0.88
TOTAL	166.6	40.9	9.0	116.7	2,348.0	2,231.3	2,272.8	0.98

To estimate the products by Eq. (1), the gross prefectural products of Akita prefecture which would be supposedly developed in 1983 if the earthquake did not occur has to be evaluated. Figure 5 shows a variation of gross prefectural products of Akita prefecture on a gross value added basis between 1975 and 1982. The gross prefectural products in 1983 may be estimated by extrapolating the relation of figure 5 as 2348.0 billion yen. Because the decrease of products by the earthquake and the increase of products due to the restoration are 166.6 billion yen and 49.9 billion yen, respectively* on a gross value added basis, it is predicted that the gross prefectural products of Akita prefecture in 1983 would be about 2231.3 billion yen (2348.0-166.6+49.9) on gross value added basis. It is noted here that the decrease of products by the earthquake of 166.6 billion yen corresponds to 7.1 per cent of the predicted gross prefectural products of 2348.0 billion yen.

On the other hand, actual gross prefectural products of Akita prefecture in 1983 was reported in 1985 as 2,272.8 billion yen, which is 41.5 billion yen bigger than the prediction. Table 9 compares the predicted products with the actual ones for each industry. When a ratio

is defined for each industry as to the actual gross products divided by the predicted gross products, the ratio takes a value between 0.67 and 1.18. The predicted results seem to give good approximations, except for electricity, gas, and water supply industries. The actual products for this industry are approximately 1.5 times larger than those predicted. This may possibly be attributed to the difference of the assumption made in this analysis. Although electricity generation was assumed to decrease in proportion to the decrease of the landing volume of crude oil at the port, actual production seems not to be reduced so significantly.

CONCLUDING REMARKS

To analyse economic losses caused by an earthquake, an analytical procedure with use of the inter-industry relation analysis, which has been widely used to evaluate an indirect impact of constructing new facilities, was applied to the Nihonkai-Chubu Earthquake of 1983. The following conclusions may be deduced from the study presented herein:

- 1) Total direct damage in the Akita prefecture caused by the Nihonkai-Chubu Earthquake was 145.7 Billion yen on the products basis. Decrease of products associated with the direct damage is predicted as 371.0 billion yen, which is 2.5 times larger than the total direct damage.
- 2) The decrease in production of 371.0 billion yen on the product basis is predicted to be caused by decreased production (first effect) of 248.1 billion yen, decreased consumption (second ripple effect) of 114.6 billion yen, and damaged materials and goods of 8.3 billion yen. The second ripple effect corresponds to 46 per cent of the first effect.
- 3) Decrease of products by the earthquake and increase of products due to restoration are predicted as 166.6 billion yen and 49.9 billion yen, respectively, on the gross value added basis. This means that the actual decrease of products would be $166.6 - 49.9 = 116.7$ billion yen. The decrease of products of 166.6 billion yen and 116.7 billion correspond to 7.1 percent and 5.0 percent, respectively, of the gross prefectural products of 2348.0 billion yen which would be supposedly developed in 1983 if the earthquake had not taken place.
- 4) Because the gross prefectural products of the Akita prefecture which were supposedly developed in 1983 if the earthquake had not taken place is estimated as 2348.0 billion yen, the gross prefectural products which would be developed in the Akita prefecture in 1983 is predicted to be $2348.0 - 116.7 = 2231.3$ billion yen. In comparison, the actual gross prefectural production in 1983 was reported by Akita prefecture in 1985 to be 2272.8 billion yen, which is 41.5 billion yen larger than the prediction.
- 5) Indirect damage is very important for assessing the extent of the impact caused by an earthquake. Further study to clarify the dependence of indirect damage on the actual extent of real damage, and characteristics of the damaged area need to be made.

ACKNOWLEDGEMENTS

The authors express their sincere appreciations to Dr. C. Scawthorn, EOE Incorporated, for his review and correction of the manuscript.

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DISCUSSION

Following the four presentations focused on "Socioeconomic Influences in the Reconstruction Process" the chairman requested the discussants to voice their views.

Kaoru Oda, Economist, Economic Research Division, The Tokai Bank, Ltd., Japan, began his comments stating that he was not an expert in seismology or researcher but he probably was asked to speak because the Economic Research Division made a report in January 1989 in which forecasts were made in the event of an earthquake equivalent in scale with the 1923 Great Kanto Earthquake in the Tokyo Metropolitan area on 1 September 1988. Studies were made as to how this disaster would effect the Japanese economy, as well as the world economy. He wished to briefly explain this report published by the Research Division of the Tokai Bank, as well as cover the uncertainties that arose while compiling the report that can serve as topics in the discussion that followed.

The report was based on material released by the National Land Agency on 6 December 1988 titled, "Assumed Damage of a Hypothetical South Kanto Area Earthquake." According to the material and assuming that the earthquake takes place at noon on an Autumn day, destruction of structures due to liquefaction and other reasons would total 806,000, including moderate scale destruction. In the Tokyo Metropolitan area, 30 per cent or 2.57 million structures would burn down and 3.75 million households would be affected. Forty-two per cent of the households would be left without electricity, 32 per cent would not have any water and sewage system services, 37 per cent would not be able to use their telephones. Based on the data, estimates were made on the damage to be sustained value-wise using the 1987 fiscal year price level. Damages would amount to 80 trillion yen and if this is converted at the one dollar being equivalent to 150 yen rate, it would total 530 billion US dollars. This would amount to one fourth of the fiscal 1987 GNP of Japan.

An attempt was also made to picture the state of the Japanese economy after the earthquake. Following the earthquake, the Japanese economy would take a sudden turn to negative growth due to the temporary paralysis of the economy around the Tokyo Metropolitan area. Then, with the high demands for reconstruction, very high growth will be expected in the areas of housing and capital investment. But as the demands for reconstruction decreases, an oversupply of goods would present a problem and business would rapidly slow down.

As far as growth rate, real GNP growth for fiscal 1988 would be -1 percent, With the assumption that the earthquake took place on 1 September 1988, in terms of real GNP growth after 1 September and by converting to an annual basis, it would be -5 per cent growth. It would subsequently fall to -12 percent in 1989, then to -10 per cent, -6 per cent, -2 percent, and finally -1 percent in 1993.

In regard to wholesale and consumer prices, together with the increased demand for reconstruction, levels would exceed 10 per cent. However, prices would peak two years after the earthquake, and then drop. As for Japan's current account or trade balance surplus, emergency imports

will increase after the earthquake; therefore the trade balance surplus will markedly decrease. Frankly speaking, Japan now has a large surplus but in the midst of the abovementioned conditions, the trade balance should reach zero or even reach a deficit. As for the foreign exchange rate, due to the worsening situation of trade balance, the yen is expected to depreciate and it is forecast that it would be 200 yen to the dollar. Regarding fiscal deficit, due to increased expenditures for rehabilitation, it is believed that the deficit will double.

These conditions will not only have repercussions within Japan, but abroad as well. Japan is currently the world's largest creditor and has a very large trade surplus. At the same time, Japan is returning this surplus to the markets abroad. In particular, it is playing a very important role in financing the U.S. double-digit deficit situation. Such flow of funds would be affected if Japan's current accounts face negative conditions and when funds for construction are required domestically. When there is a substantial and rapid decrease of such funds available from Japan, it is believed that the world-wide real GNP will decrease greatly. This is due to Japan's capital flow decrease which would also lead to the decrease of public bonds and stock market prices of the United States. Interest rates would increase and business will slow down. These conditions would probably spread to other countries of the world. This will be a blow to countries with large debts and nations closely connected with the United States.

Such an earthquake will have major repercussion in Japan as well as throughout the world because Tokyo is the centre of Japan's major functions -- political, economic, financial, and informational. Therefore, damages should be contained to the minimum and it is important that these functions be decentralized to other areas.

The greatest problem faced when drawing up the report was that from the time of the earthquake to the process of reconstruction, how long a period would be required to recover telecommunication functions, including telephones, and how soon can electricity supply be rehabilitated. What would the effects of such disruption be and in what areas? According to the National Land Agency's prediction, 42 per cent of Tokyo's power lines would be cut and 37 per cent of telephone service would be disrupted without electricity supply, and economic as well as manufacturing activities would be next to impossible. Also, a massive amount of information is collected in Tokyo and decisions are based on them. Decisions and instructions issued from Tokyo enable the operation of regional areas. Therefore, until telephone operations can be resumed under normal conditions, even regional areas unaffected by earthquakes will be subject to repercussions. The Tokai Bank survey was unable to find the answer to these questions. Rough predictions stated that manufacturing operations would come to a halt at least during the first month after the earthquake, and then a gradual recovery would be witnessed within the next three months. He hoped that during the discussion period, points would be raised regarding the effects of the disruption of information and communication facilities and how long would be required for recovery.

The second discussant, E.L. Quarantelli, from the Disaster Research Center, University of Delaware, U.S.A., posed six question with the intention of not providing answers but to suggest that certain assumptions

should be considered when discussing disasters and their impacts, and recovery from them.

1) Should we not clarify and distinguish what we mean when we talk of the poor, low-income groups, or the lowest socioeconomic strata as being the most vulnerable and impacted by disasters? Because people are not economically well off does not mean they necessarily share much more in common. For example, in most metropolitan areas, be it San Francisco or Calcutta, there are the permanent homeless; they are frequently single individuals who have little social ties, no permanent work, and who have many personal problems. They are a little different from other equally poor who live in families, who have strong social ties and links, are employed, and do not show much personal pathology. Different lifestyles, of which only two extreme examples have been given, have profound implications for disaster planning, the impact of disasters, and recovering from them. Also, in some developing and developed countries, ethnic groups outside of the main stream are often poor but rather different from Likewise, urban and rural poor do not have the same mainstream poor. lifestyles. The question is should we not make finer distinctions than just calling them the poor.

2) Does it necessarily follow that improving the pre-impact economic conditions necessarily reduce the later vulnerability of societies to disasters? It might be argued that the better off a system is, the more there is to lose in a disaster, at least by way of property, if not lives. There is a very complex relationship between improvements and economic development, possible losses in disasters, and improved disaster planning. If we make things better after a disaster, is there not more to lose in the next disaster. The matter of instituting measures to save lives may not be fully correlated with measures for reducing property losses. It is easier to plan to save lives than to reduce property losses. We need sharper tools to analyse planning problems.

3) In what sense does the disaster provide the opportunity for affecting social change? We have all made that kind of statement. What does it mean -- are we talking of a change of psychological orientation; that is, are impacted populations more open to change? Most studies suggest most people want to return to pre-impact patterns, not change. Do we mean that disasters allow political leaders and decision makers to do things they otherwise could not do? If so, most such officials, research suggests, do not take advantage of such opportunities. Why? We need to think through in a much clearer fashion why and in what ways disasters provide opportunities, windows, or leverages for change. Quarantelli believes that probably the possibility for post-impact change is rather limited or requires certain sets of conditions which are only present in relatively few cases.

4) Whose perspective should be used when assessing and evaluating disaster impact and reconstruction? Different groups, sectors, and communities will use different criteria -- different sets of victims, different government agencies, even different researchers all tend to look at the matter in different ways. For example, to a mental health expert, who examines whether victims bear some negative psychological scar from the disaster experiences for the rest of their lives and in one sense never recover, obviously judge the matter in a different way than a demographic

expert who looking at population statistics several decades after a disaster can find no noticeable or significant effects. It would seem different criteria are needed for different purposes. No one indicator for recovery or reconstruction would seem usable for all purposes. The matter of whether recovery is fast or slow may have less to do with chronological time but the implicit criteria being used.

5) Does the idea that pre-impact factors affect post-impact recovery apply equally across the board? About three decades ago. Quarantelli wrote about the principal of continuity, that what is in place before a disaster mostly determines what will occur in post-impact recovery. As a general principle, he still agrees with himself. But he feels it maybe needs some qualification. Perhaps, the larger the disaster impact, the less the principle is applicable. Or, put in another way, in a truly catastrophic disaster, as compared to a more moderate one, perhaps the disaster generated conditions become more important creating a difference of kind, not just degree. We cannot totally ignore the disaster experience itself. It may be a significant difference in the recovery process.

6) Can the political context of all recovery efforts be made part of the disaster planning process? While there is usually high consensus and moral right at the time of the disaster, conflict inevitably appears. Old, that is pre-impact differences, disagreements, and conflicts inevitably resurface. In addition, new conflicts are also generated by decisions necessary in reconstruction and recovery. These conflicts are consequences of the political process. Politics is the working out of different interests and values, be it at the community or societal level. Politics is a non-violent process of working out differences. But can that political process be incorporated into disaster planning or is it necessarily, independent of planning?

Following Quarantelli's discussion, the chairman opened the proceedings to the floor:

Kreimer raised a question regarding the discussion during the first part of the session, particularly concerning what Gavidia mentioned about the case in Ecuador. Kreimer was interested in the follow-up discussion and integration of risk management in this context. Risk management, she felt, should be an integral component of good management practices. And in the case of Ecuador, and particularly in the field of the oil industry, as Kreimer recalls, there was a comprehensive insurance from the private insurance sector for the Ecuador pipeline that was discontinued about six months prior to the earthquake. The public sector decided to carry out the losses from the catastrophic event. She wondered whether it would be possible to include in Gavidia's estimate the losses to the national budget due to the impact of these types of risk management on a key facility like the oil pipeline and whether that could be included in Gavidia's estimates on the economic impacts of the disaster.

Gavidia responded that it was true that at the moment of the disaster there was no insurance coverage for the oil pipeline. That is why it was all charged to the direct effects. He asked whether Kreimer was referring to how the cost of not taking the policy to cover the pipeline could be incorporated?

Kreimer explained further that the policy was discontinued six months prior to the earthquake. So that means it was a decision concerning risk management; the decision was that the public sector was going to carry the risk. In the situation of high risk as Gavidia described, given the location of the oil pipeline, how were the losses integrated taking into consideration that the policy was discontinued and losses to the national budget was due the discontinuation of such insurance?

Gavidia replied that only the situation at the moment of the disasters was included. At that moment there was no insurance coverage for the oil industry so the damage was taken as direct costs to the government. Such kinds of factors were not included because that was not the purpose of the evaluation. In other disasters, there was a substantial increase of income or in flows of foreign currency into the local economy due to insurance coverage because that cause from the insurance system and we counted that as flow of hard currency to the national economy. Gavidia reminded that the estimates were made within a week to ten days after the disaster so they are made based on minimal amounts of information.

Next, Mitchell directed another question to Gavidia stating that during the conference, participants were repeatedly told that society faces many problems of which disasters are only one. And that the most effective means of reducing natural disasters may be to exploit opportunities where not only natural disaster reduction is at stake, but where some other values can be attended to at the same time. Gavidia commented about the oil pipeline break in Ecuador. On the U.S. television news there was a report that the loss of oil from that pipeline during the period from 1976-1988 was greater than the oil spill that occurred in Alaska by the grounding of the Exxon Valdez tanker. The break in the pipeline due to the earthquake was responsible for some of these losses. An important environmental interest group from U.S, pressed the Government of Ecuador and Exxon Oil Co. to take steps to protect the Ecuadorian environment against oil spills. Is this an opportunity for hazard reduction and environmental protection to be undertaken together? He requested comments by Gavidia on the interplay between those two sets of goals.

Gavidia conceded that those two goals should certainly be dealt together. In identifying the environmental issues of Ecuador and a follow-up and close study of the damages has yet to be undertaken. The correct decision at that moment should have been that the pipeline was old and probably in the wrong location, so it should be relocated. And some ideas were presented as to how to relocate the old pipeline on better ground, in improved alignment. However, oil represents 50 per cent of the exports of Ecuador and they were hard pressed to resume production of exports that they ultimately decided to repair the pipes in exactly the same alignment as it was before. They were able to do this job quickly in four months and this decision was purely taken on economical grounds. Perhaps, within Ecuador, strong environmental motivation does not exist or pressure from environmental groups or society is not concerned about such issues as much as developed countries. Therefore, if another earthquake occurs, a similar situation will come about.

Webber suggested that it might have been a wise decision to replace the pipeline on the same site and at the same alignment because that earthquake is probably not going to occur again for a long time.

Gavidia added that the pipeline goes across many faults from the Amazon to the coast.

Jahan had a question for Kawashima regarding inter-industry model used. Jahan would like to know if the model used for Akita Prefecture was a national model, a larger region model, or specific model developed for that prefecture because if the larger region or national region models are used than the results might possibly be different. And secondly, if it was a regional model, was it a multi-region or single region model because in that case also results would differ.

Kawashima answered that the prefecture model damaged by earthquake was isolated so that made analysis simple and clear. When interaction between prefectures are considered, then the entire economic activity of Japan must be examined as well. Or as Oda pointed out, interaction with other countries might be also important. That is difficult to do. Therefore, for the study mentioned in Kawashima's presentation, only Akita Prefecture where the damage occurred was isolated. An analysis is also being made as to what other effects may arise when interaction with other prefectures is considered. When such an analysis is made, an increase of products in other prefectures is evident because they supply goods to Akita Prefecture where the earthquake occurred. Such an action will cause the decrease of products. So interaction may be very important. When damage is moderate and strikes only one or two prefectures, since there is redundancy in production, it will likely cause an increase in production. But if it is a major earthquake like the Great Kanto earthquake which struck a metropolitan area, there might be a sharp decrease that may not see recovery.

Arya had a question to Eibenschutz about the buildings that were not damaged and remained standing. Since the code has undergone a revision, it appears that all those buildings would now be considered unsafe. And there I will be buildings that were built before the old code came into existence so this is the kind of scenario that developed in a particular city. How does it propose to deal with such a situation in a large urban concentration like Mexico City?

Also, to make a clarification, Arya asked Yoshii about the trends of losses, unemployment, and problems and recovery that have been described. Is the model considered on the basis of the situation of the 1923 Kanto earthquake or does it take into account all the preventative and preparedness measures that are being undertaken now? And that this scenario will develop in spite of all the preventive and preparatory measures that are being taken today. If in spite of all we are doing today, the scenario is going to develop as bad as perhaps it was in 1923, then it raises very important questions about the effectiveness of efforts being taken.

Eibenschutz explained that after the earthquake and the new code was already in place, a very extensive survey was done by the federal district authorities with the aid of the engineers and architects to define which buildings had to be destroyed, which should be repaired, and which could be used again. And this classification was given to each one of the big buildings in the city. After that a follow up was done so buildings which had to be destroyed and were owned by the public administration have

already been destroyed. There are still some private buildings which have to be destroyed but their owners do not have enough resources to do it and this will probably be taken care of by the local administration. Gradually repairs have proceeded. Now it is compulsory for each building to have a plate stating the main characteristics of the building, what the use should be, and what is the load capacity of the building.

Yoshii provided additional comments in reference to Arya's question connected to the issue of estimates for unemployment. He pointed out two estimates for unemployment in the year 1923. It was not an accurate investigation so Yoshii's data was based on the extent of information he could obtain. Assumptions were made on the possibility of the occurrence of a 1923 scale of earthquake hitting the area. There are various factors involved and it was difficult, therefore a model wasn't built. Rather, for the manufacturing industry, it was concluded that a decrease in production would be expected so this is one factor we considered in our estimation. Damage to production facilities was another difficult question. It was mentioned that a 35 per cent decrease would take place in production and that was one basis for estimation. There are many buffer factors for production decrease and reduction in production will not lead to unemployment directly. It will also be affected by public policy and other factors. At the time of the Great Kanto earthquake, unemployment was at 17 per cent. At some affected factories, 83 per cent of the employees were kept on the payroll even after the earthquake. There is now good coverage available by unemployment insurance so for the employer it might be rather easy to lay employees off in the case of earthquakes. In the event of disasters, the decision as to whether a building should be reconstructed or not is a difficult one due to limited resources. According to results of one questionnaire, the unemployment number was calculated at very rough figures because no specific model was used in arriving to such conclusions.

Arya referred to another point as to the difference between the 1923 Great Kanto earthquake and now in respect to preparedness. This is a very tough question. And this is similar to what Quarantelli mentioned that when a country become wealthy and is better equipped with prevention measures for disasters, it seems to be in a better position, but that is not always the case. Japan now has very good disaster preparedness and we may be able to cope with small-scale disasters, and buildings can resist a certain amount of disasters. But if 1,000 fires break out at the same time in Tokyo, Yoshii did not think the level of preparedness in Tokyo will be able to control this extent of disasters. Very recently, there were three successive typhoons that could be managed. So for small- and medium-scale disasters, we are now in a better position to handle them but for catastrophic disasters like the 1923 Great Kanto earthquake, although we have more resources and are better prepared, asset are now larger, so damages will also be even larger.

Erdik had two questions for Prof. Kawashima: 1) Is the ripple effect, especially the second ripple effect, a natural progression to the recovery phase? 2) The second ripple effect is 50 per cent of the first ripple effect and about two thirds of the direct damages. He wondered what was the time scale between the first and second ripple effects, at least in the case of the Nihonkai Chubu earthquake?

Kawashima stated that it was assumed by the inter-industry relational analysis in which time cannot be taken into account. So it is evaluated on a yearly basis. The Nihonkai Chubu earthquake occurred in May 1983 so the decrease of products was evaluated in 1983. Therefore, in this particular analysis, the effects of time could not be accounted for. Various surveys were for the damaged region. There are many people who suffered damage from the earthquake; some fishermen lost their boats so they had to change jobs after their earthquake. Some of them went to Tokyo to look for jobs. So the time difference or time delay between the first effect and the second ripple effect many result in different situations. It is too complicated to determine how many years or how many months would elapse between the first and second ripple effects.

Kaji had a few questions for Kawashima after commenting that estimating indirect damage was a new and interesting approach. For developing nations, Kawashima's inter-industry relational analysis is not available. Under such circumstances, he wondered if there was a good way to make estimates for developing countries? The same applies in Japan between Akita prefecture and Miyagi prefecture. These prefectures happen to have such an analysis table, but not one for Tokyo so this method cannot be relied upon. Is there any alternative more simple approach? Secondly, are there separate measures taken to decrease indirect damage in addition to those for direct damage?

Kawashima admitted that he had no idea how to evaluate indirect damage in a region where inter-industry relation table is not available. In regards to the second question, he felt it was the point he hoped to pursue from here on. In Japan, an efficient system appears vulnerable to earthquakes. The concentration of population, products, and information lead to even more efficient production, decision making, or the day-to-day living of the people. But such a concentration of physical and material aspects and information makes the city very vulnerable in the event of earthquakes. So this why the study evaluating the second ripple effect was initiated. The second ripple effect seems to increase when modern civilized cities suffer damage. The ratio of the second ripple effect to the first effect seems to increase greatly in such cities.

As Yoshii mentioned, more and more items have to be considered when a city grows. It is the personal opinion of Kawashima that when the next major earthquake occurs in Tokyo, priority should be given to saving people's lives. Other matters, such as the decrease of systematic activity -- whether economic or any other aspect -- may be difficult to resolve so rescuing people should be the main concern. Based on such an understanding, he placed emphasis on examining pre-earthquake and post-earthquake countermeasures .

Commenting on Kaji's remarks, Jahan clarified that these models are available in many of the developing countries, especially at the national level. There is a similar model in Bangladesh, Sri Lanka, and India. These national level models can be applied at the regional level because the technological relationships do not change very much across regions, and can be adjusted to regions on the basis of regional data. These models are useful for taking into account the indirect effects of disasters. If such models are available at the national level of developing countries, these models can be put to good use for regional level analysis. In Japan,

Professor Miyazawa developed inter-region models for Japan so Jahan felt there was no reason why it could not be applied in Tokyo because it is, located in a region. ,

Petersen next wished to introduce how Iceland tackled the problem of catastrophe insurance system. After a series of major disasters in 1973-1974, it was decided to establish a compulsory catastrophe insurance fund in Iceland. All property values in Iceland contribute an interest to the fund annually and this fund pays off for losses in the event of natural disasters. Since this fund has grown through the years, in 1985 Parliament passed a new law to allow 10 per cent of the yearly income of the fund to be used for disaster prevention in the county.

Moderator Lechat asked Eibenschutz for further clarification about his comments on the rent control system in Mexico after the earthquake and the people proposing to reconstruct their homes themselves. In some respect, the quake was considered a blessing on the part of the landlord because due to the strict social system in Mexico which protects the tenants, they could not be expelled unless the landlord was making a major change to the house. So some tenants refused to move from some houses even if they were on the verge of collapse in order to remain there so they could not be expelled, and this sometimes almost prevented reconstruction. This was a comment heard by Lechat at a recent meeting and he wished Eibenschutz to express his views on it.

Eibenschutz stated that it was just as described by Lechat. Before the earthquake, in that part of the city there was a large number of people living in rented houses which were subject to a special law whereby the rent could not be raised. So this was disadvantageous to the owners and they could not raise the rent. This resulted in their not taking care of the houses and they were deteriorating. People lived there paying a very low rent, but in a very good central location which was convenient for them. When the earthquake came, these houses were destroyed, the owners paid by the state for the cost of the houses, and new houses were built in their place. The new houses were sold to the people who had been living there through loans. The problem of the private owners was solved and the residents were able to remain at the same place, paying now much more than before .

Yoshii had a question regarding one of the points raised by Quarantelli and comment regarding point mentioned by Oda. Quarantelli stated that the impact of disaster would differ between social classes, in particular the poor. In 1923 during the Great Kanto earthquake, the economic level was rather low in Japan. At that time there was a painting of the disaster drawn, as well as a picture from the Edo period. In Japan there is the traditional belief that an earthquake is caused underground by a catfish was depicted causing an a catfish which shakes the ground. earthquake and the poor people are shown to be happy about it. This is because the poor had nothing to lose anyway. And since they did not have enough food everyday, with the coming of the disaster they were now Artisans and supplied with free food, which was reason to be happy. carpenters could also increase their income because of the need for reconstruction. During those times of disasters, the social concept or rule was that the government had to provide for the poor during those days. The rich were forced to pay for this. Disasters had a positive effect as

well for the very poor people. That was the picture which emerged in 1923. The situation now is that this no longer applies. Now people are more affluent and the average family savings now total 10 million yen. Under such circumstances there are not many people who would rejoice in the event of an earthquake.

One example is the earthquake mentioned by Kawashima off the Japan Sea. At that time, Yoshii undertook a survey on Okushiri Island of the fishermen and the effects of the earthquake. What happened was the differentiation of classes among them. Those who used to own their own ships or vessels and had a number of employees, now had to work below someone because they had lost their vessels even though they formerly were presidents of their company. On the other hand, among the owners or managers of small businesses, sometimes they were forced to give up their jobs and depend on unemployment insurance from the government. Among the middle class in possession of some assets, the earthquakes had disintegrating or differentiating effects. Another big difference between present day Japan and 1923 is computer telecommunication technology which is substantially advanced nowadays. Oda stated that this was a very difficult aspect to handle in his analysis. The biggest effect here is the indirect effect. Kawashima attempted to calculate this indirect second effect, and I think this is where it hit most. For instance, with telecommunications, there is the telecommunication network, banks have their own lease lines. In one circuit such lease lines gave about 300,000 yen worth added value to the bank. This 300,000 yen per day is all profit. If they lose the line due to an earthquake, there will be this extent of indirect damage.

Webber felt that the ongoing discussion probably constituted an agenda for another conference. The question being who bears the costs of damage recovery. In Mexico, the World Bank came in with a huge loan and money was given to individuals to buy houses they were previously renting. They suddenly became homeowners. They could then sell the homes and make a profit. The World Bank was in effect making an outright gift to an individual family. Sometimes corporations can insure themselves. In Iceland, the government is insuring itself. The question is who bears the costs and how are those costs distributed?

Moderator Lechat presented his concluding remarks stating that if both direct and indirect costs were considered, as has been examined in case studies, simulation models, insurance estimates, and banking projects, it is clear that prevention and preparedness has great cost benefit. Adequate investment has to be made in order to prevent and mitigate disasters.

Lechat wondered if the participants were not seeing the emergence of some new attitudes for one or two decades in the future when the present IDNDR decade has already been completed. Tremendous effects resulting from even a single disaster are apparent even in the world economy. Maybe this has something to do with the term, the law of commons. Twenty years ago it was unthinkable. But now global warming is taking place, countries are polluting their neighbours, the Antarctic issue has been raised, as well as the use of natural resources from Wales to the Amazon, and respect of historical human heritage, and more recently access to natural resources are being focused upon. This is forming a new concept and a jump to a kind of world solidarity, world responsibility -- a common responsibility for

the world. Lechat wondered whether in two or three decades, there would exist a world insurance for disasters with common responsibility of various countries, a kind of new legal order that can be seen emerging. In this respect, he closed with the comment that the inclusion or involvement of international law specialists in the decade could possibly have been forgotten or overlooked.

4. OPEN FORUM: INTERNATIONAL COOPERATION FOR DISASTER PREVENTION

OPENING SPEECH, by Mr. Hori, Tokai Bank International Foundation

Ladies and gentlemen, may I present a brief speech on behalf of a co-organizer of the Open Forum. Tokai Bank International Foundation.

First of all, I would like to express my heartfelt gratitude to UNCRD, the World Bank, Aichi Prefecture, and Nagoya City.

The Tokai Bank International Foundation was established for promoting international activities in the Tokai area, in Nagoya, Shizuoka and so on. The purpose of this international forum is exactly what the establishment of Tokai Bank International Foundation is for. Therefore, it is a great pleasure for us to cooperate as a co-organizer for this forum.

Since "International Cooperation for Disaster Prevention" is the theme for this forum, according to the data of United Nations, earthquakes, floods, high tides, volcanic eruptions, natural disasters and so on, have occurred in many places in the world in recent years. In the past two decades, it is said that roughly three million people have died, more than eight hundred million have suffered from damages, and economic losses have totalled twenty-three billion US dollars.

Recently, there was an earthquake in Armenia, repeated flooding in Bangladesh in 1988, the Loma Prieta earthquake in San Francisco last year, and earthquakes in Iran and the Philippines in June and July which occurred within the first quarter of the "International Decade for Natural Disaster Reduction," and resulted in great losses and the tragedies which are still fresh in our memories. The great disasters, just mentioned, invariably cause the loss of enormous numbers of lives and destruction of infrastructure and housing.

To protect human lives and assets, and maintaining a secure environment are the bases of creating a stable society, and promoting wealth and a powerful country. Also, it is a significant subject to propel Particularly in disaster countermeasures in any country in the world. developing countries, if once a natural disaster occurs, it will cause not only great loss of life but the sudden loss of basic facilities in the society, which have been consolidated slowly year by year. Therefore, it severely effects the whole society, as it requires a long time and great difficulty to recover.

Under these circumstances, the "International Decade for Natural Disaster Reduction" was, as you know, adopted at the forty-second General Assembly in December 1987. This international campaign which should especially pay attention to building international cooperative relationships under the UN support, began in January 1990. Concerning the programme for the "International Decade for Natural Disaster Reduction," it has been taken up by various organizations in the world and a number of them are at the preparatory stage now.

Nagoya city was chosen as the host city to hold this forum as it was badly affected by natural disasters such as the Nobi earthquake, and Ise bay typhoon, etc. As a result of the various disaster countermeasures against natural disasters, they have been decreasing in recent years. Although various natural disasters have occurred regularly in Japan, fortunately, they have caused little damage. Japan has experienced them, so it is expected to contribute its experience to international society as a developed country in the field of disaster prevention.

Experts on disaster prevention from various countries in the world, also Japanese, who are related with the field, are attending today's Open Forum. The purpose of this forum is to share basic ideas and experience on disaster prevention and exchange opinions and information. I expect that the knowledge will be widely reflected in development of the disaster prevention by all participants. Also, today, there are many citizens who are mostly from Nagoya city, attending this forum in addition to experts. This is the purpose, to make as many people as possible know the reality of disasters in the world and to gain understanding of international cooperation for disaster prevention in the future.

Lastly, I do hope that regional development and a peaceful twenty-first century will come true through the great efforts of all, based upon the "International Decade for Natural Disaster Reduction."

KEYNOTE ADDRESSES

International Cooperation on Disaster Management, by Hidehiko SAZANAMI, Director of the United Nations Centre for Regional Development

INTRODUCTION

In recent years, the world public has grown increasingly alarmed by disasters such as earthquakes, floods, high winds, volcanic eruptions, and the like. In June and July 1990, the initial year of the IDNDR, major earthquakes occurring in Iran and the Philippines resulted in great losses, and the tragedies are still fresh in our memories. When great disasters occur, people suffer from both physical and economic damage. A large number of lives are lost, and all kinds of facilities and housing are destroyed. In developing countries where limited resources are available for national development, little attention has been given to disaster prevention measures with the result that enormous losses are sustained when natural disasters hit, and this, in turn, imposes further constraints on national development; thus, it is essential to incorporate long-term post-disaster rehabilitation and reconstruction programmes in our comprehensive regional development planning process as well as short-term emergency relief and recovery programmes.

Many developing countries were more concerned about economic development itself than on the impact of such development on the environment. Due to financial constraints, high priority has been given to industrialization, capital formation, and agricultural production at the expense of the necessary environmental control. Rapid economic growth has resulted in population growth, followed by extensive unregulated exploitation of natural resources. The outcome of such policies is the situation which now exists in many developing themselves, *i. e.*, degradation of the environment and lowering of the quality of life for the people who, in turn, depend on the environment. Rapid concentration of modern industry and population in larger metropolitan areas has caused not only the deterioration of the environment in these areas, but the degradation of the rural environment as well; unregulated exploitation of natural resources, such as overexploitation of forests, has made these areas disaster-prone and liable to suffer serious damage when natural disasters occur. Technical cooperation, therefore, has an increasingly important role to play in developing countries in this regard.

INTERNATIONAL DECADE FOR NATURAL DISASTER REDUCTION

Background

In response to the growing concern and interest among the international communities in disaster prevention and management, the idea of an "International Decade of Hazard Reduction" was first proposed by Dr. Frank Press, President of the National Academy of Sciences, USA, in a keynote address to the Eighth World Conference on Earthquake Engineering in San Francisco in July 1984. In view of the fact that the technical means to minimize destructiveness are becoming available at least for some of

these hazards, he considered that engineers, natural scientists and social scientists could facilitate hazard mitigation by organizing a decade of international collaborative activities.

Dr. Press' proposal attracted the attention of a large number of scientists and engineers in developed and developing countries. A meeting of experts was held in Washington D.C. in February 1986 to discuss the feasibility of a collaborative, international programme to reduce the adverse impacts of natural hazards. A working group was constituted to prepare a document reflecting the view of the meeting and a draft document was completed in July 1986.

In Resolution 42/169, dated 11 December 1987, the United Nations General Assembly decided to designate the 1990s as the "International Decade for Natural Disaster Reduction" (IDNDR) in which the international community under the auspices of the United Nations would pay special attention to fostering international cooperation in the field of natural disaster reduction. The objectives of the Decade would be to reduce, through concerted efforts, loss of lives, property damage, and social and economic disruption caused by natural disasters particularly in developing countries. The Decade's goals are:

- To improve the capacity of each country to mitigate the effects of natural disasters expeditiously and effectively, paying special attention to assisting developing countries in the establishment, when needed, of early warning systems;
- To devise appropriate guidelines and strategies for applying existing knowledge, taking into account the cultural and economic diversity among nations;
- To foster scientific and engineering endeavours aimed at closing critical gaps in knowledge in order to reduce loss of life and property damage;
- To disseminate existing and new information related to measures for the assessment, prediction, prevention, and mitigation of natural disasters; and
- To develop measures for the assessment, prediction, prevention and mitigation of natural disasters through programmes of technical assistance and technology transfer, demonstration projects, and education and training, tailored to specific hazards and locations, and to evaluate the effectiveness of those programmes. The General Assembly also noted the following important points:
- To recognize the responsibility of the United Nations system for promoting international cooperation in the study of natural disasters of geophysical origin and in the development of techniques to mitigate risks arising therefrom, as well as for coordinating disaster relief, preparedness and prevention, including prediction and warning;
- To be convinced that concerted international action for the reduction of natural disasters over the course of the 1990s would give genuine impetus to a series of concrete measures at the national, regional and international levels;

- To recognize that the primary responsibility for defining the general goals and directions of efforts undertaken within the framework of an international decade for natural disaster reduction and for implementing the measures that would result from its activities lies with the governments of the countries concerned; and
- Considering the concept of a global programme for natural disaster reduction is based upon collaborative efforts among culturally and economically diverse nations, together with relevant organizations of the United Nations system and other national and international non-government organizations including the scientific and technological institutions concerned.

Preparation

In February 1988, the United Nations Secretary-General established a Steering Committee on the Decade to assist him in developing an appropriate framework to attain its objectives. To assist him in this work, the Secretary-General appointed the International Ad Hoc Group of Experts consisting of twenty-five eminent scientists and experts drawn from around the world and representing the whole spectrum of disciplines engaged in disaster reduction, under the chairmanship of Dr. Press, President of the National Academy of Sciences, USA. Before submitting its report to the Secretary-General, the Group held four meetings between July 1988 and April 1989. In the final meeting in Tokyo, a Declaration (The Tokyo Declaration) was drafted, and the experts discussed this in detail on the last day of the meeting. The final draft was then unanimously adopted. The main part of the text of the "Tokyo Declaration 1989" is as follows:

Thus we, the Ad Hoc International Group of Experts, call on:

- The people of the world, as well as their governments, to work toward greater security against natural disaster.
- The governments of all countries to participate actively in the Decade by educating and training their citizens to increase awareness, by enhancing social preparedness, by integrating disaster-consciousness into their development programmes, and by making available the power of science and technology to reduce disaster losses.
- The United Nations, scientific and technological institutions, non-governmental organizations, and the private sector to support international and regional cooperation on disaster-related activities and to contribute to the transfer of disaster-reduction technology, particularly in disaster-prone developing countries.

Each member country is asked to establish a national committee to design and coordinate national activities in the Decade. International communities are also asked for funding contribution to implement the Decade smoothly .

Organization

Organizations described in the Resolution 44/236 dated 22 December 1989 the United Nations forty-fourth General Assembly adopted are as follows :

- Special High Level Council: The Secretary-General is requested to establish, with due regard to equitable geographical representation, a Special High Level Council, consisting of a limited number of internationally prominent persons, in order to provide him with overall advice with respect to the Decade, to take appropriate action to promote public awareness and to mobilize the necessary support from the public and private sectors.
- Scientific and Technical Committee: The Secretary-General is requested to establish, with due regard to equitable geographical representation and covering the diversity of disaster-mitigation issues, a Scientific and Technical Committee on the IDNDR, consisting of 20 to 25 scientific and technical experts selected in consultation with their Governments on the basis of their personal capacities and qualifications and including experts from the organs, organizations and bodies of the United Nations system. The role of the Committee is to develop overall programmes to be taken into account in bilateral and multilateral cooperation for the Decade, paying attention to priorities and gaps in technical knowledge identified at the national level, in particular by national committees; to assess and evaluate the activities carried out in the course of the Decade; and to make recommendations on the overall programmes in an annual Report to the Secretary-General.
- Secretariat: The Secretary-General is requested to establish a small secretariat, to be funded by extra budgetary resources, as follows: The secretariat shall be established at the United Nations Office in Geneva, in close association with the Office of the United Nations Disaster Relief Co-ordinator, with its members drawn, as appropriate, from the international community of disaster reduction experts and other relevant experts, inter alia, seconded from competent United Nations organizations, Governments and nongovernmental organizations:

The secretariat shall be responsible for the day-to-day coordination of Decade activities and shall provide substantive and secretarial support to the Special High Level Council and the Committee, as well as for other related activities.

Policy Measures to be Taken at the National Level

Based on the Resolution 44/236, all governments are called upon to:

- Formulate national disaster-mitigation programmes, as well as economic, land-use and insurance policies for disaster prevention; and particularly in developing countries, to integrate them fully into their national development programmes;

- Participate during the Decade in concerted international action for the reduction of natural disasters and, as appropriate, establish national committees in cooperation with the relevant scientific and technological communities and other concerted sectors with a view to attaining the objective and goals of the Decade;
- Encourage their local administrations to take appropriate steps to mobilize the necessary support from the public and private sectors and to contribute to achieving the aims of the Decade;
- Keep the Secretary-General informed of the plans of their countries and of assistance that can be provided so that the United Nations may become an international centre for the exchange of information and co-ordination of international efforts concerning activities in support of the objectives and goals of the Decade, thus enabling each nation to benefit from the experience of other countries;
- Take measures* as appropriate, to increase public awareness of damage risk probabilities and of the significance of preparedness, prevention, relief and short-term recovery activities with respect to natural disasters and to enhance community preparedness through education, training and other means, taking into account the specific role of the news media;
- Pay due attention to the impact of natural disasters on health care, particularly to activities to mitigate the vulnerability of hospitals and health centres, as well as the impact on food storage facilities, human and other social and economic infrastructure; and
- Improve the early international availability of appropriate emergency supplies through the storage or earmarking of such supplies in disaster-prone areas.

UNCRD'S ACTIVITIES IN THE IDNDR

Background

The United Nations Centre for Regional Development (UNCRD) has dedicated its efforts to solving the varied problems in the urban and rural areas of developing countries within the framework of regional development. The successive large-scale catastrophes that have occurred throughout the world in recent years have made people aware of yet another dimension of regional development planning. The occurrence of these natural disasters has been a great setback to regional development in numerous countries. UNCRD has faced the growing necessity of incorporating disaster prevention and mitigation considerations into regional development planning concepts, and therefore, established the Regional Disaster Prevention Unit (RDPU) in 1985 to implement a new project on the integration of disaster prevention and mitigation measures into the local and regional development planning process. In this project, great emphases are placed on harmonizing hardware systems with software measures such as legislation, institutional arrangements, education, and so forth, against disasters. Research, information dissemination, and training for disaster management are intensively organized along these lines.

Seminar, Symposium, and Workshop

The following are the major activities of the RDPU on disaster management which have been carried out since 1986.

- (1) International Seminar on Regional Development Planning for Disaster Prevention, September 1986, Nagoya, Shizuoka, and Tokyo. Three major themes were examined in this seminar: (a) Drawing up of a set of guidelines on policy implementation in disaster prevention; (b) The improvement of technologies on disaster prediction, forecasting, emergency relief, post-disaster recovery and reconstruction; and (c) Reports and analyses of particular disaster cases .
- (2) First International Research and Training Seminar on Regional Development Planning for Disaster Prevention, October 1987. Tokyo and Nagoya . The main objectives of this seminar were to: (a) Investigate ways to strengthen the resiliency of communities in developing countries through the integration of pre-, mid-, and post disaster measures in regional development planning; and (b) Set guidelines to compile curricula and teaching materials for organizing training courses.
- (3) Second International Research and Training Seminar on Regional Development Planning for Disaster Prevention. July 1988, Nagoya and Shimizu. This seminar was cosponsored by the Institute of Social Safety Science (Japan) and the Earthquake Engineering Research Institute (USA). The following themes were discussed: (a) Policy problems of earthquake prediction; (b) Public and private awareness; (c) Estimation of earthquake vulnerability/damage; (d) Fire and hazardous materials following earthquake; (e) Short-term emergency responses; and (f) Long-term recovery/reconstruction .
- (4) International Symposium on Challenges of the IDNDR, April 1989, Yokohama.

The symposium was jointly organized with UNDTCD (United Nations Department of Technical Co-operation for Development) with the collaboration of national and local government of Japan. The members of the International Ad Hoc Group of Experts for the IDNDR and experts from Japan attended the symposium to share their basic ideas pertaining to the report finalized at the Fourth Meeting of the Group of Experts and also to exchange views and information.

- (5) Third International Research and Training Seminar on Regional Development Planning for Disaster Prevention. September 1989, Nagoya. The following three themes were discussed: (a) Flood disaster prevention and mitigation strategies from the viewpoint of information systems; (b) Institutional arrangements for integrating measures against flood disasters into the regional development planning process

such as land-use regulation, safety evaluation of development, regional conservation, and infrastructural equipment.

- (6) UNCRD-CIRDAP Workshop on an Integrated Approach to Disaster Management and Regional Development Planning with People's Participation, January-February 1990 Dhaka, Bangladesh.

The main aim of the workshop was to emphasize inclusion of disaster management and community participation in development planning and to assist the developing countries of the Asia-Pacific region in manpower development through research and training to achieve such a goal.

Major Fields of Study

Through the above-listed activities, two major study areas, which are divided into eight fields of study, have been identified as priority work for UNCRD'S Disaster Management Research Group. They are as follows:

(A) INTEGRATION OF DISASTER PREVENTION AND MITIGATION PROGRAMMES INTO THE FRAMEWORK OF REGIONAL DEVELOPMENT

In developing countries, it is commonly seen that regional development investment tends to be made in the project which is expected to have the greatest economic effects, rather than in disaster prevention projects which are apparently irrelevant to economic growth. When disasters occur, however, not only the regional , but also the national economy suffers as a result. Thus, it is necessary that regional development planning currently in progress should be completely reconsidered and should be reconsolidated to include disaster prevention and mitigation measures over a long-term perspective.

(1) Measures against Progressive Regional Vulnerabilities to Disasters Caused by Rapid Urbanization

In developing countries, the metropolitan area is increasingly vulnerable to disasters because of rapid population concentration. Disasters in urban areas are complex and interrelated with various other factors. Therefore, drastic measures against them are urgently required. - Measurement of progressive vulnerability to disasters caused by the sprawl of built-up areas and industries, and the weakening of community awareness brought about by urbanization.

(2) Evaluation of Urban Functions, and Prioritization of Disaster-Resistant Programmes of Urban Facilities

Urban functions are almost completely disrupted when disasters occur. Tardiness in restoration and the prolonged period of a freeze in functions can lead to subsequent secondary and tertiary disasters. For rapid recovery and reconstruction, it is vital to minimize the damage to facilities that must serve as keystones to recovery and reconstruction, and to promptly halt the spread of damage. Measures are listed as follows:

- Disaster resiliency of facilities which are vital to disaster prevention such as schools and hospitals (consider allocation and structure) :
- Low-cost housing, affordable improvements, repair, and strengthening of general construction methods; and
- Risk assessment and safety-promoting design of network facilities.

(3) Assessment of Hazard-prone Regions Based on Micro-zoning and Its Application to Urban/Regional Planning

For disaster prevention, it is clearly effective to regulate human activities in highly hazardous areas with respect to disasters. Highly hazardous areas mean both hazardous areas due to natural conditions (geographically hazardous areas) and hazardous areas resulting from the concentration of human activities (demographically hazardous areas). In this field, assessment systems will be developed for the aforementioned areas, and action will be taken in the application of measures to assess urban/regional planning. They are as follows: - Mapping of hazard-prone regions by micro-zoning;

- Technical consideration towards mitigation of geographical hazards and
- Reference to hazard-prone region maps in planning procedures.

(4) Problems Concerning the Introduction of a Disaster Prevention Assessment System to the Planning Process

When making decisions regarding various types of development plans, the impact of disasters, if the plan is implemented, is assessed in advance, thereby testing the validity of the plan. The contents of disaster assessment systems and how they may be introduced and put into practice are also considered. The following activities may be undertaken:

- Enquiry into aspects of disaster prevention assessment;
- Establishment of forecasting methods for disasters; and
- Consideration as to what systems should be adopted.

(B) DEVELOPMENT AND TRANSFER OF PLANNING AND MANAGEMENT TECHNOLOGY FOR DISASTER PREVENTION

Socioeconomic conditions rather than disaster prevention technology make developing countries more vulnerable to disasters. In these countries, crises caused by poverty frequently exceed any crisis caused by natural disasters, and greatly distress people in their daily lives. Advanced technologies and systems for disaster prevention in industrialized countries often cannot be transferred to developing countries because these technologies and systems are unsuited to the socioeconomic conditions of developing countries. It is, therefore, necessary to develop technologies which can be maintained by a possible excess of manpower and expenditure at

varying economic levels and in the different social systems of developing countries.

(1) Establishment of Data Base and Disaster Management Information Systems

When considering disaster prevention measures in developing countries, it would be very useful to learn from past disaster experiences. However, methods and systems for recording experiences of disasters have yet to be established, and there is little chance for exchanging information in order to learn from other countries. Furthermore, their data collection systems and forecasting/prediction and warning systems for disasters are generally very poor. In order to support these information systems, not only soft technologies but also hardware arrangements such as infrastructure and utilities are also essential. The set of factors are as follows:

- Setting up a data base to include not only digital information but also accurately recorded information (mainly documentary); a method and system which are especially important in developing countries;
- Forecasting/prediction and early warning systems, timing of announcement and impact; and
- Establishment of a system in order to systematically and accurately understand pre-disaster measures and damage and restoration after disaster occurrence so that disaster measures and disaster studies may be satisfactorily undertaken.

(2) Guideline Formulation for Pre-, Mid-, and Post-disaster Countermeasures

Pre-, mid-, and post-disaster countermeasures involve management of information, mitigation, prevention, evacuation, relief, short-term emergency responses, and rehabilitation/reconstruction. Developing countries lack guidelines on necessary countermeasures to be taken, which are relevant to the countries concerned and based on similar experiences in other countries of the world. In developing countries, two important considerations are that the guidelines should:

- Include information on the different environmental conditions likely to be found in different countries and the different kinds of disasters that could occur under such conditions; and
- Indicate which mechanisms to implement in accordance with each country's conditions.

(3) Technology Transfer from Industrialized to Developing Countries

It is necessary to promote programmes for the transfer of disaster prevention technologies and institutions from industrialized to developing countries in accordance with the conditions of the receiving countries. Disaster prevention is not a technological problem, but an economic one. Therefore, it means that more institutions need to collaborate in studies and research. They are as follows:

- Comparison of casualty rates from different disasters with the rate from starvation and epidemics; and

- Comparison of capital costs and maintenance costs performance on hard/soft disaster technologies involving regular use.

(4) People's Awareness-Building Programmes to Educate and Train the General Public on Disasters

It is necessary to develop short- and long-term programmes, which include training for administrators, researchers, and trainers on disaster prevention, and enhancement of the general public's awareness on disaster prevention. However, few countries have the conditions necessary to implement these programmes. Therefore, suitable conditions need to be met first .

Research Projects

Based on the major fields of study mentioned above, UNCRD is currently planning to initiate the two major research projects on urban disaster prevention and management in metropolitan contexts.

In general, rapid urbanization causes population concentration into a few selected metropolitan areas. Much of this inflow of population to metropolitan areas is composed of those belonging to the low-income groups from rural areas. Upon reaching the metropolitan areas, in-migrants build low-cost accommodation in hazardous areas which actually should remain uninhabited. Accordingly, vulnerability to disasters in metropolitan areas is gradually increasing. Thus, disasters in the metropolitan context in developing countries display a complex phenomena combining various factors, including not only physical factors but also social and economic factors. However, development in hardware systems cannot keep up with the speed of growing urbanization. It is, therefore, vital to speedily undertake countermeasures against disasters, focusing on software systems.

Thus, one of the research projects aims to understand the structure of the issues and problems concerning disaster prevention and mitigation in the metropolitan context of developing countries, and to consider planning from the viewpoint of disaster prevention and management when drawing up and implementing development plans in metropolitan contexts, and formulate guidelines for revising and/or implementing supplementary plans.

First theme of this project includes the following issues:

- Interrelation between economic growth levels and appropriate investment in disaster prevention and management;
- Geographic hazards; urbanization and Increased vulnerability to disasters; and
- Interrelationship between socioeconomic characteristics and awareness of disaster prevention and management with regard to the general public.

One of the major issues of the interrelation between economic growth and investment is related to investment and technology for disaster prevention and management adapted to the economic level of each country. To consider geographic hazards in metropolitan areas, it is necessary to

draw up risk and hazard maps with reference to natural conditions, such as microzonation for earthquake disasters, maps of flood-risk areas for flood and high wind disasters, and maps of lava flow and ash fall areas for volcanic eruption disasters.

Major components of urbanization and the increased vulnerability to disasters are population growth and its change, distribution of income level, building structure and its yearly changes, assessment of disaster-resistant and mitigating functions of open spaces in urban areas, and the process of reduction of open spaces accompanying urbanization.

Interrelationships between socioeconomic characteristics and the awareness of disaster prevention and management with regard to the general public have three aspects -- psychological, economic, and sociological. The psychological aspect includes the relationship between an aspect of disaster and investment in safety measures. The relationship between income and investment in safety measures is the economic aspect. The sociological aspect concerns community organization and joint activities for disaster prevention and management.

To consider planning and formulate guidelines as have been previously mentioned, issues of the second theme are classification of disaster prevention technology in urban and regional planning and application of plans, and development of a programme for deciding planning prioritization in view of disaster prevention from the standpoint of planning technology. The former includes regulatory standards for land use in view of disaster prevention (assessment of present standards and possibility of revision), appropriate distribution of open spaces for safety precautions, and introduction of an assessment system for disaster prevention in the decision-making process of development planning. The latter includes evaluation of the importance of facilities, and decisions regarding measurement priorities in view of maintaining urban functions, selection of alternatives for arranging facilities to maximize disaster mitigation effects, and development of a prediction programme to determine areas in which vulnerability would increase if improvements fail to be made.

From the viewpoint of emergency technology, the third theme consists of development of systems for warning and information dissemination, preparation of guidelines for drawing up emergency planning measures, and development of effective restoration programmes taking into consideration and formulating the aforementioned guidelines. The first includes evaluation of the existing warning information dissemination systems, classification of information network systems, and the updating of such networks. The second includes classification of general and individual items for disaster prevention and management, and survey on the present condition of materials and supplies used for disaster prevention and management, and supply planning. The third includes clarification of the extent and structure of disaster impact technology for prevention against damage expansion, priority in restoration, and regulatory measures against uncontrolled reconstruction based on regional risk assessment.

Findings derived from this project are to be classified and will be submitted as basic information for dealing with issues and problems concerning disaster prevention and management in the metropolitan context in view of metropolitan development planning in developing countries.

Based on these findings, comparison of various methodologies for urban disaster prevention and management planning measures will be carried out with the aim of building disaster-resilient communities and safe metropolitan environments in the developing countries. Ultimately, investigations are intended into the application of advanced technologies from the developed countries to the developing countries, drawing up a manual of technology transfer for disaster prevention and management in metropolitan contexts.

The second project is to develop a gaming simulation model to be used to strengthen the capabilities of participants in a training course on disaster prevention in urban areas. This model, named METRO-DIMEX, is a simulation exercise designed to provide training in the management of comprehensive metropolitan planning for personnel in government and non-governmental organizations who are responsible for urban planning in metropolitan regions. It simulates the process of urban growth as well as the effects of major disasters and rehabilitation. Participants will be faced with various issues and problems of urban planning and pre-, mid-, and post-disaster measures. It will also help to develop skills in assessing information, identifying projects, quantifying requirements, and managing resources. It emphasizes the importance of integrating disaster prevention and management measures into the process of metropolitan planning .

Training Activities

Although respective agencies are currently carrying out research, information gathering, and training exercises for each type of potential disaster (floods, earthquakes, storm surges, etc.), it is essential to unify these specific fields in order to be able to incorporate them into general disaster prevention measures for regional development, particularly in developing countries.

Therefore, the UNCRD training course will aim to conduct high-level research and training on regional development for disaster prevention for experts working in research and training at institutions related to disaster prevention and regional development in developing countries, and to train the manpower needed to formulate, and implement, regional development planning for disaster prevention.

Training courses will deal with the following subjects: How comprehensive regional development planning for disaster prevention is carried out; coordination among organizations related to disaster prevention and regional development; and the drawing up of regional risk maps and their application to development planning. For the training, new manuals/texts will be prepared covering applications of new technology and appropriate technology transfer with submission of materials collected through information activities related to natural disasters. The training will utilize these new manuals/texts. Training in each area is to be performed by those training institutions already implementing such training at present.

In order to prepare texts of the training courses, various international comparative studies and state-of-the-art research studies will be implemented, especially promoting research studies by participants

of the training courses initially as part of the training curriculum. The findings of the research studies will be summarized into modules, and arranged, according to issues covered, as data for international comparison. A small symposium is scheduled to be held to present the findings. Issues of the research and studies are as follows:

- International comparison of histories of regional disasters and changes in disaster prevention planning and management:
- International comparison of disaster prevention and management systems focusing on building codes; and
- Collection and classification of safe design technologies in each country .

After collecting both "hard" and "soft" information relating to natural disasters, the information required for training and research activities will be arranged. Through close exchange with other United Nations agencies, international organizations, and organizations in charge in each country, materials related to regional development planning for disaster prevention will be collected and arranged for easy reference.

CONCLUDING REMARKS

The international response to natural disasters has focused primarily on relief action, examples of which are seen immediately following disasters, in the responsive actions of United Nations agencies, international institutions, and countries throughout the world. Nevertheless, complete prevention of disasters would seem impossible at the present time, given the current state of science and technology. Hence, it is widely understood that greater importance needs to be given to creating a system which will limit the damage and loss of life to a minimum in the event of a disaster. In addition, post-disaster rehabilitation and reconstruction measures are increasingly regarded as preventative measures in the event of future disasters. Hence, disaster prevention measures which incorporate rehabilitation and reconstruction are important for both developing and developed countries to consider. Developed countries have a responsibility to offer and to share their accumulated knowledge on disaster prevention with other disaster-prone countries, particularly those developing countries with limited resources. This can be done through the training of specialists and with the reliable supply of essential materials .

Mr. Chairman, Ladies and Gentlemen:

I would like to thank the Government of Japan and the United Nations Centre for Regional Development for organizing this Forum giving us an opportunity to exchange ideas and experiences, to analyse international priorities for the IDNDR, and to discuss the challenges that are posed by a plan of action for the Decade.

We are very pleased to cosponsor this event. On behalf of The World Bank we would like to express the commitment on the part of our institution to the IDNDR, to this forum and to the Tokyo Declaration on the IDNDR. We are in agreement with the Tokyo Declaration concerning the fact that the Decade is a moral imperative. Not only it is the first coordinated effort to prevent the unnecessary loss of life from natural disasters, but it also makes practical sense and we are ready to join in the global efforts and concerted action to promote natural disaster prevention and mitigation.

As we move forward into the new decade, we are taking a hard look at the priorities for the IDNDR, which are important issues for both developed and developing countries. The recent experiences with natural disasters illustrate some of the very important problems we need to address fast, particularly if we are committed to reducing severe losses that threaten our countries' welfare.

What are the challenges the Decade poses and why does the Bank have a commitment to the goals of the IDNDR? There are several reasons:

1. Disasters threaten development. Housing, agriculture, energy, industry, health, education, and infrastructure are negatively impacted by earthquakes, hurricanes, floods, volcanic eruptions, and droughts. The lives, income, and well-being of millions and millions of people are threatened by disasters. As you know, every year about 150,000 people are killed and an additional 5 million persons are severely affected. We have witnessed recently earthquakes in the Philippines, Iran, Mexico, and Nepal, major floods in China, Bangladesh and Sudan, cyclones in Jamaica and in India, and crippling droughts in Ethiopia and Sudan.

2. Disasters impact both developed and developing countries. As you know, the Government of Japan was one of the leading forces in bringing As a country that is highly prone to the impact of about the Decade. major natural disasters (earthquakes, tsunamis, volcanic eruptions, typhoons, floods and landslides). Japan is also one of the world leaders in the development of disaster prevention and mitigation measures. earthquake of 1923 was a major landmark in the development of prevention Japan has substantial know-how and investments and mitigation mechanisms. in disaster prevention, mitigation, and preparedness programmes. Developing countries that are disaster prone do not have access to economic, financial, or technical resources for disaster prevention and We think that there is a mitigation, and are far behind in this area. substantial gain that can be made by fostering the appropriate two-way transfer of knowledge and sharing of experience between the developed and

developing countries on problems of natural disaster reduction. For example, the very difficult experience after the earthquake in Mexico in 1985 provided a number of lessons in risk reduction, assessment of damage and needs and seismic resistant construction and technologies that were applied worldwide, in both developed and developing countries. Given the high impact and low frequency of this kind of event, sharing the lessons learned is an important aspect in reducing losses in both rich and poor regions of the world.

3. Disasters hit the poor harder than the hit other groups. Major disasters often leave large groups of population homeless, damage capital assets, and disrupt productivity. In most cases the poor are particularly vulnerable to being severely affected by natural disasters since they live in marginal settlements, poorly serviced or with no services at all, in areas ill-suited for development, or exposed to high risks such as floods, landslides, mining quarries, erosion or soil instability. In addition, such groups may work in overloaded structures that are highly vulnerable to seismic phenomena and rent housing in crowded urban slums that collapse due to earthquakes or are washed away by floods. They may become unemployed and homeless overnight. Poverty reduces in a most substantial fashion the resilience of population groups that are exposed to natural hazards to respond and cope with disasters.

4. Disaster stops or slows down development. In addition to destroying homes and social infrastructure, natural disasters have an impact on the development of business, industry, and agriculture. All these are productive assets which in many cases back several decades to build with scarce resources and that are essential for development.

5. Environmental degradation contributes to disaster vulnerability. With both rapid-onset events such as floods, landslides, wind storms, forest fires, and earthquakes, damage and destruction can be increased because of a history of environmental tampering. With slow onset events, like droughts, it is sometimes difficult to distinguish any difference between a natural disaster and the natural results of environmental degradation.

In sum disasters and resilience pose challenges to the IDNDR. Those challenges are directly related to the work of The World Bank. In other words, the impact of disasters is closely linked to what we do. As I mentioned, disasters threaten development and are promoted by environmental degradation. Although they impact both developed and developing countries, in most cases the poorest of the poor are the hardest hit. Thus, they pose a challenge to the work of the Bank both in development and in the environment.

The Bank has a long tradition of working with countries affected by natural disasters. Understandably enough, the majority of the Bank's emergency projects are concerned with the welfare of the victims and have focused on rebuilding infrastructure and productivity in the disasters' aftermath. It is now being suggested that more efforts should be made to ensure preventive measures to protect future development efforts from falling victim to potential catastrophes and to preventing the environmental degradation which can augment and spark further natural disasters.

What can the Bank do?

This is a critical time. We need to emphasize the fact that we are at a crossroads, and that in the last few years we have been faced with a number of changes, uncertainties and questions. As development proceeds, vulnerability increases. In addition, the conceptualization of development activities and strategies has recently changed and now it encompasses broader concerns than it has in the past. Disaster reduction and the environment are only two examples of the new areas that come into play.

Concerning environmental degradation, the problems we face now are not guided by traditional national or even regional boundaries. As a development institution The World Bank is now paying more attention to preventive efforts geared to reducing environmental degradation which can generate or increase the impact of extreme events. Land degradation, erosion, reduction of groundwater and absorptive capacities and alteration of surface and subterranean pressures are instances of environmental degradation linked to extreme events.

The degradation of the urban environment also has an impact on disaster-proneness. For example, erosion and water-logging, stemming from lack of drainage, compaction of soils and accumulation of solid waste deposit all increase the vulnerability of urban areas to flooding. The urban dimension of natural disasters is important, and the lessons learned in the past few years, for example in Mexico and Armenia, show that urban vulnerability is growing. We need to pay more attention to environmental impacts in urban areas, and to work with special emphasis on the impact of poverty on disaster vulnerability. In the urban environment we confront difficult constraints --infrastructure deficiencies, inappropriate economic policies, and weak institutional frameworks for city management are some of the main challenges we need to address in order to increase resilience. What is even more problematic is that while the stakes are increasing (population growth, industrialization, urban congestion), we have very limited data and our ignorance is increasing. For instance, we do not know with precision what is the role of cities in the global environmental problems we face, or how to make urban areas more efficient and resilient to extreme events.

In conjunction with UNDP and Habitat we are currently planning a study on the vulnerability of metropolitan areas to natural disasters. In that study we will be looking at different oases of cities in disaster prone-areas (e.g., coastal areas, seismically active areas, areas subject to drought) in order to identify mechanisms and resources required to reduce their vulnerability.

As you may see, we currently face many complex challenges concerning disaster prevention and mitigation. You may wonder how does the Bank respond to a disaster? What is the role of the Bank immediately after a disaster?

In fact, the Bank does not have a role in the immediate relief stage, since there are other organizations, like community organizations, the Red Cross, UNDRO and NGOs that are better prepared to help the impacted community. The main aspect the Bank is concerned with is disaster

prevention and risk reduction before the disaster, and helping countries to restore their losses afterwards. Immediately after a major crisis, the role of the Bank is on assessing damage and needs realistically, helping to define priorities for recovery, and if necessary, coordinating the financial contributions of other donors during the recovery phase.

In crisis management and recovery, there are many tasks for the Bank. Disasters not only create physical disruption but they bring about issues that are sometimes politically sensitive, create logistical problems, and require very visible responses. Immediate post-disaster decisions which have long-term implications need to be taken after every major disaster. Effective crisis management is crucial. The World Bank can help by strengthening the local capacity to manage recovery, or if such capacity does not exist, help install it. This usually means working with the local authorities before the disaster occurs.

In the overall assessment of damage and planning for recover also are man challenges and complexities. In our experience, damages are very difficult to estimate after a disaster; they may be grossly overestimated in some sectors and underestimated in others. As a consequence, unrealistic plans for reconstruction which are counterproductive are often proposed. In many cases, the World Bank complements the local capacity available in order to develop a realistic assessment of damage and an overall recovery programme to match needs and resources, and ensure that the focus shifts from crisis recovery to development.

The coordination of financial assistance to the impacted area is a most important issue. Large-scale disasters attract the attention of many agencies with similar interests. Within our capabilities in each case, if possible, we encourage other agencies to contribute, and if possible to co-finance the recovery. An efficient coordination of aid avoids a costly multiplication and enables an assessment of the comparative advantages of each agency in doing so.

In sum, after a disaster the World Bank provides assistance in several ways:

- a. Through the modification of ongoing projects and loans;
- b. If necessary, through the organization of an emergency recovery loan. It is part of the Bank policy to lend for emergencies but there are several criteria for lending and for the design of the operations:
 - (i) it must address recovery and not relief;
 - (ii) economic benefits must be significant;
 - (iii) the impact of the emergency has to be substantial enough to cause the government to modify its priorities in a drastic way ;
 - (iv) an urgent response must be vital, otherwise the project is treated as a normal development project;
 - (v) there must be prospects of -and commitment to- the reduction of hazards from similar disasters in the future.

In recent years the Bank has lent for disaster recovery in many countries: the Philippines, Sudan, Mexico, Brazil, India, Nepal, among others. In the last two years of the decade of the 1980s, lending for emergency recovery amounted to about 4 per cent of our total lending portfolio (approximately \$2 billion dollars)

This brings about two questions:

What can and should be done in poor countries to reduce or mitigate the impact of disasters?

We have seen how people in the U.S., in Japan, and in other developed countries adopt sound measures to prevent the damage caused by natural disasters. Last year, in the Loma Prieta earthquake in California, we saw how, even though the seismic event was of a considerable magnitude, the damage was relatively limited. What can one expect a country like Nepal, or Bangladesh or Brazil to do? The experience indicates that there is a lot that can be done to mitigate against the worst even in the poorest countries, and we are working in order to help reduce losses.

The problems we face now transcend national and even regional boundaries. As I mentioned earlier, both industrialized and developing countries share similar problems. However, the special needs of the developing countries, including their vulnerability to the impact of climate change and their limited financial and technological resources call for recognition, cooperation and assistance. It is essential to develop a sustained scientific and technological expertise using local resources in We very much hope that the Decade will contribute developing countries. to highlight areas in need of assistance and priorities and help to develop and apply preventive and mitigate mechanisms. We firmly believe in a proactive approach in which we integrate disaster reduction management with general development.

Mr. Chairman, ladies and gentlemen, my address has been about the challenges confronted by a Decade devoted to disaster reduction, about the complexities we face, and about the increased vulnerability that poverty brings about. As a Development Bank, we are only one institution among many others working on this issue. We are convinced that on this matter we have to go hand-in-hand with regional, national and local organizations which have a key role to play in facing the challenges posed by the IDNDR.

Thank you.

PRESENTATIONS FROM PANELISTS

LESSONS FROM THE LOMA PRIETA EARTHQUAKE: CRITERIA FOR INFRASTRUCTURE PLANNING IN EARTHQUAKE COUNTRY, by Melvin M. Webber, University of Berkeley, California

The major message from the October quake -- it was redundancy that saved us. The major lesson -- we should plan now to build in more redundancy, even as we accelerate efforts to retrofit existing facilities to withstand the major shocks that will come.

Of course the first and major effort must be to strengthen existing bridges, overpasses, roadbeds, buildings, and other structures that will be endangered by severe earth shaking. But despite the most valiant efforts, there will inevitably be structural failures, even then. Smart planning requires that we recognize the inevitability of failure and plan to accommodate it.

The October Quake has once again demonstrated that parallel systems provide options permitting the overall transport system to continue to function effectively, even when parts get broken.

Next time, we should be prepared by deliberately installing parallel routes -- and the more the better. For the Bay Area. I suggest that means more parallel bridges, more freeways, and more transit routes.

Bay Area transport capacity is already deficient, especially in the suburbs where growth was earlier spurred by congestion in the metropolitan centre and where congestion levels have been rising lately. But I suggest we need more than just-enough additional capacity to relieve congestion. We also need to build in safeguards.

Public officials will think it wasteful and inefficient to build a lot But the Bay Area's of capacity in excess of predicted traffic volumes. future viability may well hang on the region's ability to continue functioning after The Big One hits -- after the region has been shaken by 7 immediately after an earthquake hits, the or 8 Richter points or more. ability to move emergency equipment freely can spell the difference between life and death for potentially tens of thousands of persons and the preservation or loss of tens of thousands of buildings.

The long-term dislocation of passenger and freight movements that would follow severe damage to the transport system could, in turn, inflict severe and long-term damage to the local economy. By averting some of the horrendous costs that The Big One will generate, investment now in future options and additional capacity will surely yield tremendous returns then.

The conclusions we have drawn concerning transportation must be equally applicable to other public services. San Francisco was without electricity for about a week after the Loma Prieta shock, because several large transformers and circuit breakers were damaged; and it took time to find and install replacements parts. Redundancy in telephone lines and other communication channels, water lines, hospitals, and the large arrays of emergency equipment will all surely increase the chances of surviving a large quakes in the future.

Are the costs of these additional facilities warranted? It depends on the time horizon we assign to our estimates. In the present, any benefits accruing in the long-term future tend to be heavily discounted. However, when the next quake strikes, everyone will be grateful for the foresight that averted future disaster.

And for survivors of The Big One -- for those who live to tell about it -- redundant public facilities systems could well prove to have been a major source of their survival.

CASE STUDY OF FLOOD DISASTERS IN BANGLADESH, by S.I. Khan, UNCRD, Nagoya

MAJOR RIVERS CAUSING FLOODS

Flood water is brought into Bangladesh mainly by the three big rivers of South Asia, namely the Brahmaputra, the Ganges and the Meghna. These three rivers together with their numerous tributaries drain a catchment area of about 1.6 million km² out of which only 116,000 km² (7.5 per cent) lies in Bangladesh. The rest of the catchment area covers Nepal, Bhutan, Southern China, and northern, central, and eastern India.

The Brahmaputra river has originated from the northern slopes of the Himalayan mountains in Tibet (China) and after travelling through China and India, collecting surface runoff on its way, has entered into the deltaic flood plain of Bangladesh in the final stage of its journey.

The Ganges has originated from the southern slopes of the Himalayas and after travelling through Indian territory enters Bangladesh.

The third big river the Meghna originates from the hills in eastern India and the catchment area of the Meghna river includes Cherapunji in India which has the world's heaviest annual rainfall.

Main Features of Major Rivers in Bangladesh (p151)

	Brahmaputra	Ganges	Meghna	Total
Length of river (km)	2,800	2,600	800	6,200
Length within Bangladesh (km)	270	230	400	900
Total catchment area (km ²)	583,000	907,000	64,000	1,554,000
Catchment within Bangladesh (km ²)	31,000	39,000	46,500	116,500
Highest recorded discharge (m ³ /s)	99,500	76,000	19,800	-
Lowest recorded discharge (m ³ /s)	3,300	1,200	370	-
Average discharge (m ³ /s)	12,900	11,700	3,500	-

The Ganges meets the Brahmaputra (Jamuna) inside Bangladesh and this mighty combined flow called Ganges-Padma meets the Meghna river before The lower discharging into the Bay of Bengal in the name of Meghna. Meghna river which is the combined flow of the above three big rivers discharges about 145.000 tons of water per second into the Bay of Bengal The sediment carried by the three big rivers is during high flood. believed to be about 2,400 million tons per year, a considerable portion of The main which is deposited in the river beds and in the flood plains. features of the above three rivers are summarized below.

AREA INUNDATED BY FLOOD

In a normal year about 26.000 km² which is about 18 per cent of the total area of Bangladesh is flooded. In 1954, 1955, 1962, 1963, 1968, 1969, 1970, 1971, 1974 more than 25 per cent of the total area was flooded. In 1987 the flooded area increased to 40 per cent and in 1988 flood ravaged about 60 per cent of the area of Bangladesh causing widespread damage. The records indicate that floods have been increasing both in frequency and severity. Figure below shows flood-affected area since 1954.

<Figure here>

CAUSES OF FLOOD IN BANGLADESH

The following factors are considered to be the main causes of flooding in Bangladesh:

- (1) heavy monsoon rainfall in the catchment areas of the Ganges, the Brahmaputra and the Meghna;
- (2) snow melting in the Himalayas;
- (3) deforestation and flood protection projects in the upper catchment;
- (4) low general topography of Bangladesh;
- (5) heavy localized rainfall within Bangladesh;
- (6) backwater effect of major rivers at their points of confluence;
- (7) man-made constructions in the form of roads, railways, homesteads, industries, etc. in the flood plain obstructing natural flood flows;

- (8) rise of mean sea level in the Bay of Bengal due to monsoon wind; and
- (9) flow tide in the Bay of Bengal twice a day retarding discharge of upland rivers.

FLOOD DAMAGE

The following tables offer estimates of the damage caused by the 1988 flood.

General Impact and Physical Damage

Flooded area	81,800 km ² (57% of the country)
Number of people affected	46.7 million including 3.8 million totally destroyed, and 3.4 million damaged
Crop damage	7.54 million ha, including total destruction in 4.26 million ha, and partial losses in 3.28 ha
Rice	2.5 million tons
Livestock	172,000 cattle, goats, etc. 410,000 chickens and other poultry
Flood control and irrigation facilities	2,500 km of embankments 1,900 hydraulic structures 23,500 small-scale irrigation facilities
Roads	3,000 km of national roads 10,000 km of regional roads 913 bridges and culverts
Railways	1,303 km of track 269 bridges
Communications	20,400 telephone circuits
Electric power	16 sub-stations 2,000 km of distribution lines 12,000 power poles
Industry	1,070 small and medium sized factories
Public health	1,468 hospitals and health centers
Education	19,016 schools
Water supplies	240,000 hand pump wells

COST OF REPAIR AND REHABILITATION

The total cost of repair and rehabilitation of agriculture, public facilities and general facilities has been estimated to be US\$ 2.14 billion.

ACTION PLAN FOR FLOOD CONTROL

The Donor Agencies/countries and Government of Bangladesh have identified the following 26 plan components and supporting activities towards a long-term action plan for flood control in Bangladesh.

PLAN COMPONENTS	DONOR INTEREST
1. BRE Strengthening	IDA
2. Brahmaputra Right Bank - NW Drainage Study - NW Diversion Drain - NW Interceptor Drain	UK, Japan (Germany) (ISDB)
3. Brahmaputra Left Bank - NC Regional Study - BL Embankment (N) - BL Compartment (N)	EEC France
4. Ganges Right Bank - SW Regional Study - Gorai Intake & GRE - SW & SC Drainage Improvement	ADB/UNDP
5. Meghna Left Bank - SE Regional Study - Gumti & SE Drainage	IDA/UNDP
6. North East Region - NE Regional Study - Rehabilitation Project	Canada
7. Cyclone Protection Project	EEC
8. Dhaka Town Protection	Japan, ADB, UNDP *
9. Other Towns Protection	ADB, IDA *
10. Flood Forecasting and Early Warning	UNDP, Japan, ADB
11. Flood Preparedness	UNDP, USA (Switzerland) *
SUPPORTING ACTIVITIES	
12. FCD/I Agricultural Study	UK, Japan
13. Operation and Maintenance Study	UK
14. Socioeconomic Study 1	USA
15. Socioeconomic Study 2	Sweden (USA)
16. Environment Study	USA
17. Fisheries Study and Pilot Project	UK
18. Topographic Mapping	USA, Finland, France, Japan, Switzerland, Sweden
19. Geographic Information System	USA, Switzerland
20. Compartmentalization Pilot Project	Netherlands, Germany (USA)
21. Bank Protection Pilot Project	Germany, France
22. River Training/AFPM Pilot Project	Germany (UK)
23. Flood Proofing Pilot Project	USA
24. River Survey Program	EEC (France) (USA)
25. Flood Modelling/Management	Denmark (France) (UK)
26. Institutional Development Programme	UNDP (France)

The first phase of the Action Plan is proposed to be undertaken during the 5-year period from 1990-1995. During this period surveys, studies, planning and project formulation works will be undertaken. Activities of the Action Plan have already been launched.

VOLCANIC BRUPTION DISASTERS IN THE PHILIPPINES

by Raymundo S. Punongbayan, PHIVOLCS, Philippines

The Philippines has had a vigorous history of volcanic activity manifested both in its geologic and recorded past. It has 220 Quaternary volcanoes distributed in five trench-related volcanic belts. Twenty one of these volcanoes are considered active having erupted during historic times or within the last 600 years.

There are accounts of violent volcanic eruptions in the 18th, 19th and early 20th centuries which devastated entire communities. But these events were largely considered God-given punishments for man's sins which did not generate any scientific action or volcanic disaster countermeasures on the part of the nation.

This presentation will focus on volcanic disasters which were instrumental in the emergence and subsequent development of volcano disaster prevention/mitigation systems in the Philippines. These volcanic disasters are the Hibok-hibok eruptions in 1948-1953, the Taal Volcano eruption in 1965, and the Mayon Volcano eruption in 1984.

The Hibok-hibok activities had precursors--earthquakes which were felt months before the actual eruption, rock falls, debris avalanches and minor slides, and steaming activities. The most destructive phase of the eruption occurred three years after the onset of the eruptive state. Yet when the 4 December explosion occurred, the people and the government were caught unprepared. About 3000 died and hundreds of thousands worth of properties and structures were destroyed.

The Hibok-hibok disaster was a major factor which led to the creation in 1952 of the then Commission on Volcanology (COMVOL), an agency tasked primarily to "safeguard life and property against volcanic eruptions and dangers" and provide relief for victims in the event of such calamity.

The 1965 Taal Volcano eruption was COMVOL's baptism of fire. It took place when COMVOL was still groping and starting its data base--with a technical staff of five. The eruption was not predicted, and the response operations were chaotic. About 200 people died, most of them while fleeing as their boats capsized due to the combined effects of overloading, falling ejectamenta and turbulent base surge.

The 1965 Taal disaster underscored the precariousness of living on the volcanic island, an area which had already been delineated by COMVOL as a Permanent Danger Zone to be barred from human habitation. It also emphasized the need to upgrade the volcano monitoring agency's capability to monitor and predict volcanic eruptions and issue timely warnings. Furthermore, it exposed the government's unpreparedness to handle a national emergency and the need for a disaster response-rehabilitation machinery .

To rectify these shortcomings, moves were effected to relocate and rehabilitate the volcanic island's inhabitants and the government declared Taal Volcano as a national park. COMVOL was reorganized several times, transformed from a mere monitoring commission into a research and development institute - the Philippine Institute of Volcanology and Seismology (PHIVOLCS) - with added mandates to conduct R&D to develop/adapt techniques for eruption prediction at the same time develop/adapt technologies for harnessing the beneficial potentials of volcanoes and volcanic terrain.

In 1978, the then President, Ferdinand Marcos created, by Presidential decree, a National Disaster Coordinating Council (NDCC) and counterpart organizations at the regional, provincial and municipal levels to coordinate disaster and/or emergency operations. He also decreed the preparation of a National Disaster and Calamities Preparedness Plan, the conduct of community drills periodically and the establishment of facilities and training of properly equipped disaster action teams.

The Mayon Volcano eruption in 1984 showed how the affected people had fairly well developed coping mechanisms, and the timely mobilization of well-emplaced government response machinery, nongovernmental organizations as well as international scientific and relief agencies, minimized, if not prevented, the disaster which would have resulted from the eruptions. Nevertheless, it showed the inadequacy of PHIVOLCS' capability for eruption prediction. The onset of the eruption was not predicted. Luckily, the build-up of the eruption's intensity was gradual.

No lives were lost as a direct result of the eruption but damages to agricultural land, infrastructure and other properties were estimated at \$7.2 Million.

The impacts of the Mayon eruption somehow brought into focus the issue Before the eruption, of volcanic hazards as development constraints. regional and urban planners were complacent about the development of Legaspi City (which is right at the foot of Mayon Volcano facing the newly formed breach at the edifice's crater) as a regional capital and major After the eruption, Legaspi City's suitability for the urban centre. To date, however, the questions have chosen role began to be questioned. been mostly academic and no actions have been initiated to review and re-plan the development of the city.

The integration of volcanic disaster prevention into development planning and implementation is just beginning to be promoted in the Philippines. It has not gone beyond the workshop and discussion stage. The Regional Development Councils (RDCs) are in the process of preparing Regional Physical Framework Plans and the Institute has launched an information campaign to promote among the planners awareness of geologic hazards as development constraints and the need to build in disaster prevention/mitigation measures into development plans and programmes. Hazard zonation maps for the five most active volcanoes have been updated and circulated, waiting to be inputted into the country's regional and urban development plans.

<figure here>

CASE STUDY OF MEDICAL ASSISTANCE ACTIVITIES IN EMERGENCIES, by Michel F. Lechat, Catholic University of Louvain, BELGIUM

Health management of natural disasters has three objectives: (a) to reduce the number of deaths and injuries; (b) to prevent health damages resulting from the disaster, including diseases, environmental stress, and psycho-social consequences; (c) to protect or restore health facilities and services. For a long time, health response consisted of rescue and relief, usually provided from external sources. A number of stereotypes were and are still prevalent, publicized by the media, such as the need for drugs, field hospitals, volunteers, or mass vaccination. We now realize that many more lives could be saved and injuries prevented by adequate preparedness in disaster-prone countries.

Emphasis has thus shifted from a post-disaster improvised response to pre-disaster health planning. Credit should be given to the World Health Organization, including its Regional Office for the Americas, the Pan American Health Organization, for actively promoting this approach whose relevance is documented by a number of epidemiological studies. Earthquakes are good examples. These observations can however be transposed to other natural disasters, with their own requirements, taking into account their recurrence and time-lag for warning.

While in the past, the ratio of severely injured persons to deaths following an earthquake was approximately three to one (1,2), in recent earthquakes such as Armenia 1988 it was about one to three (3). New buildings materials and inappropriate design have made earthquakes more Prevention of death now calls for structural engineers effective killers. The effectiveness of anti-seismic building codes over instead of surgeons. the last 20 years can be demonstrated in Japan by the considerable decrease The hazards of living in mortality resulting from earthquakes. traditional dwellings in Guatemala were studied following the 1976 earthquake, especially as related to new designs and materials associated More recent data on faulty structural design with rural development (4). These studies paved the way for targeted were collected in Armenia (5). efforts in the fields of education, design, land-use planning and legislation.

Post-impact case studies have clearly demonstrated the importance of adequate preparedness for the population which must take evasive action, as well as the great potential of the local people for rescue and self-help.

Age-specific death rates in Guatemala, 1976, were considerably higher for children aged 5 to 9, indicating that parents are wrong when they consider that children 5-9 years old are able to avoid danger by themselves (1). The relationship between death, behavioural patterns and location at the time of an earthquake has been further documented in Armenia (6).

Studies on the behaviour of populations during or immediately after an earthquake have shown that a large proportion of the population is actively involved in effective rescue operation within half an hour after the first tremor (7).

In the earthquake of Tangshan, China (1976) and Irpinia, Italy (1980) (figure 1), the number of people extricated alive declined from 88 percent

after half an hour to 3 and 7 per cent after 3 days (8,9). As external aid is delayed by necessity, the concept of the "Golden Twenty-Four Hours" arises. The local population must take all responsibility for saving of lives during this time. Again, this calls for preparedness.

In Italy, death rates were significantly higher in persons who were alone in the house at the time of impact as compared to persons living in multiple households. Delay in extrication was longer for those living alone (10) (table 1). This is a good indicator both of the effectiveness of local rescue activities and the deficiencies in targeting these activities.

Relief often arrives too late and is non-specific. Studies have shown that promptness of relief is not a substitute for relevance. There should be a trade-off between information and action.

From these studies, it has now become clear that rescue following earthquakes is part and parcel of primary health care. This should not imply that external aid for relief and rescue is unnecessary. It is and will remain important. However, efficacy in terms of number of lives saved rests with local preparedness.

More research is needed. Anti-seismic building codes are one thing. They are not applicable everywhere, and cannot necessarily be oriented toward maximal life saving or protection from injuries. A major field of research, taking advantage of IDNDR, should be an international interdisciplinary programme involving structural engineers, emergency physicians, and epidemiologists to study the habitat as a risk factor in disaster-prone countries, both urban and rural modern and traditional. This programme could lead to simple measures to make the dwellings less lethal or less injury-prone.

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<figure here>

Table 1 Death rate and rescue time according to size of household, Italy, 1980 (p160)

	One person present in household	Two or more persons present in households
Crude death rate	11.2%	5.1%
Death rate amongst trapped	45.6%	33.6%
Proportion of trapped extricated (dead or alive) within 24 hours	46.5%	61.0%

PRESENTATION ON FAMINE DISASTERS AND THE IDNDR, by Timothy P. Allen, Oxford University, UNITED KINGDOM

Allen's presentation was, he said, intended to take the workshop off at a tangent, away from its exclusive focus on the IDNDR which had dominated the proceedings of the previous days.

He began with the salient observation that if all the casualties resulting from rapid onset disasters, such as earthquakes and typhoons, which had taken place since the beginning of the century were added together -- the number would be far below that of deaths resulting from a single decade of slow-onset disasters. (By slow onset disasters the speaker was referring to long-term lack of access to food, i.e., famine, partly caused by long-term ecological degradation and drought). He noted that an almost continuous drought had plagued the Nile basin for the last ten years - total deaths were unsure -- at least up to 1.5 million.

The speaker was of the strong belief that if disasters in the 1990s were to be truly confronted, then the issue of slow-onset disasters had to be considered; however, he realized that there was a natural aversion to facing this type of disaster --it was not a tidy problem, there were no purely technical solutions, and developed countries ("well-fed" countries) tended to like technical solutions. Famines were more complex phenomena than earthquakes. The actual mechanics of famine were obscure. A comparison of the food situations of India and China, over the last 40 years indicated that India had avoided major famines whereas China had not. Comparative demographic statistics indicated that millions must have died in famines around the time of the 1958 "Great Leap Forward" . However, if mortality rates linked to malnutrition-related disease are compared, the death rates are higher in India. This was due to the success of grass roots health care in China and highlighted the fact that there was often no relation between famines and demographic indicators. Experience from Africa indicated that death rates were no higher among populations fleeing famine areas than among populations living outside the famine zone. From the Sahel came evidence of a net demographic increase after the devastating famines of the 1970s. Highest mortality and morbidity rates appeared to be among those refugees who wound up in camps run by the UNHCR. Allen felt that the only thing, sometimes, which differentiated between a famine and conditions of ongoing grinding poverty was publicity. Problems of famine identification were further compounded by the difficulties in identifying simple food shortages from other, wider development problems. Food availability, even more than earthquakes could not be divorced from socioeconomic and political factors. Drought and ecological decay can cause food shortages but the problems were usually complicated by wars, poverty, or political oppression.

Two crucial factors pertained, he observed. Firstly, markets. It had been demonstrated that famines often occur when food stocks were not fully depleted. During the 1970s in the Sahel, some areas recorded bumper harvests. In Sudan and Ethiopia, food was exported even while sections of the population starved. [He noted in an aside that during the nineteenth century, England imported food from Ireland during that country's potato famine.] The problem lay in the reality that shortages of food drove up prices, thus making it unavailable to the poor, who have lost their own food resources.

Secondly, and of related importance, was access to political influence. Famine or food shortages usually did not occur among those whose voices were heard near the centre of political power. Famines in the Ukraine in the 1930s and in China in the 1960s, occurred because totalitarian governments had no interest in the affairs of the peasants afflicted.

These two factors illustrated the fact that famines were not single incidents and therefore could not be treated as if they were. The media, unfortunately, portrayed them as if they were, and therefore, huge amounts of money had to be spent in short spans of time -- following times when very little money is available. Crisis, TV pictures of mass migration tended to attract donations, he said, whereas bulk grain storage techniques did not. Famine mitigation strategies required long-term strategies. The problem that relief work and economic development have few obvious connections had prompted international and national aid agencies to seek new approaches, in recent years. Sudden distributions of food from developed countries often triggered further hardship. Thus, big agencies often tried to channel aid through NGOS (nongovernmental agencies) at grass roots level. In the past they had specialized in top-down relief interventions, but now, despite assertions that they are non-political, many NGOS were attempting to build up the structures to permit the poor to gain access to power. [The current jargon referred to this as the business of "empowerment"]. Such NGOS tried to locate local NGOS with whom to work so as to ensure project continuity once outside funding had stopped. [The speaker referred to his distributed paper which discussed various empowerment strategies and NGO structures. In his view, the belief that such approaches represented a long-term solution to the problem was overly optimistic].

He was of the opinion that NGOS in general lacked funds, expertise, coordination, and overall experience, and were simply not in a position to "empower the poor". It was naive to suggest that they were.

In summing up his argument, Allen stated that he thought the chronic disaster of hunger could not be solved at the national level. National political and socioeconomic structures were part of the problem. NGOS could help at a limited local level but real change could only be affected if the poor were empowered internationally. There was a great need to put pressure upon governments which exploited famine disasters for political purposes. Using famine as a political weapon should become unacceptable as the use of chemical weapons. There was a need for international efforts to bring an end to wars which exacerbated the effects of famines, There was also a need for more research into drought-resistant crops (in the same way as successful research had been conducted into high-yielding fertilized varieties). He was critical of structural adjustment programmes which often ignored local conditions or were based upon poor statistics. International monitoring of mortality and morbidity controls was necessary, perhaps under Red Cross auspices. The pertaining ignorance of the links between environmental degradation and famine should be corrected. Simple medical solutions such as rehydration salts should be more rapidly available on a larger scale than ever before, and, unlike now, on time and where needed. Although he felt it unlikely that the chronic disaster of hunger would be ended in the next decade, unless the issue was seriously addressed by the programmes of the IDNDR, so that it

does not become worse, it (the IDNDR) would be largely irrelevant for the majority of the world's population.

RECONSTRUCTION AND DEVELOPMENT: THE WORLD BANK'S WORK EMERGENCY RECOVERY PROJECTS, by Alicia Kreimer, The World Bank

Introduction

This presentation will discuss efforts in reconstruction that have been financed by the World Bank, after major natural and man-made disasters. During the presentation I will examine (i) the background of reconstruction activities within the context of the Bank's work; (ii) the linkages between reconstruction and development; and (iii) problems concerning resource mobilization for emergency recovery.

Back round on Emer enc Recover Activities Within the Work of the Bank

The World Bank (the International Bank of Reconstruction and As a first step it would provide Development: IBRD) was created in 1947. the capital needed urgently to assist Europe in the reconstruction after the war. Secondly, it would turn to economic development around the globe. The very first operations were targeted for reconstruction assistance to France in 1947 (US\$ 250 million), and in 1948 to Denmark (US\$ 40 million), and to Luxembourg (US\$ 12 million). It was soon found that the financing of post-war reconstruction was beyond the capabilities of the organization and that the countries devastated by the war needed funds for purposes that fell outside the criteria of project financing, such as restocking of inventories, import of foodstuffs, raw materials, and fuel. Thus, the IBRD, turned to its other mandate, that is, to development.

Since 1947 there have been about 100 operations financed by the Bank targeted for reconstruction in developing countries after various disasters such as earthquakes, floods, hurricanes, volcanic eruptions and civil wars. The activities of the Bank in emergencies focus on recovery or rehabilitation of destroyed assets. The Bank does not participate in immediate relief activities on the understanding that there are a number of national and international organizations that are better equipped to provide relief.

The total amount of Bank contribution for reconstruction was approximately US\$6.5 billion in constant 1989 prices. In terms of regional distribution, the majority of emergency reconstruction activity was in Latin America and the Caribbean, followed by Asia and Africa and finally the region comprising North Africa and Europe. Examples of the countries that received assistance include among others, (i) for floods Bangladesh, Pakistan, Sudan, Brazil , Nepal , Yemen AR, India, Honduras , Nicaragua, Peru, Romania, and Western Samoa; (ii) for earthquakes, the Philippines, Mexico, Nepal, Romania, Guatemala, Nicaragua, and Peru; and (iii) for hurricanes, India, Costa Rica, Jamaica, Mexico, Madagascar, Dominican Republic, Swaziland, Fiji, Mauritius, and Bangladesh.

In the past few years, there has been an increased concern for disaster reduction. In 1984 the Bank adopted a set of guidelines for

reconstruction projects that encouraged the inclusion of disaster prevention and mitigation in post-disaster activities. This was based on the notion that disasters provided a "window of opportunity" to introduce measures to reduce losses. The concern for vulnerability reduction went beyond reconstruction projects; the guidelines advocate the reduction of vulnerability reduction measures in disaster-prone countries, not only after major catastrophic events but also in regular operations and in the dialogue with member countries.

Post-disaster Needs

The needs posed by different types of catastrophes are varied. They depend on the type of disaster agent, size of the area affected, complexity of socioeconomic development, institutional and managerial capacity in the country to react rapidly, and human and physical resources available. Disasters can be sudden or of slow onset, with the speed of impact influencing the type of response required.

Sudden onset disasters, e.g., earthquakes or hurricanes can destroy the housing stock of a country, its infrastructure, commercial, and industrial facilities, making large populations homeless and disrupting the productive base. Not only do they damage capital assets, but they have long term effects on the economy. The cost of repair and replacement may require the diversion of investment from uses that could have created a net addition to productive capacity in the country. Earthquakes can bring substantial changes in expanding the area occupied by a given city for example, and accordingly pose new demands of infrastructure (water supply, roads, transportation) and social services (schools, health service facilities) in addition to simple reconstruction.

In slow onset disasters like droughts, the situation created by the failure of rains is compounded by longstanding problems such as rural poverty, an inefficient pattern of land use and tenure, soil erosion, and deforestation. Droughts generate massive migrations of population in search for a livelihood and have high costs not only in human lives but also as an agent that can destroy a way of life. The prolonged droughts in the Sahel, in Sudan and in Ethiopia had dramatic consequences. Millions of pastoral people in already impoverished regions were driven from their economy and traditional cultures constituting a severe burden to society.

Although the so-called "natural" disasters are given features of the environment, the extent of damage that results from them is to a large extent a function of development decisions. Costly but avoidable losses In many cases significant losses are the result of are commonplace. inadequate design, weak building techniques, lack of quality control during reconstruction and changes in building occupancy. The lesson learned in the recent earthquakes in the Philippines, in 1985 in Mexico and in 1988 in Soviet Armenia is that we are currently building an increased vulnerability. We saw in the Loma Prieta earthquake in California, how efforts to reduce vulnerability paid off, and although the impact of the 1989 earthquake was extensive, the damages were not as significant as they would have been, had there been no mitigation and prevention in place.

Recover Strategies

The works financed by the World Bank in post-disaster recovery ranged from single sector reconstruction and rehabilitation work, such as the reconstruction of a damaged road in Peru after the earthquake of 1970, to the financing of a slice of an overall reconstruction programme after the earthquakes in Colombia in 1983 and in Mexico in 1985. In those two cases the projects financed programmes for the recovery and reconstruction of urban and rural infrastructure, housing, education, health, industry, power, and transport.

In all cases of Bank-financed recovery programmes, the general objectives of the implemented reconstruction projects was to restore normal life and production rapidly by rebuilding a portion of the destroyed system or by supporting a reconstruction programme. Although long-term development is certainly an essential concern, and the reconstruction needs to be planned within this framework, it is not easy to address it at a time when the community in crisis has to face very basic infrastructure, physical plant and productive life reconstruction needs. It may be assumed that if the project addresses a number of basic reconstruction needs, these in turn, will have a rebound effect. That is, those basic aspects will promote further restoration efforts as well as the restoration of complementary sectors in the system, and in the long run, will be beneficial to the development of the impacted area.

As mentioned above, the approach used in the past five years has tended to consolidate different sectoral needs into a single programme and to support existing institutions to the maximum extent. In Popayan, Mexico, Nepal, Sudan and the Yemen Democratic Republic the World Bank supported a limited portion of an overall reconstruction programme rather than concentrating on one or a few specific subcomponents. The approach was based on a multi-sectoral strategy encompassing all major aspects of the programme: demolition and rubble removal, shelter and settlements, production, infrastructure networks, community services, and public management. Such an approach was designed to support a coherent reconstruction process and provide a foundation for the restoration of economic activity.

Resource Mobilization

In all the post-disaster reconstruction cases after natural disasters mentioned above there was an intensive mobilization of resources immediately following the disaster. On the domestic front, efforts included the enactment of regulatory measures, legislation and other mechanisms such as the mobilization of manpower, to assist the impacted areas in alleviating the losses. On the international front, governments sought diverse sources such as international relief aid, and financial assistance from other governments as well as from multilateral organizations. The financial arrangements to mobilize resources for recovery works in the different post-disaster experiences included funds from extraordinary taxes, temporary increases in tariffs, bond issues, contingency funds from the national budget, of reallocation in priorities in the national budget.

In addition to financial contributions, post-disaster needs also required the extraordinary mobilization of manpower and materials. In many cases, in addition to a domestic and international mobilization of financial resources the affected governments implemented measures to meet urgent manpower needs by (i) mobilizing the working population not directly involved in the production process (e.g., white collar workers); and (ii) reallocating construction workers from non-affected parts of the countries. Governments also established the diversion of all equipment not directly used in production to emergency-related construction enterprises, the reduction of exports of construction materials (cement, timber, pipes and fuels), and (iv) the postponement of all construction activities not related to reconstruction.

Prevention and Mitigation: A Conclusion

An important component of reconstruction projects financed by the World Bank and implemented in the last few years after natural disasters has been the inclusion in those projects of measures geared to preventing losses and reducing vulnerability to disasters. Those measures included, among others, (i) mechanisms to strengthen the capability of institutions in the disaster-prone areas to deal with risk reduction, mitigation and rehabilitation, (ii) implementation of instruments to avert future losses such as seismic-resistant codes, (iii) evaluation of insurance needs, (iv) development of studies in microzonation, structural systems, quality of building materials, and (v) implementation of training on building techniques and construction management.

In spite of their importance, the inclusion of disaster prevention and mitigation concerns into reconstruction projects is not an easy task. In many cases governments either resist discussion of the prospect of natural disasters, or allocate minimal resources to prevention and mitigation. Those issues tend to be perceived as add-ons to development rather than as integral components of a process of growth. However, from the discussion and the examples mentioned above, it is obvious that policies and activities geared to strengthening local capabilities to reduce disaster-induced losses can only contribute to the achievement of sound development. We hope that the International Decade objectives and sustainable growth. for Natural Disaster Reduction will help to reduce the negative impacts of extreme events by promoting disaster prevention and mitigation measures worldwide.

DISCUSSION FOLLOWING THE PRESENTATIONS OF THE PANELISTS

Following the panellists presentations, moderator Yanagawa opened the proceedings to the floor. There being no immediate response he took it upon himself to "break the ice" by declaring his surprise at the degree of spontaneous voluntary contributions from the general public following the Loma Prieta earthquake. The public response was excellent. Webber responded that there was a long tradition of volunteerism in the US, originating from the settler mentality ("help thy neighbour"). There was an expected pattern, even in the poorest areas, whereby citizens voluntary participation was anticipated. Quarantelli concurred with this and added that generally existing societal norms continued into periods of emergency. Societies generally drift in the same direction, individual patterns prevailed. Mitchell, in comments aimed specifically at media representative Yanagawa, noted how TV journalists were seem to be participating in recovery work themselves, while broadcasting the news. He referred to an on-the-spot "Rather scale" of increasing participation by a well known media star. He went on to summarize lessons which appeared to have be learned, or not learned, from previous earthquake experience, in application to the Loma Prieta earthquake. Firstly, the need for public emergency management facilities had seemingly been learned; secondly the need for hospitals to maintain emergency facilities had not been learned; and thirdly, due to the enormous economic losses of the Loma Prieta earthquake, he was confident that learning will result, in preparation for next time. Quarantelli observed that the US case of volunteerism was not unique and described the Mexico City earthquake where two million volunteers were recorded within 48 hours. This was not pre-planned, but informal. Initial rescue efforts were laudable. Lechat questioned Yanagawa on the Niigata earthquake, where reportedly, half the population were prepared to assist. Were they volunteers or not? Yanagawa ' s response was to say that differences in scale were important. Niigata was a provincial city, but in Tokyo, vast in-migration had greatly weakened communal ties. Cultural alienation had resulted to an extent whereby a similar response to a disaster as San Francisco could not be anticipated. He noted that government efforts were aimed at strengthening community ties, in a top-down fashion. Webber wanted to ask the mainly Japanese audience if Yanagawa's views were deemed correct. Hori, of the Tokai Bank Foundation, agreed that young Japanese lacked community spirit but related his experiences in New York during the 1975 power-cut during which he noted that not all segments of the community were helpful in preventing large-scale chaos. Yanagawa noted the sensitivity of such topics and urged caution, although Hori repeated that he was an eyewitness. Webber noted reverse situations had occurred, specifically a case from Dallas, Texas. In response to a request for a direction change, Johari volunteered a contribution based on the Bangladesh experience. He noted the usefulness of non-structural measures in disaster prevention considerations. The Grameen Bank, hitherto in existence to promote agricultural development in the country could be extended, to promote appropriate technology disaster prevention. Definite improvements in people's ability to cope with disasters had been noted between 1974 and 1988. The most recent disaster (1988) had not been so disruptive. Wider employment issues, following disasters, needed closer attention. Erdik broached the question of protection of cultural objects during disasters. Implementation of measures should be relatively simple. He advocated publishing the results

of work in progress and the preparation and distribution of manuals. Consideration of this aspect should be incorporated into IDNDR'S Scope. there was material Lechat's response noted that in the Annex of It was a major contribution, he felt. pertaining to this important issue. Kuroiwa, focusing on Webber's idea of built-in redundancy being a viable earthquake protection measure (i.e. , building two bridges, two roads, etc. , to heighten survivability), noted that as far as the developing countries are concerned, the idea is of limited applicability. Shortage of resources prevents construction of even essential infrastructure. Webber concurred, observing that two small hops were frequently better than one Lechat stated that two roads were not necessary, citing an big leap. example in Algeria where a camel route was also a road suitable for four-Watanabe, from the Construction Ministry, agreed wheel drive vehicles. "Prevention (of famine) with comments from the presentation of Tim Allen. is better than cure", but how could empowerment of the poor actually be carried out through international pressure; what form would it take? He felt frustrated by what he perceived as the IDNDR'S overemphasis on What real pressure could be brought to engineering/technological aspects. The speaker's He requested some response from Allen. bear? presentation, said Allen, had focused on food availability problems but perhaps there were wider ramifications for other disasters. He suggested a widening of thinking on the problem, from a national to an international Organizations such as the UN could put pressure upon governments level, which persecute sections of their populations, such as in the Horn of Africa. He felt there were possibilities for such international bodies to He also advocated intensified put pressure on these governments. monitoring of health conditions (morbidity and mortality rates). There needs to be an agreed standard upon which to base "food aid" provision. Empowerment to the poor could be extended in this way. Mitchell then directed a question to the panel and to the floor concerning the characterization of disasters.

Thirty years ago disasters were characterized in physical science terms but now they are increasingly being termed "human" disasters. This is going too far, he felt. Disasters are complex feedback systems between man and nature and it would be wrong to eliminate the contribution of scientists, just as it would be wrong to ignore the human viewpoint. The scientific debate around the question of "the Nuclear Winter", particularly in the USSR, grew into such a constructive chain of events, which contributed, in part, to the economic His main message was to caution against restructuring of the country. giving "disasters" a too-narrow definition. Lechat's rejoinder was to agree on the difficulties of labelling disasters and to note an arbitrary but all-embracing definition which had met with general approval. "Natural disasters are ecological disruptions exceeding the adjustment capacities of the affected community", in other words, an interface between It depended to a large extent the physical world and the human world. upon the coping capacity of the community. He cited the case of a destructive earthquake in the Balkans which was described as an "opportunity" in Albania, but a disaster in neighbouring Greece.

Moderator Yanagawa, noting the change in emphasis, towards environmental issues, cautioned about the potential problems associated with global warming. In this respect, he was aware that Khan, in his presentation on Bangladesh had had insufficient time to touch on this issue, and invited him to contribute further. Khan, in response, described a report, commissioned by the Commonwealth secretariat, on the

effects of global warming on several low-lying countries, such as the Indian Ocean nations of Maldives and Bangladesh. He documented the potentially disastrous effects of a global warming of between 2 and 5 degrees Celsius. 20 million people would be affected in Bangladesh alone by such phenomena as increased sea levels, (from polar ice-cap melting), increased run-off from the Himalayas (from snow melting), and increased back-water effect due to thermal expansion inland of the ocean. These factors combined to make a difficult set of problems for the future. Kreimer was then invited to add comments. She rated that there was no disagreement in the scientific community about the global warming problem. She called for prudence in dealing with the immense difficulties which will Yanagawa, who was involved in this be brought on by this phenomena. issue, observed the vast array of issues regarding global warming. He In reply, Yamada of the National Land Agency, invited further comment. gave some ideas on how the global warming issue could be handled in the He noted that other fora are examining this important topic and I DNDR . that therefore it should be left to the appropriate bodies, (for example, the ICCF, the Intergovernmental Climatic Changes Forum) rather than Lechat, as a member of the IDNDR Committee, stated becoming a UN concern. The difficulty which the committee had faced in defining exactly what limits would be put on the definition "natural disasters". He agreed that there was a long-term relationship between global warming and ecological damage but the committee had decided upon an interpretation of natural disasters as meaning those phenomena, the effects of which could be limited This was to ensure some visible by human action within the decade. He also noted that there were huge ongoing achievement during that time. programmes working in this area, such as the EC, with multimillion dollar Yanagawa, moving on, noted time limitations, and addressed a projects. Having recently been in the Philippines, he had question to Punongbayan. Firstly, despite the disaster-prone nature noted two interesting aspects. of the country, there was a singular lack of heavy equipment such as He also commented on the bulldozers and rescue machinery such as cranes. apparent happiness of the Philippine people despite the hardships. He Punongbayan's response was to say that the requested some comments. Philippine people's apparent happiness was true - but there was no choice, Yanagawa had commented that were similar circumstances but to be happy to affect the Japanese, there would be gloom everywhere. Only slowly was the government realizing that there was a great need for heavy equipment to Slow assist in rehabilitation following disasters, said Punongbayan. progress was being made.

Moderator Yanagawa, then, noting that the forum was completed, traced the course of the previous days' meetings and spoke of the huge amount of discussion and the knowledge produced. Observing the increased role of the UN in global affairs, particularly with reference to the ongoing Middle East crisis, he felt that such man-made problems should be able to be resolved. However, the complete prevention of natural disasters cannot be envisaged. He thanked the Forum's sponsors and organizers and then, through master of ceremonies Tsukagoshi, called upon UNCRD Director Sazanami to present a closing speech.

CLOSING SPEECH, by Hidehiko SAZANAMI, Director of UNCRD

Distinguished Participants. Ladies and Gentlemen:

Today, following the panel discussion, we shared basic ideas concerning disaster management experienced in both developed and developing countries, and also had a fruitful exchange of views and information.

The achievements of this open forum have rested upon you --both participants as well as the many collaborating institutions. Let me take this opportunity of expressing my gratitude, on behalf of UNCRD, to the World Bank, the Tokai Bank Foundation, Aichi Prefecture and Nagoya City Governments, as well as numerous other organizations and individuals who have unstintingly given much time and effort. As director of UNCRD. I would also like to express my deep appreciation for having the privilege of hosting these well attended sessions.

In seeking an environmentally compatible path to development, in addition to seeking technical solutions, a broad perspective of the issues -- a bird's eye view -- is important. A strong sense of public awareness regarding the relevance of development paradigms to natural disaster mitigation and prevention should be promoted. This is the starting point in our quest for alternative approaches for making the world a safer and more secure place in which to live.

The earnestness and enthusiasm with which the issues were presented and discussed at this open forum have convinced me that, with your continued cooperation, we can sustain the momentum we have built up over these two days. We, at UNCRD, pledge to make every effort, through our training, research and knowledge-dissemination activities to further this globally significant cause of regional development planning for disaster prevention. In the future, we hope that this can positively contribute towards the programmes carried out during the IDNDR.

In concluding my remarks, I wish to thank you all for your strong support and goodwill and look forward to your continued encouragement and assistance in the years to come.

Thank you very much.