UNCRD Proceedings Series No.1

DISASTER MANAGEMENT IN METROPOLITAN AREAS FOR THE 21ST CENTURY

Proceedings
of the
IDNDR Aichi/Nagoya
International Conference 1993 JAPAN

1–4 November 1993
Nagoya, Japan

United Nations Centre for Regional Development

Japanese Government Headquarters for the IDNDR

Aichi Prefectural Government

City of Nagoya

Japan National Committee for the IDNDR

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FOREWORD

The Scientific and Technical Committee (STC) for the International Decade for Natural Disaster Reduction (IDNDR) has proposed risk assessment, mitigation planning, and warning systems for natural disasters as the three major targets of the Decade to be achieved by all countries throughout the world by the year 2000.

International activities to achieve those targets, in line with continuous efforts at the national level, should thus be developed with highest priority given to areas with major concentrations of population and resources where modern societies supported by advanced technologies and developed economic activities are located.

Most of these special areas, so-called mega-cities, are exposed to a number of natural hazards and threatened by the risk of extensive damage to both human resources and accumulated properties. In consideration of the fact that such mega-cities are important elements of our global society, it should be noted that the responsibility of protecting these mega-cities from the threat of natural disasters lies in the hands of the international community, and the targets of the IDNDR shall be achieved in those areas when efforts by the international community are carried out in cooperation and coordination.

Towards this end, the United Nations Centre for Regional Development (UNCRD), in cooperation with the Japanese Government Headquarters for the IDNDR, Aichi Prefectural Government, the City of Nagoya, the Japan National Committee for the IDNDR, and the World Bank organized the IDNDR Aichi/Nagoya International Conference 1993 JAPAN with a focus on disaster management in metropolitan areas, which was held 1-4 November 1993, in Nagoya, Japan.

This record of the conference contains useful and instructive suggestions and recommendations raised at the above meeting. It is hoped that this valuable output will be applied to metropolitan areas around the world in order to reduce risks and mitigate damages from future disasters.

This conference'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 towards the preparation of the conference as well as during its entire programme. We owe a special thanks to all invited experts who presented their papers and comments, raised questions, and assisted in the conference, particularly the session coordinators who also served as members of the Organizing Committee of this conference, staff of the secretariat of the conference comprised of members of the Japanese Government Headquarters for the IDNDR, Aichi Prefectural Government, and the City of Nagoya, and to all participants. We look forward to their continued collaboration in the years to come, especially during the IDNDR.

March 1994

Hideki Kaji
Director, UNCRD/UNDDSMS

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PART 2 PAPER PRESENTATIONS

PART 1

REPORT OF THE CONFERENCE AND OUTLINE OF THE SESSIONS

GENERAL INFOMATION OF THE CONFERENCE

OBJECTIVE

Achieving sustainable growth and ensuring a comfortable and hazard-free life by reducing the risk of damage by natural disasters is a common concern shared by people throughout the world. At the 42nd Session of the United Nations General Assembly in 1987, all countries unanimously adopted a resolution to designate the 1990s as the "International Decade for Natural Disaster Reduction (IDNDR)". The resolution states that the purpose of the IDNDR is to reduce the loss of human lives and property damages caused by natural disasters throughout the world, particularly in developing countries, through concerted international action, and calls on all countries of the world to make every possible effort in preparing for natural disasters and reducing the various damages resulting from them through international collaboration and cooperation. Nevertheless, natural disasters such as earthquakes, floods, and volcanic eruptions have continued unabated, causing serious damage to metropolitan areas in particular.

Many people have been drawn to urban areas for economic reasons in recent years, and disaster preparedness has not caught up with rapid pace of urbanization. As a result, increasing numbers of people are living in areas susceptible to disaster. In developing countries, in particular, disorderly development is accelerating the expansion of slum districts, which, in addition to the self-perpetuating cycle of population growth, population overconcentration in urban areas, and poverty, is increasing disaster vulnerability. Almost every year, developing countries suffer a huge loss of human lives from natural disasters.

Urban social and economic activities are supported by lifeline systems -- including supply, disposal, transportation, and communication -- that encompass broad metropolitan areas. Even if only one part of those systems is disrupted, a tremendous impact is felt throughout the urban area. Moreover, the huge population influx into the city has weakened the urban dwellers' sense of solidarity and belonging and of global citizenship, resulting in ineffectual disaster mitigation activities. Thus, the social transformation that is taking place parallel to urbanization has increased disaster vulnerability.

Urban areas are sites of dense convergence of economic infrastructure and population. Consequently, the damage caused by disasters is not limited to urban areas alone and often spreads over entire nations and even beyond national boundaries. It is therefore all the more important to decrease disaster hazards in major cities. In developing countries, the social and economic damage caused by disasters is much greater than that experienced by developed countries. Among the major political issues, disaster prevention should be afforded a high priority in the interests of sustainable development.

Against this background, the necessity to convene an international conference was recognized to discuss and exchange information on efforts made in metropolitan areas worldwide to undertake research and advance the technology of urban disaster prevention and actual urban disaster prevention projects. By so doing, disaster mitigation measures in the world's metropolitan areas could be expected to be aggressively and efficiently promoted. This led to the organization of the IDNDR Aichi/Nagoya International Conference 1993 JAPAN under the theme of "Disaster Management in Metropolitan Areas."

DATA AND VENUE

1–2 November 1993:	Nagoya Congress Center
3 November 1993:	Field Trip
4 November 1993:	Nagoya Kanko Hotel

ORGANIZED BY:

United Nations Centre for Regional Development (UNCRD)
Japanese Government Headquarters for the IDNDR
Aichi Prefectural Government
City of Nagoya
Japan National Committee for the IDNDR
International Bank for Reconstruction and Development (The World Bank)

WITH THE COOPERATION OF:

The Japanese Red Cross Society
United Nations Development Programme (UNDP)
United Nations Centre for Human Settlements (UNCHS–Habitat)

SUPPORTED BY:

Japan International Cooperation Agency (JICA)
Japan Broadcasting Corporation (NHK)
Japan Newspaper Editors and Publishers Association
The National Association of Commercial Broadcasters in Japan
International Federation of Red Cross and Red Crescent Societies
Department of Humanitarian Affairs (DHA)/IDNDR Secretariat of the United Nations
United Nations Educational, Scientific and Cultural Organization (UNESCO)
Department of Humanitarian Affairs (DHA)/Geneva Office
Economic and Social Commission for Asia and the Pacific (ESCAP)
World Meteorological Organization (WMO)
Gifu Prefectural Government
Shizuoka Prefectural Government
Mie Prefectural Government

OFFICIAL LANGUAGES

English and Japanese

CONFERENCE SCHEDULE AND PROGRAMME

SCHEDULE

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– Plenary Session
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PROGRAMME

1 Nov. (Mon.) Century Hall, Nagoya Congress Center

13:25 **Opening Ceremony**

Addresses by representatives of the conference organizers:
- Morihiro Hosokawa, Prime Minister, President, Japanese Government Headquarters for the IDNDR
- Reiji Suzuki, Governor, Aichi Prefecture
- Takeyoshi Nishio, Mayor, City of Nagoya
- Jiro Kondo, Chairperson, Japan National Committee for the IDNDR/President, Science Council of Japan
- Mohamed T. El-Ashry, Chief Environmental Adviser to the President and Director of Environment, The World Bank
- Hideki Kaji, Director, United Nations Centre for Regional Development (UNDDSMS/UNCRD)

Speech of Guests:
- His Imperial Highness, The Crown Prince
- Olavi Elo, Director, United Nations IDNDR Secretariat

14:15 **Keynote Speech:** "The IDNDR: Its Importance for Metropolitan Areas"
by James P. Bruce, Chairman, The Scientific and Technical Committee (STC) for the IDNDR, Canada

Coffee Break

15:15 **Plenary Session: Worldwide Loss of Life and Property from Natural Disasters**

Chairman: *Kenzo Toki*, Professor, Faculty of Engineering, Kyoto University, Japan

Rapporteur: *Carmen Almedia-Biggart*, Executive Vice-Director for Operations/ Disaster Services Liaison, American Red Cross, USA

Focal Point of the Session *by K. Toki*

Paper Presentations:

"Impacts of Volcanic Eruptions and Earthquakes and Disaster Mitigation Measures in the Philippines"
by Raymundo S. Punongbayan, Philippines

"Trends in Urban Earthquake Hazard and Earthquake Hazard Mitigation in Developing and Industrialized Countries"
by Brian E. Tucker, USA

"Emergency Relief in the Context of the World's Natural Disasters"
by Tadateru Konoe, Japan

Panel Discussion

Summarization of the Session *by K. Toki*

17:15 Closing Time

2 Nov. (Tue.) Conference Room 402–403, Nagoya Congress Center

9:30 **Session 1: Urbanization and Natural Disasters**

Coordinator and Rapporteur: *Yasuo Nishiyama*, Associate Professor, Nagoya Institute of Technology, Japan

Focal Point of the Session *by Y. Nishiyama*

Session 1–1: Increase in Vulnerability Accompanying Rapid Urban Development

Chairman: *Atsushi Takeda*, Director, Earth Science Research, National Research Institute for Earth Science and Disaster Prevention (NIED), Science and Technology Agency, Japan

Focal Point of the Sub–session *by A. Takeda*

Paper Presentations:

"Characteristics of Urban Natural Disaster and Its Scenarios Toward Catastrophe"
by Yoshiaki Kawata, Japan

"Potential Hazards and Vulnerability in Urban Development of Rio de Janeiro"
by Thereza Lobo, Brazil

"Vulnerability Assessment and Its Application in Peru"
by Yoshio Kumagai, Japan

"Socioeconomic and Environmental Impacts of Flood Control Facilities in Dhaka City"
by Mohammad A. Mohit, Bangladesh

"Earthquake Damage Caused by District Differences in Urban Structure: Lessons Learned from the 12 October 1992 Earthquake"
by Sherif H. Kamel, Egypt

Coffee Break

Panel Discussion

Commentator: *Yoshiteru Murosaki*
Professor, Kobe University, Japan

Summarization of the Sub–session *by A. Takeda*

12:30 Lunch

Nov. 2 (Tue.) Conference Room 402–403, Nagoya Congress Center

14:00 **Session 1–2: Urban Planning to Reduce Damage from Natural Disasters**

Chairman: *Hideki Kaji*, Director, UNCRD

Focal Poin of the Sub–session *by H. Kaji*

Paper Presentations:

"Urban Planning Based on Disaster Risk Assessment"
by Itsuki Nakabayashi, Japan

"Cost–effectiveness of Disaster Mitigation in the Development of Metropolis"
by Dusan Zupka, DHA–Geneva

"ViSP –– A New Methodology in Urban Planning and Disaster Management"
by Jukka Nieminen, UNCHS–Habitat

"Introduction of a Vulnerability Assessment System to Development Planning"
by Andrew W. Coburn, UK

"Disaster Vulnerability in the Formal and Informal City: Lessons from Istanbul"
by Ronald S. Parker, USA

"Control of Construction Activities for Disaster Mitigation in Metro Manila"
by Ulpiano P. Ignacio, Jr., Philippines

Coffee Break

Panel Discussion

Commentator: *Takashi Onishi*
Professor, University of Tokyo, Japan

Summarization of the Sub–session *by H. Kaji*

17:00 Closing Time

2 Nov. (Tue.) Conference Room 302–305, Nagoya Congress Center

9:30 **Session 2: Potential Loss of Urban Infrastructures from Natural Disasters**

Coordinator and Rapporteur: *Hiroyuki Kameda*, Professor, Kyoto University, Japan

Focal Point of the Session *by H. Kameda*

Session 2–1: Potential and Early Restoration of Lifeline Facilities, Including Transportation Networks

Chairman: *Fusetsu Takagi*, Professor, Nagoya University, Japan

Focal Point of the Sub–session *by F. Takagi*

Paper Presentations:

"Lifelines in Urban Areas: To What Extent Can Their Importance During Disasters Be Justified"
by Tsuneo Katayama, Japan

"Lifeline Seismic Disaster Mitigation: Research and Implementation"
by Masanobu Shinozuka, USA

"Seismic Damage of Lifeline Facilities and Disaster Prevention in China"
by Sun Shaoping, P. R. China

"Seismic Monitoring and Emergency City Gas Operating Systems"
by Yoichi Yoshikawa, Japan

Damage of Highway and Effects on Passengers/Goods Flow in Disaster Emergency"
by Manuel M. Bonoan, Philippines

Coffee Break

Panel Discussion

Commentator: *Masami Kobayashi*
Associate Professor, Kyoto University, Japan

Summarization of the Sub–session *by F. Takagi*

12:30 Lunch

2 Nov. (Tue.) Conference Room 402–403, Nagoya Congress Center

14:00 **Session 2–2: Disaster Management in Public Facilities, Including Schools and Hospitals**

Chairman: *Naotsune Taga*, Professor, Nagoya University, Japan

Focal Point of the Sub–session *by N. Taga*

Paper Presentations:

"Hospital Functions after an Earthquake Disaster"
by Masanori Izumi, Japan

"Hospital Disaster Mitigation in Latin America and the Caribbean"
by Claude de Ville de Goyet, PAHO

"Cyclone Shelter and Its Multipurpose Use"
by Jamilur R. Choudhury, Bangladesh

"Disaster Protection of School Buildings"
by Badaoui M. Rouhban, UNESCO

"Seismic Damage and Reconstruction of Tangshan City"
by Xie Zongfu, P. R. China

"Island of Civilization; Key to Urban Disaster Mitigation due to Large–Scale Lifeline Functional Failure"
by Haruo Hayashi, Japan

Coffee Break

Panel Discussion

Commentator: *Michel F. Lechat*
Professor, Catholic University of Louvain, Belgium

Summarization of the Sub–session *by N. Taga*

17:00 Closing Time

2 Nov. (Tue.) Century Hall, Nagoya Congress Center

9:30 **Session 3: Local Disaster Management and People's Participation**

Coordinator: *Hiroshi Higashiura*, Deputy Director General, Disaster Relief and Social Welfare Department, Operation Sector, The Japan Red Cross Society, Japan

Rapporteur: *R. B. Singh*, Associate Professor, University of Delhi

Focal Point of the Session *by H. Higashiura*

Session 3–1: Information Control and Disaster Management by Local Administrations

Chairman: *Keizo Okabe*, Professor, Teikyo University
Professor Emeritus, University of Tokyo, Japan

Focal Point of the Sub–session *by K. Okabe*

Paper Presentations:

"The Development of Urban Disaster Prevention in Nagoya City after the Ise Bay Typhoon"
by Nobuyoshi Tsuji, Japan

"Experiences, Strategies, and Courses of Action for the Prevention and Management of Emergencies in Mexico City"
by Efraín de Gyvés, Mexico

"Seoul City's Approaches and Problems in Preventing Metropolitan Disasters"
by Cheong Heung Soo, Republic of Korea

"Recent Earthquake in Maharashtra, India: Uncertainty, Existing Reality, and Task Ahead: A Report"
by R. B. Singh, India

Special Speech Presentation:

"Indonesia Experience in Coping with Natural Disasters"
by H. Soesanto Mangoensadjito, Indonesia

Coffee Break

Panel Discussion

Commentator: *Robert M. Hamilton*
Special Assistant to the Chief Geologist, United States Geological Survey (USGS), USA

Summarization of the Sub–session *by K. Okabe*

12:30 Lunch

2 Nov. (Tue.) Century Hall, Nagoya Congress Center

14:00 **Session 3-2: People's Participation and Disaster Management**

Chairman: *Yoshiro Yanagawa,* News Commentator, Japan Broadcasting Corporation (NHK), Japan

Focal Point of the Sub-session *by Y. Yanagawa*

Paper Presentations:

"Aichi Prefecture's Efforts Against the Tokai Earthquake and Approaches to the Residents"
by Hideji Aoyama, Japan

"Disaster Relief Activities and Problems of Civil Protection Organizations in the World"
by Sadok Znaidi, ICDO

"The Disaster Reduction Role of Government in Enhancing People's Participation"
by Lei Zhiyan, P. R. China

"A Review of Volunteers Relief Activities in San Francisco Following the 1989 Loma Prieta Earthquake"
by Frank T. Blackburn, USA

"Activities of Volunteers in Disaster Management in the Philippines and Their Problems"
by Lourdes C. Masing, Philippines

Coffee Break

Panel Discussion

Commentator: *Naruko Takanashi*
Senior Researcher, The Institute for Future Technology, Japan

Summarization of the Sub-session by Y. Yanagawa

17:00 Closing Time

4 Nov. (Thu.) Nago-no-ma Hall, Nagoya Kanko Hotel

9:30 **Session 4: Recent Research on Disasters and Reducing Disasters**

Chairman: *Takao Takeda*, Professor, Nagoya University, Japan

Rapporteur: *Zhao Bolin*, Professor, Peking University, P. R. China

Focal Point of the Session *by T. Takeda*

Paper Presentations:

"Probability Forecast for Disaster Preparedness"
by Ryozo Tatehira, Japan

"Observation and Forecasting of Heavy Rainfall in China"
by Zhao Bolin, P. R. China

"Remote Sensing and Heavy Rainfall Disasters"
by Takao Takeda, Japan

"Toward the Global Seismic Hazard Assessment"
by Domenico Giardini, Italy

Special Speech Presentations:

"Doppler Radar Network Observation in the USA"
by Yoshi K. Sasaki, USA

"The POSEIDON Project and Its Possible Contribution to Seismic Hazard Reduction"
by Yoshio Fukao, Japan

Coffee Break

Panel Discussion

Summarization of the Session *by T. Takeda*

12:30 Lunch

4 Nov. (Thu.) Nago-no-ma Hall, Nagoya Kanko Hotel

14:00 **Summarizing Session**

Chairman: *Shinjiro Mizutani*, Conference Chairman
Professor, Nagoya University, Japan

Opening Remarks *by S. Mizutani*

Session Report by Rapporteur

Plenary Session: *Carmen Almeida-Biggart*
Executive Vice Chairperson for Operations/Disaster Services Liaison
American Red Cross, USA

Session 1: *Yasuo Nishiyama*
Associate Professor, Nagoya University, Japan

Session 2: *Hiroyuki Kameda*
Professor, Kyoto University, Japan

Session 3: *R. B. Singh*
Associate Professor, University of Delhi, India

Session 4: *Zhao Bolin*
Professor, Peking University, P. R. China

Coffee Break

Discussion

Commentators: *James P. Bruce*
Chairman, STC for the IDNDR, Canada

Claudia H. Candanedo
Head, Department of Hydrometeorology,
Development and Engineering Division, IRHE, Panama

Concluding Remarks *by S. Mizutani*

16:30 **Closing Ceremony**

16:45 Closing Time

OPENING CEREMONY

Opening Address

Throughout human history, natural disasters have resulted in untold casualties and widespread damage.

Today, with the dawn of the twenty-first century approaching, the danger is no less real. Natural phenomena such as windstorms, floods, earthquakes, tidal waves, and volcanic eruptions remain a serious threat to life and property in many parts of the world. Therefore, the United Nations has designated the 1990s as the International Decade for Natural Disaster Reduction and many countries are now engaged in reducing the damage caused by natural disasters through concerted international action.

As one of the few advanced nations to have achieved both economic growth and natural disaster reduction simultaneously, despite being a country geographically vulnerable to natural hazards, and also as one of the main countries proposing the IDNDR, Japan has taken positive actions to promote the IDNDR through international cooperation in the field of disaster prevention. Thus, it is our great pleasure to be sponsoring the IDNDR Aichi/Nagoya International Conference 1993 JAPAN, the fourth such IDNDR conference to be held.

In recent years, many developing countries have undergone rapid urbanization without having implemented sufficient preparations against natural disasters. Their vulnerability has raised fears of the potentially massive loss of life and property that could result if a natural calamity should befall such a city. In developed countries as well, the increased dependence on such lifeline facilities as electricity, gas, and water, coupled with the overcrowding of metropolitan areas, has magnified the risk of an urban catastrophe.

It is, therefore, very appropriate that this conference is being held under the theme "Disaster Management in Metropolitan Areas for the 21st Century." I firmly believe that this conference, by focusing on disaster prevention in urban areas, will provide a timely opportunity for a full exchange of the latest knowledge and experiences toward reducing the tragedy of natural disasters among all countries and regions of the world.

I am confident that this will be a highly productive conference, and earnestly hope that all the participants will continue to promote the IDNDR through the years to come as well.

Morihiro Hosokawa
Prime Minister
President, Japanese Government
Headquarters for the IDNDR

Opening Address

It is my very great pleasure to host the IDNDR International Conference Aichi/Nagoya 1993 JAPAN. We feel very fortunate to have the participation of His Imperial Highness, the Crown Prince and Her Imperial Highness, the Crown Princess, as well as experts in the field of disaster prevention from about fifty countries. To all of you, I extend a most sincere welcome to Aichi Prefecture.

Humanity has overcome numerous natural disasters on its long journey to today's prosperity. As the twenty-first century draws near, however, it is very regrettable that many human lives and much property are being lost from natural disasters that continue to occur around the world.

In the we we world's major cities, where economic infrastructures and populations are densely concentrated, new approaches to minimizing the effects of natural disasters are being sought. It is clear that such cities, which are particularly vulnerable to natural disasters, are likely to suffer extensive damage in the event of a natural calamity.

Aichi Prefecture itself has overcome several serious natural disasters in its history, notably the Nobi Earthquake and the Ise Bay Typhoon. Following a period of dramatic industrial and economic growth, Aichi Prefecture has today become a megalopolis that plays an important role both at home and abroad.

It is therefore truly significant that this conference is being held under the theme of "Disaster Management in Metropolitan Areas for the 21st Century." It is my sincere hope that this conference will achieve resounding success through the exchange of valuable knowledge gained from experience, the sharing of the most recent information, and active discussions on current global disaster-prevention efforts.

I would like to end my greeting by expressing my wish that, through your admirable efforts, this conference will succeed in diminishing the effects of natural disasters while contributing to world peace and security.

Reiji Suzuki
Governor of Aichi Prefecture

Opening Address

On the opening of the IDNDR Aichi/Nagoya International Conference 1993 JAPAN here in Nagoya, I would like to extend my most sincere welcome to all of you on behalf of the more than 2 million citizens of Nagoya.

This marks the fourth year of the International Decade for Natural Disaster Reduction. The theme this year is "Disaster Management in Metropolitan Areas for the 21st Century." It is well understood that when a metropolitan area is hit by a natural disaster, overwhelming and incalculable damage can result. It is therefore our grave responsibility to determine the best methods of protecting the lives and property of our citizens from such disasters. Consequently, it is indeed significant that at this conference, distinguished specialists from around the globe are gathered to discuss disaster countermeasures by exchanging information and conferring on fundamental issues and contemporary topics related to metropolitan areas.

Several serious disasters have stricken the Nagoya metropolitan area, the worst having been the Ise Bay typhoon of 1959, which claimed over 5,000 lives and caused more than 500 billion yen in damage. This was the most severe natural disaster to have occurred in this area since the Meiji era. The city was greatly supported in its reconstruction by the generous donations of aid from other parts of Japan and from many countries.

The Ise Bay typhoon was the event that prompted us to undertake a disaster management initiative. Since then, we have worked continually to protect our city from disaster. Our experiences have inspired us to strengthen disaster countermeasures and to make a greater effort to promote international cooperation for the benefit of people around the world who have suffered from the effects of natural disasters.

Finally, I would like to express my sincere wish for the success of the IDNDR Aichi/Nagoya International Conference 1993 JAPAN.

Takeyoshi Nishio
Mayor
City of Nagoya

Opening Address

On the occasion of the opening of the IDNDR Aichi/Nagoya International Conference 1993 JAPAN, I would like to express my gratitude to Your Imperial Highnesses, the Crown Prince and the Crown Princess, distinguished guests from the United Nations and the Japanese Red Cross Society, and everyone participating in the conference, for their gracious participation.

In 1990, the United Nations designated the 1990s as the International Decade for Natural Disaster Reduction in an effort to minimize, by the year 2000, the damage wrought by natural disasters worldwide. As part of this effort, annual conferences are held on specific themes. The theme for this fourth annual conference is "Disaster Management in Metropolitan Areas for the 21st Century."

The concentration of populations in metropolitan areas is a relatively recent phenomenon common to both developed and developing countries. In extreme cases, the disruption from an urban natural disaster may extend beyond the lives of its citizens to affect the world economy.

In this conference, discussions will focus on urban disaster prevention, particularly on problems connected with the disruption of distribution facilities such as pipelines and roads. Experts on urban disaster countermeasures from fifty countries will participate, sharing information and expertise with their administrative and academic counterparts in Japan. We are confident that all participants will obtain up-to-date information on urban disaster prevention and disseminate this knowledge worldwide.

During the past year, several serious natural disasters have struck. Fresh in our minds was the terrible, almost inestimable damage caused by the large earthquake in a little-known region of India southeast of Bombay. In Japan, we experienced an earthquake and tidal waves off Hokkaido, landslides caused by prolonged rain in southern Kyushu, and severe damage from Typhoon No. 13.

Six years remain before the IDNDR draws to a close. Now almost at mid-point, we must redouble our research efforts to make the coming century more secure for humanity.

In closing, I would like to express my wish for the great success of the conference.

Jiro Kondo
Chairperson
Japan National Committee for
the IDNDR
President
Science Council of Japan

Opening Address

Your Imperial Highnesses, Excellencies, Distinguished Guests, Colleagues, and Friends

The International Decade for Natural Disaster Reduction and the recent United Nations Conference on Environment and Development together highlight two closely interlinked issues -- natural disasters and the environment. Both issues are of the highest priority for the developing countries and, therefore, for the World Bank. Designation of this decade, the 1990s, by the United Nations as the International Decade for Natural Disaster Reduction, recognizes the first coordinated effort to prevent unnecessary losses of life and property from disasters.

Sustainable development as we now understand it, has three essential elements -- economic prosperity, environmental protection, and social stability. All three elements of sustainable development are threatened by natural disasters. Therefore, disaster prevention is now widely accepted by everyone as a key element of sussustainable development itself. And sustainable development is in fact the major challenge facing humanity for the remainder of this century and for the twenty-first century.

Because natural systems and human lives are affected by extreme events (as the recent disasters in India, Turkey, and elsewhere have demonstrated), the World Bank -- as a development institution -- will continue its support for improving the capacity of our member countries to mitigate negative impacts of both natural and technological hazards.

We are particularly concerned because disasters affect the poor the most. And poverty alleviation and improving the welfare of the poor is one of the fundamental purposes of the Bank's policy.

Finally, let me close by assuring you that we strongly support and endorse the objective of this conference and eagerly await your findings and recommendations. We hope to incorporate your results into our policies and operations on disaster prevention and management, and also environmental protection. We wish the conference every success in meeting its important objectives for the entire world community.

Mohamed T. El-Ashry
Chief Environmental Adviser to the President and Director of Environment
The World Bank

Opening Address

Your Imperial Highnesses, the Crown Prince and the Crown Princess of Japan. Distinguished guests from overseas and Japan, Ladies and Gentlemen:

It is indeed a great honor for me to extend a few words at the opening of this most meaningful conference on behalf of the United Nations Department for Development Support and Management Services (UNDDSMS) and the United Nations Centre for Regional Development (UNCRD).

As a member of the United Nations system, the UNCRD has long been concerned with disaster management issues for regional development through technical research work, human resource development, and knowledge dissemination.

Through these experiences, UNCRD has reaffirmed its belief that highest priority of international cooperation for natural disaster reduction should be given to the protection of metropolitan areas which contain the majority of populations and infrastructures for supporting advanced modern societies and their economic activities.

As a consequence of the continued demographic concentration to urbanized areas, there will be approximately sixty mega-cities with a population of over 5 million by the beginning of the next century. If a major disaster were to strike any one of these mega-cities, the effects would be catastrophic with immeasurable losses of human resources and properties. In consideration of this fact, all members of the world community should cooperate with one other in seeking out effective measures and establishing operational programmes to cope with possible future natural disasters that threaten metropolitan areas throughout the world, particularly in developing countries.

With this policy in mind, this IDNDR Aichichichi/Nagoya International Conference 1993 JAPAN has been organized with the collaboration of the Japanese Government Headquarters for the IDNDR, Japan National Committee for the IDNDR, Aichi Prefectural Government, the City of Nagoya, the World Bank, and UNCRD.

Ladies and gentlemen, I do hope that this international conference will serve in producing significant results which may serve as the basis of discussions at the upcoming World Conference to be held in May next year. I would like to conclude my address by encouraging your active participation in this conference so that we may together realize fruitful results that will contribute to the creation of a less hazardous world.

Hideki Kaji
Director
United Nations Centre for Regional Development
UNCRD/UNDDSMS

Speech of His Imperial Highness, The Crown Prince

I am pleased to welcome the many people from around the world who have gathered here today to participate in the IDNDR Aichi/Nagoya International Conference 1993 JAPAN.

The International Decade for Natural Disaster Reduction, which was declared by the resolution of the 42nd United Nations General Assembly, is now in its fourth year. I am told that this conference is but one of many forms of disaster prevention activity being conducted around the world for the purpose of reducing disaster damage through international cooperation.

In spite of such activity, this year too has seen many large-scale natural disasters throughout the world, including Japan -- torrential rains, flooding, earthquakes -- resulting in the loss of precious human life and property. I would like to take this opportunity to offer my heartfelt sympathy to those who have been the victims of these disasters.

It is said that the damage from natural disasters is particularly great in metropolitan areas, because of the high population density and the concentrated economic infrastructure in such places. This Conference will place special emphasis on "Disaster Management in Metropolitan Areas." I sincerely hope that Japan and other countries of the world can pool their priceless experience and knowledge through discussion and research, to advance the cause of international cooperation.

Finally, I also hope that the International Decade for Natural Disaster Reduction will provide the occasion for the nations of the world, in preparation for the twenty-first century, to work together ever more closely for the prevention of disaster and the reduction of disaster-related damage.

Congratulatory Speech

Your Imperial Highnesses, distinguished organizers of the conference, ladies and gentlemen,

It is a great honor for me to address this inaugural session of the IDNDR Aichi/Nagoya International Conference on Disaster Management in Metropolitan Areas for the 21st Century, and to represent the United Nations, Department of Humanitarian Affairs, and the IDNDR Secretariat.

I am particularly pleased to be here because of the strong interest and support of the Japanese Government and Japanese people to the work of the United Nations. I should like to express our sincere gratitude for this leadership and support of Japan.

The presence here today of the members of the Imperial Family signifies the strong commitment of Japan. I trust that this commitment will continue and find new, increasingly significant avenues in future. We are prepared to work in close cooperation with Japan to make the plans of today materialize tomorrow.

The orientation of this conference is future. It is in the rapidly growing metropolitan areas of today and of the twenty-first century, where disaster reduction activities will have to be intensified, to protect our assets, the results of development, and to protect the lives of the ever-increasing numbers of families, many living in urban slums vulnerable to disasters.

Therefore, I should like to congratulate the organizers of this conference for the initiative: the Government of Japan, Aichi Prefectural Government, the City of Nagoya, Japan National IDNDR Committee, the World Bank, the United Nations Centre for Regional Development as well as the many scientists in the planning committee and the promoting committee members.

We have among the speakers and participants many members of the IDNDR Scientific and Technical Committee and representatives of the UN system and voluntary sector, notably the Red Cross. Many of us are deeply involved in the preparatory work for another very important event, the World Conference on Natural Disaster Reduction which, at the invitation of the Government of Japan, will take place in Yokohama in May next year. This conference in Nagoya/Aichi will undoubtedly have a profound effect on next year's conference and on the future direction of the decade in enhancing disaster reduction through the sharing of information, knowledge, experiences, and the results of science and technology. We shall all help to make a safer world for the 21st century.

I wish the conference every success.

Olavi Elo
Director
United Nations IDNDR Secretariat

KEYNOTE SPEECH

"The IDNDR: Its Importance for Metropolitan Areas"

James P. Bruce
Chairman, Scientific and Technical Committee (STC), IDNDR, Canada

At the United Nations Conference on Environment and Development held in Rio de Janeiro in June 1992, leaders from many countries assembled to sign "Agenda '21," an environmental statement focused on the twenty-first century. At that conference, natural disasters were referred to as problems involving the atmosphere, water, desertification, and oceans.

Urban development was studied as an issue of human settlement in disaster-prone areas, especially in section 7, "Development of Sustainable Human Settlements." In a similar context, special attention was also given to the issue of large cities in the UN's International Decade for Natural Disaster Reduction.

It is significant that the issue of disaster prevention is being taken up as part of the "Development of Sustainable Human Settlements" in Agenda '21 because the cities of the world are vulnerable to natural disasters.

Hurricane Andrew rushed through Miami and southern Florida in 1992 causing damages of approximately US$20 to 25 billion. Such extensive damage was the result of the rapid development of the coastal areas of Florida since the 1940s.

The world population is heavily concentrated around coastal areas, leading to a situation in which coastal cities are more vulnerable than ever to damage from tropical cyclones, tsunami, and storm surges.

Even though such cities as Tokyo, Mexico City, and San Francisco lie in seismic zones, their development continues. Moreover, the risk of damage from flooding is increasing in areas such as Manila, the Philippines; Lagos, Nigeria; and Accra, Ghana because many houses and buildings are being built illegally along diversion channels that carry strong currents following rainstorms.

There are some aspects of urbanization that make it possible to reduce the damage from natural disasters. For example, large cities, as opposed to smaller local cities, are equipped with many services, such as hospitals, ambulances, electricity, waterworks, and educational institutions that are able to educate the populace about disaster prevention, thus giving the larger cities an advantage over small local cities. However, although some effort to prevent damage from disasters is being made in developing countries, sufficient countermeasures are hampered by overconcentration of population, an increasing number of dangerous buildings, environmental disruption such as the removal of vegetation, and the compounded effects of natural and artificial disasters.

A significant issue for the IDNDR is to mitigate urban disaster vulnerability in developing countries by applying the benefit of the experience of developed countries.

The populations of the world's cities have been increasing at a rate of 4 per cent per year since 1990 while the global population has been increasing at a rate of 1.7 per cent per year, resulting in a situation in which the populations of the world's cities are growing at twice the rate of the global population. As well, urban populations in the developing countries are increasing at three times the above figure, creating a scenario in which urban populations in the developing countries will have increased by about 50 per cent by the year 2000.

Mega-cities are also found in developing countries, and one estimate states that of the twenty cities likely to have populations in the tens of millions by the year 2000, seventeen are in developing countries.

Since populations are becoming concentrated in cities, the risks from natural and artificial disasters are increasing. Ninety-five per cent of deaths from natural disasters occur in developing countries representing two-thirds of the global population. Since the urban population in developing countries is increasing at a significant rate, this issue is becoming increasingly serious.

When damage from natural disasters is studied in terms of economic loss, the losses of developed countries can be said to be higher in absolute terms. However, the effect on individual countries cannot always be measured in purely monetary terms. For example, the drought in southern Africa in 1992 caused losses of US$1 billion, but the drought's influence upon the economic development of the region was much greater than the US$25 billion in damage wrought by Hurricane Andrew.

There are three general categories of natural disasters that cause many deaths: drought, geological disasters, and hydrometeorological disasters. Of these, hydrometeorological disasters and drought account for a large proportion of victims.

Meteorological disruption caused by global human activity has recently been giving rise to public debate. It is said that there is a relationship among the El Niño effect, unusual weather, and the greenhouse effect. The possibility exists for further increases in the El Niño effect. In addition, the rise in the sea level is a very important issue, since this is said to cause tsunami when cyclones or typhoons occur.

I would like to suggest that we consider what we can do within the framework of the IDNDR, and what is now available for us to reduce the vulnerability of cities to natural disasters. In developed countries, many countermeasures, such as limits on development, disaster prevention, and geographical preservation are successfully planned and carried out in order to mitigate the influence of natural disasters. In developing countries, such countermeasures must also be implemented from now on in line with the specific needs of the objective areas.

The IDNDR believes that we should provide developing countries with an international framework and investment to encourage sustainable development.

One hundred and ten scientific and technological committees have already been established for the IDNDR worldwide, and Red Cross organizations, government agencies, and private sector groups are becoming involved.

The IDNDR is already under way, allowing us to anticipate urban disaster mitigation projects. One hundred and twenty-five IDNDR projects have already been registered in the Geneva office of the IDNDR, of which twenty-five are endorsed by the Scientific and Technical Committee as international collaboration projects. Of these, some projects follow the 1993 IDNDR theme, "Stop natural disasters by focusing on schools and hospitals".

For future IDNDR activities, 1994 will be an important year. The "World Conference on Natural Disaster Reduction" will be held in Yokohama, Japan in May 1994. The UN General Assembly will also verify the progress made to date to prepare for the remaining five years of the IDNDR.

The upcoming conference in Nagoya will focus upon possible disasters in mega-cities. This will send a strong message to next year's world conference. Careful consideration should

be given to the deliberations in Yokohama, and the IDNDR's remaining five-year programmes. By carrying out IDNDR activities while giving preference to those countries vulnerable to natural disasters, it will be possible to ensure a safer world for humanity in the twenty-first century.

PLENARY SESSION

WORLDWIDE LOSS OF LIFE AND PROPERTY FROM NATURAL DISASTERS

Coordinator/Chairman:
Kenzo Toki
Professor, Faculty of Engineering, Kyoto University

Rapporteur:
Carmen Almeida-Biggart
Executive Vice-Director for Operation
Disaster Service Liaison, American Red Cross, USA

Focal Point of the Session by K. Toki

Various conferences and meetings were held prior to and following the commencement of the IDNDR at which the importance of disaster estimates and the meaning of disaster prevention were discussed. However, the importance and effect of these conferences and meetings have not yet been made clear. One of the reasons is that definite numbers are not available.

Before the inauguration of the IDNDR, Frank Press of the United States National Academy of Sciences, an advocate of the IDNDR, called on possible members for aid, and encouraged discussions to reach some decision. Although it was attempted to establish specific numerical targets as those of the IDNDR, our efforts did not meet with success due to various difficulties. This could be as a result of definite numbers not being available for the IDNDR, and the feeling of it being necessary to set targets.

Against this background, discussions focused on disasters using definite values and numbers as much as possible in this session. Since disasters involve a number of difficult aspects, including social problems and human group configurations that are difficult to grasp, it was felt that all possible efforts should be exerted in this session.

Paper Presentations

"Impacts of Volcanic Eruptions and Earthquake and Disaster Mitigation Measures in the Philippines"

Raymundo S. Punongbayan
Director, Philippine Institute of Volcanology and Seismology (PHIVOLCS), Philippines

There are various deformations under the earth's crust in the Philippine Archipelago. Many volcano groups are also concentrated at the surface on the east and west sides of the Archipelago. There also exist "slip-ins" of the earth's crust and large faults. These Philippine faults are liable to cause earthquakes such as the one that occurred in July 1990. This condition of the earth's crust represents a significant cause of earthquakes in the Philippines.

The earthquake in August 1976 killed 3,739 inhabitants, and the one in July 1990, 1,200. The former caused a 5 m tsunami that killed many people. The Philippines have many areas vulnerable to tsunami. Every earthquake near the Philippines is soon followed by a tsunami.

The public must realize that we do not have enough time to issue alerts. We are attempting to educate the community while cooperating with the local mass media.

Although no eruption of Mt. Pinatubo had ever been recorded, it was recognized as an active volcano before its eruption. In addition, although continuous, adequate monitoring had not been carried out, we learned of various warning signs from the volcano.

An earthquake monitoring network and a hazard map were created that enabled us to forecast the danger that would result from Pinatubo's eruption. Areas possibly exposed to pyroclastic flows in particular were represented on maps, and distributed to the proper communities. This helped to reduce the number of deaths due to the pyroclastic flow.

Each of the eruptions killed fewer than 2,000 people in most cases. For example, 300 people were victims of the Pinatubo volcano. Not all deaths were a direct result of the Pinatubo eruption; some people were killed by buildings that collapsed from the weight of accumulated ash on the roof; some were killed by aftershocks following the eruption. The number of victims totaled 300, including deaths that occurred some time after the eruption.

Looking to the relationship between the actual and forecasted pyroclastic flow areas, we assumed that the channels would be lahar paths, an assumption that helped to reduce the number of victims since in fact the lahar ran along the anticipated channels.

The eruption of Pinatubo started on 9 June, blowing up to about 125 km. The eruption blew off part of the volcano, leaving craters. It also generated many pyroclastic flows that flowed through the forests.

We produced pyroclastic flow danger maps in May 1991 that enabled us to recommend to the people to evacuate from the dangerous zones, saving many lives.

Through the lessons learned from various earthquakes, we compiled a Philippines Earthquake Map that forecasted the locations of possible liquefaction and landslides following earthquakes of magnitude 7 or higher.

A hazard map for mitigating damage in the event of a volcanic eruption was also produced. When we examined the Majorn Volcano Hazard Map, we found that there are cities at the centre of the hazard zone; moreover, these cities are being allowed to develop northward. Although we indicated to policy makers that Majorn would erupt at some time, they did not listen to us. The February eruption, which was not large, killed seventy-seven inhabitants in the danger zone with heat.

We have forewarning of a possible re-eruption of Pinatubo. We are forecasting areas that would be affected by any pyroclastic flows and areas that would be affected by any lahar flows, and we are conveying this information to policy makers. Since eruption forecasts involve much uncertainty, policy makers are not eager to heed them. Good communication in some form between scientists and politicians must be achieved in the future.

"Trends in Urban Earthquake Hazard and Earthquake Hazard Mitigation in Developing and Industrialized Counturies"

Brian E. Tucker
Director, GeoHazards International Oyo Pacific, USA

The urban earthquake threat is greatest in developing countries. Nevertheless, most efforts to mitigate disaster damage concentrate on the needs of developed countries. In view of this discrepancy between countries in which efforts are made to mitigate earthquake damage

and countries in which the earthquake threat actually exists, I would like to present some conventional and new techniques to correct this situation.

Before comparing the urban earthquake threat between developing and developed countries, the terms must be defined. Looking at the classification of cities, we find that expressions such as "cities in developed countries" and "cities in developing countries" are incorrect. Despite being situated in a developing country, a city may be highly developed; the level of urban development varies with time.

"Earthquake threat" indicates a case in which a city lies within 200 km of a fault that may generate an earthquake of magnitude 7.

We studied the world's fifty largest cities, referring to them as urbanized areas. In the 1950s, the total population of these fifty cities accounted for one-fifth of the global population; by the year 2000, it will account for only one-sixth.

When we studied the extent to which the populations of these fifty cities are exposed to earthquake threat, it was found that, while one in four persons in these fifty cities was earthquake-threatened in 1950, one in two will be earthquake-threatened in 2000.

In the 1950s, 60 per cent of the world's largest earthquake-threatened cities were in developing countries; in the year 2000, 90 per cent of the world's largest earthquake-threatened cities will be situated in developing countries. This is a significant problem in developing countries; the number of victims from earthquakes in developing countries surpasses that of developed countries.

The economic influence of earthquakes is increasing more in developing countries than in developed countries. Earthquakes caused billions of dollars in losses over the last three decades, and losses have multiplied fourfold. Moreover, the majority of resources devoted to earthquake loss mitigation is focused on developed countries.

Only about 2 per cent of the world's earthquake hazard mitigation research and development has been focused on developing countries; the remaining 98 per cent has been concentrated on developed countries. Although efforts to mitigate earthquake damage have not changed in the past few decades in developing countries, various efforts have been attempted in developed countries.

Conventional assistance bodies include overseas disaster assistance agencies in various countries, such as ODA in the UK; JICA in Japan; and AID in the US; these bodies are willing to give a helping hand to affected countries, but their budgets may have been reduced since the Cold War ended.

Priorities for assistance extended by overseas assistance agencies in different countries are determined by the countries concerned. Since such priorities have not been established consistently or systematically, consistent benefit from assistance cannot be predicted.

In order to stimulate research into disaster mitigation in developing countries, I have come up with some unusual resources for funding.

I would like to propose the establishment of charity funding by private organizations. Such funding would assist efforts toward disaster prevention in cities exposed to earthquakes in developing countries. Various agencies would receive a subsidy according to donor funding.

New resources for funding and international cooperation must be established in order to curb the human and economic losses of developing countries. In this way, the burden on

leaders and on the public in earthquake-threatened cities will be lightened. Since these cities will be exposed to higher risks, it must be fully understood that conventional assistance from abroad can no longer be relied on and assistance must be made through these new channels.

"Emergency Relief in the Context of the World's Natural Disasters"

Tadateru Konoe
Vice-President, The Japanese Red Cross Society, Japan

The number of events and victims of large-scale disasters that have attracted the attention of international relief agencies have been increasing considerably over the last two to three decades. UN statistics tell us that the number of deaths from natural disasters was 1 million through the 1970s and 2 million through the 1980s; while the number of people affected was 300 million through the 1970s and 500 million through the 1980s.

The International Red Cross Society is now providing relief for about 10 to 20 per cent of those affected. The frequency of requests for relief placed by various countries to the International Red Cross Society was once every two weeks in the 1970s, once every ten days in the 1980s, and once a week in the 1990s.

People in developing countries make up the overwhelming majority of those affected; the potential number of victims is estimated at 1 billion, or 20 per cent of the global population. The majority of developing countries are, at the same time, countries in which natural disasters occur frequently. These countries, therefore, are caught in a vicious circle: they cannot take advantage of opportunities for development due to poverty and, also due to poverty, they cannot overcome their vulnerability to disasters.

The tendency toward frequent disasters has been accelerated by the newly emerging problems of the post cold-war era, such as social and political turmoil, economic failure, ethnic and religious struggles, and increasing numbers of refugees. The causes and effects of disasters have become interwoven in a complex manner, giving rise to "complex emergencies" that cannot be classified simply as natural or artificial disasters by conventional classification methods.

The number of complex emergencies has increased by 35 per cent in two years from 1991 to 1992. The number of refugees, including internal refugees, has doubled in the last decade, with the result being that one in 134 of the global population, or about 37.5 million people, are now considered refugees or internal refugees.

The end of the Cold War has enabled the international community to coordinate humanitarian efforts, such as disaster relief. However, a "humanitarian gap" has arisen between the relief on offer and the problems which international agencies face in attempting to meet everincreasing humanitarian needs, such as difficulty in securing financial resources, barriers in the name of national sovereignty, worsening security conditions, and shortages of relief funding for growing needs.

Many problems remain to be solved before "humanitarian intervention" is established as an international rule. These problems include the nationalistic mentality that sees relief efforts as a form of foreign intervention, lack of transparency of the basis and criteria for intervention, opposition by the government and citizens of recipient countries, increasing costs, and the influence of intervention stressing efficiency.

Since international assistance involves a tendency for charitable activities to be extended from developed countries to developing countries, the objective, content, and scale of assistance tend to be affected by such issues as domestic affairs and the level of concern. These

all have a bearing on the purposes of the donor country itself, giving rise to forced assistance, competition among various forms of assistance, and other problems. In an effort to correct such situations, international regulations and systems for assisting another country were put forth in the early 1970s. International cooperation in strengthening disaster prevention in order to assist the serious self-help efforts of recipient countries also focused on improving awareness of disaster prevention, compiling relief plans, requesting staff assistance, and assistance projects in both the tangible and non-material aspects of disaster prevention.

Disaster relief activities for developing countries should not be limited to after-the-fact efforts to treat only the effects of disasters. Projects designed to limit vulnerability to disasters must also be attempted, including those to prevent environmental disruption that may trigger a disaster and integrated development of farm villages to improve the lifestyles and health of the inhabitants.

Recent earthquake damage, particularly in mega-cities, does not represent a problem of ensuring public hygiene, drinking water, food, and the like; instead, it requires vast amounts of money and much labour for the rehabilitation of lifelines, houses, and infrastructure, resources that exceed the capacity of the recipient government. Since every relief effort is naturally limited by the contributions of the international community, the content and manner of providing assistance must be balanced in terms of disaster prevention, emergency relief, and rehabilitation to ensure high levels of rationality and cost-effectiveness.

A series of grave situations, such as complex emergencies, a humanitarian gap, and humanitarian intervention, can be said to be the price we must pay for peace as a result of the end of the Cold War. The conventional paradigm of international relief in the Cold War era no longer applies. International society is now groping for a new order. By reviewing the humanitarian missions originally devoted to assistance at the IDNDR -- the first example of a global effort toward issues common to all humanity since the end of the Cold War -- and by reviewing the economic role the IDNDR can perform, we can contribute on a grand scale toward the formation of a new international order.

Discussion

Following the paper presentations, the chairman commenced with the floor discussion. The coordinator and three speakers participated as panelists. Details of the discussion were as follows.

Andrew W. Coburn

It takes a long time before the effects of international aid become visible. Therefore, since the effects of continued aid are not immediately apparent, the situation becomes difficult for donor countries. This might, however, be a good occasion for developed countries, after the end of the Cold War, to stabilize other political powers and political activities in order to obtain an unobstructed view of the future. Technology transfers have not yet been carried out in a desirable manner. How can future international aid work positively in areas of disaster prevention?

Brian E. Tucker

Although the United States was occupied with the Cold War, countries such as Finland, the Netherlands, Sweden, and Switzerland provided aid in a very positive manner as neutral powers during this period. This suggests that aid will not be affected by the end of the Cold War.

The pressure of international public opinion was mentioned during the session. Isn't it possible to gauge the need for aid according to rising international public opinion?

Tadateru Konoe

I have focused primarily on complex emergencies. These are a new phenomenon following the end of the Cold War. It is also a fact that the number of natural disasters is increasing. The need for funding for emergency relief will increase.

One major issue will be finding out where we can obtain the funding for such relief activities. In northern European countries, which have so far been enthusiastic in funding international aid, the use of ODA budgets is now being discussed as a primary source of such funding.

Although prospects for increased disaster prevention funding are negative at present, establishing a UN power framework for international aid to mitigate complex emergencies would decrease the risk of disasters due to complex emergencies. Arms reduction would proceed in parallel with this.

Raymundo S. Punongbayan

The results of talks among scientists are now represented as multi-sector coordination. In the Philippines, no talks are held between scientists and policy makers, leaving scientists from various sectors to talk among themselves.

Although we do not know when Mt. Pinatubo will erupt next, another eruption is forecast. We are appealing to the policy makers and decision makers accordingly. We are also holding meetings and trying to impress upon the policy makers that these are danger zones and that no one should inhabit these zones.

However, we have received no reply from the policy makers. Educating politicians at the highest levels is an important issue for us.

Tadateru Konoe

Certainly, a complex emergency is now understood to be a situation in which disputes and natural disasters are combined. However, this concept can be taken in a wider context. When a complex emergency is taken to be a disaster involving both artificial and natural disasters, other disasters can be said to be complex emergencies, such as those compounded by technological or industrial situations, those due to environmental disruption, and those due to population increase.

When a natural disaster is caused by a natural disruption, it cannot be assumed that the disaster was caused only by natural phenomena. In such a context, I think that the concept of a complex emergency could be widened in scope.

Relief activities made with the parachute approach -- the Gulf War was an example -- that focus upon recipient countries, impose a substantial negative burden from the viewpoint of IDNDR activities upon the international community. In this connection, I feel the same misgivings as the questioner. Certainly, allowing the international community to press stopgap relief activities upon recipient countries with no definite rules or principles would make it difficult for these countries to promote independent relief activities at the local or national levels. In order to avoid such a situation, I would propose the establishment of rules governing international humanitarian intervention.

Tsuneo Katayama

I think the discussion at this session is heading towards two extremes; namely, international programmes or problems, such as those at the political, national, or international levels on one hand, and human problems or problems related to individuals on the other. There should be a bridge between these issues at both the international and individual levels.

What we should do now is to come to grips with programmes or countermeasures within our reach, and not try to jump suddenly to grand projects.

Mr. Kubota

I represent one of the organizers of the IDNDR Aichi/Nagoya International Conference 1993 JAPAN. The effect of our activities would be limited if we relied solely upon activities at the UN or national levels in order to enhance international cooperation for the IDNDR.

The importance of activities by NGOs and international cooperation at the regional level has been pointed out at environmental conferences. Various multilevel channels must be used in order to enhance these international activities. In addition to national and UN-level activities, multilevel channels such as local governments, individuals, and scientists must be utilized.

SESSION 1

URBANIZATION AND NATURAL DISASTERS

Coordinator/Rapporteur:
Yasuo Nishiyama
Associate Professor
Faculty of Engineering, Nagoya Institute of Technology, Japan

Focal Point of the Session by Y. Nishiyama

Many factors have contributed to the evolution of cities, including demographic currents, cultural transitions, technological innovation, changes in values and social norms, and shifts in political structures. The goals of urban residents are convenience, efficiency, and economy, and urban planning was considered a means of achieving these goals.

However, these goals are dependent upon the stability of daily life during peaceful times. Ensuring safety during emergencies has not been a prime consideration. Major cities where populations, resources, and capital are densely concentrated are highly susceptible when hit directly by a large-scale natural disaster. Urban planning should be required to devise and implement disaster prevention and land use in preparation for emergencies.

This session is divided into two parts: "Increase in vulnerability accompanying urban developments" in the morning and "Urban planning to reduce damage from natural disasters" in the afternoon. Consideration of disaster prevention and administrative measures to mitigate disasters will be discussed.

Participants are encouraged to focus not on general, abstract discussions, but rather on the exchange of opinions on concrete matters while learning from specific disaster experiences of other nations.

Session 1-1: Increase in Vulnerability Accompanying Rapid Urban Development

Chairman:
Atsushi Takeda
Director
Earth Science Research, National Research Institute for Earth Science and Disaster Prevention (NIED), Science and Technology Agency, Japan

Commentator:
Yoshiteru Murosaki
Professor
Department of Architecture and Environmental Planning
Kobe University, Japan

Focal Point of the Sub-session by A. Takeda

The recent rapid and heavy concentration of populations in many developing countries has prevented city administrators from formulating appropriate disaster-prevention plans. Many cities have been left vulnerable to disaster through the implementation of uniform

urbanization programmes that disregard local differences in disaster risks, as well as the risks inherent to each specific region. Risks in cities have intensified specifically through the emergence of settlements in high-risk areas, the wholesale transplantation of urban technology from developed countries, the delay in infrastructural improvement, and the loss of a sense of community. Moreover, these factors have damaged not only physical environments, but also the societies and economies of developing countries. The extent of these problems may be endangering the economic foundations of these countries.

Topics for the morning session will cover the kinds of risks existing in mega-cities and how these risks lead to urban damage in tandem with changes in urban activities and urban development. Information will also be exchanged on the impact of urban disasters.

Paper Presentations

"Characteristics of Urban Natural Disaster and Its Scenarios Toward Catastrophe"

Yoshiaki Kawata
Professor, Research Center for Disaster Reduction Systems
Disaster Prevention Research Institute, Kyoto University, Japan

Approximately 45 per cent of the world's population now lives in urban areas. The figure reaches 72 per cent in Japan, with the cities being almost saturated. In developing countries, however, these figures fall to around 37 per cent, leaving room for future population concentration. In 1900, only eleven metropolitan cities had populations of over 1 million. In the year 2000, there will be over 400 such cities. Twenty-eight mega-cities, with populations of over 8 million, will emerge by that date, with twenty-two of them in developing countries. Therefore, urban disaster issues will dramatically increase in gravity.

Disasters in metropolitan cities have two characteristics: first, they may lead to secondary or even tertiary disasters and prolonged reconstruction periods; and second, they are highly vulnerable to the huge external forces that occur at intervals of 100 to several hundred years. In other words, they are vulnerable to low-probability disasters with severe consequences. Furthermore, large cities face serious problems from an increase in newcomers who are uninformed about past disasters in their new hometowns or about the characteristics of such disasters. As well, such cities are vulnerable to the effects of disasters on highly information-reliant societies.

Although high technology provides people with conveniences, modern facilities are very vulnerable to earthquakes and floods. It is likely that large, dense populations will result in magnified disaster damage. Furthermore, the dual structure of cities, such as the coexistence of modern facilities and slums, will dramatically change the nature of disasters.

Urban disasters have three distinct categories: urbanization disasters (disasters that occur due to enlarged living spaces and infrastructure); urban-infrastructure disasters (destruction of infrastructure, particularly lifeline systems, but with less loss of human lives); and urban disasters (disasters magnified by the overconcentration of population and social capital).

There is a clear interrelation between Japan's prefectural income and average life expectancy. Average life expectancy as a social index is one factor denoting the disaster-reduction capability of a society.

The mortality rate from natural disasters has been falling annually in Japan -- deaths per disaster do not exceed 300. This statistic may dramatically increase, however, if an urban disaster occurs.

There are many scenarios for heavy disaster casualties. For instance, if an earthquake destroys sea walls, areas below sea level will be submerged even before tidal waves arrive. Such areas total as much as 124 km^2 in Tokyo and 60 km^2 in Osaka. Liquefaction of the ground can cause earthquake-driven floods. Underground gas tanks can explode. Destruction of storage tanks of other flammable substances such as petroleum combined with simultaneous earthquake-driven flooding may spread fires over a wide area. Commuter panic during a rush-hour period is another risk. These are scenarios that can greatly magnify disaster damage. Whether damage will occur through these particular scenarios is uncertain, as is the process of how an external force leads to particular types of damage. This uncertainty is a problem.

If a society's disaster reduction capability is measured by average life expectancy, it is more important to formulate anti-disaster strategies than to build disaster prevention facilities in the developing countries of Asia, Africa, and Latin America where the average life span is below sixty years. For industrializing and industrialized countries, disaster-prevention strategies are all the more important.

"Potential Hazards and Vulnerability in Urban Development of Rio de Janeiro"

Thereza Lobo
Consultant/Director
Center for the Study of Public Policies, The World Bank, Brazil

Rio de Janeiro is a beautiful and world-renowned city. Natural beauty is one of Rio's most vulnerable assets. The tendencies toward overuse and irresponsibility are factors in the destruction of cities. To avoid them, sustainable development is the only solution. We need to implement development that allows coexistence with the ecosystem. It is important to promote education toward sustainable development. The development of cities in Brazil has proceeded quite rapidly, as in other parts of the world. Since the 1950s, urbanization has rapidly advanced. In the 1990s, 70 per cent of the population now live in urban areas. In the twenty-first century, over 80 per cent will be concentrated in urban areas.

Another problem in Rio is that there is a slum district known as *favelas*. Such slums have also increased dramatically, a result of uncontrolled urban expansion.

We have been very fortunate regarding natural disasters. We have neither volcanoes nor hurricanes. The physical characteristics of the city, however, present an interesting paradox of both beauty and environmental risks. Man-made disasters are, in fact, more prevalent than natural disasters in Rio.

There are two aspects to this: one is the increase in the number of poor; the other is the inadequate functioning of the public sector. The poor not only concentrate in urban areas, but poverty is also increasing more among the urban population than among rural residents. This has resulted in a lowered living standard in the major cities.

The causes of the inadequate functioning of the public sector are a distorted development strategy and unsuccessful urban planning. To date, there has been no analysis of the impact of environmental costs. Exploitation of natural resources and uncontrolled development have continued and cities have expanded through environmental destruction.

Local governments have not had sufficient authority to manage adequate public facilities or to implement public policy. Comprehensive decisions that consider the above points have not been produced in the decision-making process.

Macroeconomic restrictions are also significant. For example, although Brazil is one of the largest countries in the world, it suffers from a high inflation rate. All macroeconomic

adjustment policies carried out during the past decade have failed. Moreover, several political scandals have occurred. These political and institutional problems have had effects worse than the earthquakes that have struck our country.

"Vulnerability Assessment and Its Application in Peru"

Yoshio Kumagai
Associate Professor, Institute of Socioeconomic Planning
University of Tsukuba, Japan

The Grau region of Peru is an earthquake-prone area. Large-scale earthquakes hit this area roughly every 100 years. As well, the El Niño weather phenomenon regularly brings heavy rains. Recently, for example, an area with an average annual precipitation of about 60 mm received more than forty times this amount in 1983 due to a large-scale El Niño phenomenon. Southern Peru, however, was stricken by a severe drought at that time. It was reported that the annual average temperature of the capital, Lima, rose 5°C.

The Grau Region is the first area to be involved in a decentralization scheme begun in 1988. A pilot study was carried out to determine disaster countermeasures for local governments with the aim of formulating a national programme for disaster prevention and mitigation. The goal is to implement, in a wide sense, microzonation in this region, considering both natural disasters and socioeconomic conditions. A more comprehensive, advanced, and detailed socioeconomic development plan based on the results of this study will be needed.

This project included the Lima metropolitan area. Some 8 million people, or nearly one-third of Peru's population, are clustered in this area. Most of the population increase occurs among those living in the surrounding slum districts and in the central buildings built during the Spanish colonial period. In some cases they are illegal squatters.

Lima has suffered from several destructive earthquakes. A hazard map indicating the earthquake vulnerability of buildings is posted on each block in the city centre. Individual plans for building improvement will be implemented according to this map.

Among the most important and useful advice for Peru and other developing countries is to apply the macrozonation method. With this method, we can clearly define safer areas for urban expansion, substantially reducing infrastructure construction costs.

A major challenge for developing countries is, however, the lack of detailed data. In Japan, for example, many technological supports use such detailed data. We need to develop a new method utilizing comprehensive data. Urban renewal of existing metropolitan areas is of course necessary, but it is also important to formulate relocation plans (although several such plans have already been made in Peru) to define suitable locations beforehand.

In Japan, both structural and non-structural countermeasures are carried out simultaneously when disaster countermeasures are implemented. However, it is very difficult for developing countries to take structural measures first. Placing priority on non-structural countermeasures -- including disaster education for citizens -- can be considered one option for developing countries.

"Socioeconomic and Environmental Impacts of Flood Control Facilities in Dhaka City"

Mohammad A. Mohit
Associate Professor, Department of Urban and Regional Planning
Bangladesh University of Engineering and Technology (BUET), Bangladesh

In 1988, Bangladesh experienced a devastating flood that inundated 58 per cent of the area of the country and caused property losses totaling US$1.3 billion. In the city of Dhaka alone, it was estimated that 77 per cent of the total area was submerged and about 60 per cent of the city's population was directly affected. The misery caused by the flood created a global awareness of flood-management problems in the country. In the wake of the flood, the government at the time appointed a Committee for Flood Control and Drainage Plans in order to protect investments in the city. It was decided that sixteen programmes would be implemented in two phases.

Eight flood-control programmes were submitted and US$142 million was budgeted. Of this, 77 per cent was spent for constructing embankments. Almost all the programmes in Phase I have been completed. Newly constructed embankments are having a social, economic, and environmental influence on Bangladesh.

Construction of the embankments has resulted in the following confirmed positive influences. They have (1) given the people a sense of security; (2) facilitated population movements; (3) facilitated land utilization and improved accessibility; (4) expanded services; (5) increased employment; and (6) increased land prices.

Among the socioeconomic effects, however, we discovered the following negative impacts: (1) human relocation problems at construction sites; (2) disruption of many activities due to the construction of embankments; and (3) adverse effects on farmland.

We implemented an environmental impact assessment that led to the submission of short-, medium-, and long-term programmes and policies.

As short-term programmes, (1) water-drainage facilities are needed immediately where water is landlocked by embankments; (2) perfect walls need to be built; (3) internal drainage is needed within the city; (4) maintenance and repair of embankments are necessary for flood control; and (5) illegal squatters should be expelled from the embankment areas.

As medium-term programmes, (1) solid waste should be collected; (2) low-cost hygiene programmes should be implemented, particularly in slum districts; (3) waste should be reduced; (4) industrial waste should be disposed of; (5) pumps should be installed to drain stagnant water; and (6) residents should be educated on how to dispose of wastes.

As long-term programmes, we need to consider (1) controls on land utilization; (2) environmental restrictions; (3) flood-control programmes; (4) formulation of drainage plans and flood-control plans; and (5) the devising of programmes to improve slum districts.

Flood-control programmes and other programmes should be integrated. Urban planning should integrate flood control within the framework of infrastructure improvement programmes.

Although I stressed the importance of building structures as a programme for urban disaster reduction, other measures that do not rely on structures should also be considered. For instance, zoning and other such measures should be considered.

"Earthquake Damage Caused by District Differences in Urban Structure: Lessons Learned from the 12 October 1992 Earthquake"

Sherif H. Kamel
Chairman, General Organization for Physical Planning (GOPP), Egypt

On 12 October 1992, Egypt experienced a severe earthquake with a moment magnitude of 5.8. The epicenter was 20 km southwest of Cairo, with the depth determined at around 25 km. This earthquake was the first disastrous one to occur near Cairo since 1847. Although this earthquake was a relatively mild event by global standards, it was a serious event for Egypt. The earthquake caused much damage to buildings, killed about 560 people, and injured over 10,000. There was much serious damage to the historical districts near Cairo. Houses, schools, mosques, and other Islamic monuments were affected.

Cairo's Old City was most seriously damaged because its houses were the roof-supportive type, and many different types of houses were intermingled in this area. Lack of quality control of housing exacerbated the damage. It was found that some construction subcontractors used unskilled workers or substandard materials to reduce construction costs.

As well, maintenance was insufficient. For example, plumbing leaks had deteriorated concrete and steel structures. Building proprietors disregarded inspections of their buildings.

We are considering making the following recommendations in Egypt: (1) to conduct surveys on the hazards in each region to define earthquake-vulnerable areas and to know the reasons for this vulnerability; (2) to promote urban renewal and create urban structure capable of withstanding earthquakes and reducing the impact of earthquakes; (3) to design better buildings, in particular, to design disaster-proof buildings; (4) to create programmes for assessing building vulnerability; (5) to enlarge or to renovate buildings to reduce their vulnerability to earthquakes; (6) to incorporate earthquake-proof designs into construction codes and urban planning; and (7) to formulate measures for reducing the vulnerability of the urban area and to develop such an infrastructure.

Many lives and much property have been lost in earthquakes. These losses will be even greater in the world's metropolitan areas, because their population is concentrated in these areas. It is very important for developing countries to mitigate the impact of natural disasters and earthquakes in particular.

Comment by Y. Murosaki

Professor Kawata pointed out the necessity of separating the issue of being a major city and that of urbanization.

As to the problems of major cities, it has been pointed out that because of the overconcentration of populations in cities, being a major city itself leads to disaster vulnerability; moreover, a city's disaster frequency has a close relationship with its being a major city. In other words, disaster risks in urban areas correlate with high population density. Overconcentration in cities is likely to create conditions in which disaster risk factors may lead to chain reactions and combinations of disasters.

If a disaster occurs in a major city where a country's principal functions are concentrated, the functions of that entire country as well as those of the city will be affected, seriously damaging the economy in particular. It should be recognized that a disaster in a developing country could lead to a national crisis.

The problems of urbanization lie in its rapidity and in the resultant uneven development. The cycle of and interval between disasters is quite long while urbanization has developed more rapidly. The present speed of urban development has proceeded too rapidly, and regardless of whether development has taken the right track or not, it can be checked by a disaster.

Professor Kawata pointed out that a new scenario is needed. Estimates of potential damage in Japan are based on the damage caused by the Great Kanto earthquake in 1923, for example. Such estimation is not necessarily useful in addressing the risks of large underground shopping malls in metropolitan areas or underground tanks of hazardous substances such as petroleum. The extent to which we can anticipate such new hazards created within cities and the problems they could cause is very important.

In many cities, imbalances are reflected economically. When a city is rapidly developing, investment in disaster prevention is likely to be put on the back burner. As a result, vulnerability increases. We cannot overlook the problem of development by overlooking the poor areas. How to make poor areas secure is one of our greatest challenges.

Many speakers have pointed out that there is a huge difference between the history of the city and the urbanization process. In this sense, we need to take specific disaster reduction measures tailored to the characteristics of particular regions.

We need to recognize the difference between urbanized and urbanizing areas. Urbanizing areas must develop their economy as well as their culture. It is very important to balance economic development with the city's security.

The report from Rio de Janeiro referred to the close relation between natural protection and disaster prevention. It has been pointed out that disaster prevention programmes can cause the deterioration of the natural environment, the economy, and the social life of the community.

It is also important for us to recognize that security does not count without convenience and community. It is necessary to acknowledge that a vibrant culture and a natural environment are necessary to ensure security. In this respect, we cannot ensure security if we focus only on disaster reduction.

Moreover, it is very important to assess hazards possibly resulting from the development of rapid urbanization.

Hard countermeasures alone cannot ensure the security of a city, as the report from Dhaka emphasized. Professor Lobo used the term "sustainable development". This viewpoint is needed to review disaster–prevention measures.

Discussion

Following Murosaki's comments, the chairman commenced the floor discussion. The coordinator, five speakers, and a commentator participated as panelists. Questions were collected from the general participants during the coffee break. Details of the discussion were as follows.

Yoshio Kumagai

Two questions were directed at me from the floor: one is the question of the specific approach to be taken after microzonation and citizen response to the results of microzonation; the other is to clarify microzonation according to both the natural and artificial conditions of

earthquake microzonation.

Let me clarify microzonation according to both the natural and artificial conditions of earthquake microzonation. Generally speaking, microzonation often refers to geological engineering or seismology. Geological engineering gives a narrow interpretation to microzonation. Microzonation based on artificial conditions has a wider interpretation. It is important to clarify the difference. The first step in microzonation according to natural conditions is to determine an area's most hazardous zones on on an absolute scale; generally speaking, the most hazardous zone does not cover a wide area. Very safe zones are also determined. Other areas are identified as gray zones.

The specific use of microzonation requires legal controls as well as management.

Experience of and education on disasters is a major factor in citizen response. I had the impression in Peru that disaster-prevention techniques are not being passed on to the next generation. To do so, many pilot projects should be implemented and new building construction methods should be dispersed. Also, it is important to create a forum for citizens when they construct buildings.

Yoshiaki Kawata

I have been asked about what strategies exist to increase wealth and information for people of developing countries that are vulnerable to disasters. My answer is to expand school education; residential registration and land registration are also important; and the nation's fundamentals should be improved. The Ministries of Education and Health and Welfare, as well as the Prime Minister's Office, should improve resident and land registrations.

The IDNDR approach so far overemphasizes technology. An emphasis on socioeconomic areas is necessary to strengthen disaster reduction capability. I'd like to have opinions on this point from the speakers.

Thereza Lobo

I think the problem of poverty is most serious. The poor are the most seriously affected by disasters. Therefore, we need to pay attention to the socioeconomic impact of disasters; otherwise, no matter how hard we try to reduce disasters through technology, we cannot overcome the negative impact of a disaster.

Mohammad A. Mohit

Structural disaster reduction efforts are not enough. Disaster reduction control is necessary. We need to formulate socioeconomic countermeasures and improve the living standard of the poor as well as slum districts. It is important to develop the economies of urban areas.

Sherif H. Kamel

All the problems are interrelated. I do not think that technology is any more important than socioeconomic aspects. All are related and inseparable.

Session 1-2: Urban Planning to Reduce Damage from Natural Disasters

Chairman:
Hideki Kaji
Director
United Nations Centre for Regional Development (UNCRD/UNDDSMS)

Commentator:
Takashi Onishi
Associate Professor
Department of Urban Engineering, University of Tokyo, Japan

Focal Point of the Sub-session by H. Kaji

During the morning session, the relationship between urbanization and hazards was discussed. The problem is that countermeasures against disasters cannot catch up with the increasing disaster vulnerability of cities. In order to mitigate this disaster vulnerability, it is important to incorporate in urban planning itself disaster prevention mechanisms that support urbanization, thereby reducing the expansion of vulnerability accompanying urbanization.

Conventional urban planning is largely centred on convenience and enhancing economic activity. Safety considerations tend to be neglected. Particularly in developing countries, the rush toward economic growth is delaying disaster mitigation planning. When a large disaster occurs, the progress achieved through development is, in many cases, wiped out. A disaster could well obliterate a major portion of a country's GNP.

In this session, I hope that each speaker will introduce examples of how to incorporate disaster mitigation mechanisms into urban planning.

Paper Presentations

"Urban Planning Based on Disaster Risk Assessment"
Itsuki Nakabayashi
Professor, Center for Urban Studies, Tokyo Metropolitan University, Japan

Safety in urban areas is apt to be overlooked in everyday life. As a result, developed areas as well as developing countries promote urban development and urbanization without considering the disaster risk.

As urbanization progresses, the surrounding environment in respect to security and convenience deteriorates. Convenience and hygiene improve as the city urbanizes, but safety does not necessarily improve. Urban disaster prevention plans to enhance safety and halt the increase in urban hazards should be made.

The most pressing requirement for an urban disaster prevention programme is that residents of the city recognize the disaster risks. Disaster prevention activities are implemented through the correct recognition of the disaster information and decision-making. This process can be enhanced by repeating actual disaster experience or education and training.

There are two objectives in assessing disaster hazards for disaster information: first, to clarify the challenges of urban disaster prevention planning to make the city "resilient" to disasters; and second, to clarify the possible damage in order to prepare for emergency countermeasures against disasters that have already taken place. The former could be called

"regional risk assessment" and the latter, "damage estimation."

Regional disaster hazard assessment is based on the small-scale regional unit called the "statistical survey zone" to assess the relative disaster vulnerability and to measure which zone is more vulnerable. Using the results of the assessment, the most vulnerable area in a surveyed city is defined. Conversely, it is important to control and manage urban development to avoid deterioration of safety caused by disorderly urbanization in relatively safe areas.

Damage estimation assesses the extent and the type of damage that would be caused by an urban disaster. By clarifying damage to buildings and facilities and human casualties, basic data could be provided to prepare disaster countermeasures quickly and efficiently in an emergency.

Tokyo's weaknesses to earthquake disasters are as follows: (1) the city is located on soft ground, such as alluvial deposits, which are likely to liquefy; (2) many parts of houses are made of wood, and population density as well as building density is high; (3) there are too many people and traffic is heavy; some areas lack sufficient roads and empty space, and land use is mixed in urban areas; (4) there are many large structures such as subways, underground shopping malls, highways, crowded railroads, high-rise buildings, and skyscrapers which have never been subjected to an earthquake; (5) there are many hazardous substances such as a large volume of gas and petroleum; and (6) industrial economic and political centres are concentrated in Tokyo.

On the basis of regional risk measurements, Tokyo has promoted several programmes: (1) to improve the fire break consolidation plan, which will form an urban disaster prevention "life sphere"; (2) to designate evacuation spaces and roads to ensure open space; (3) to implement aggressive urban renewal plans to improve urban areas; (4) to obtain permission and to implement regulations for zoning programmes and development plans; (5) to carry out several projects to enhance the safety of existing buildings.

To develop an urban disaster mitigation plan is to reduce vulnerability. Changes made to the city also change the nature of a disaster, create unexpected damage, and may cause new risks. Urban preparedness planning should improve hazardous environments and conserve and develop safe environments.

Disaster risk assessment serves as a very important source of disaster information for implementing urban disaster mitigation planning and for disseminating it to citizens so that they can be prepared for disasters. Disaster risk assessments should be made available to citizens and public corporations.

"Cost-Effectiveness of Disaster Mitigation in the Development of a Metropolis"

Dusan Zupka
Disaster Mitigation Co-ordination Officer, United Nations Department of Humanitarian Affairs (DHA), Switzerland

Many lives are lost every year due to natural disasters. The direct economic loss is enormous, and there are many human casualties in developing countries. Moreover, the loss measured against GNP can be twenty times that of developed countries. This situation will continue well into the next century.

The risk to the natural environment in urban areas of developing countries is accelerating due to overconcentration of population, particularly in slums. The ratio of the population in the city's major slums is 80 per cent in Addis Abeba and 60 per cent in Casablanca. Much of the urban population in developing countries is concentrated in slum

areas.

We should conduct a cost-effectiveness analysis and identify when, where, and how disaster prevention measures are required. Large cities have become increasingly complex. We need to review the priorities of disaster-prevention measures.

There are two phases to a decision-maker's adoption of policy options: first, decision and selection; and second, appropriate implementation.

The method most frequently applied for deciding alternative disaster-mitigation investment options is cost/benefit analysis. This analysis adds all the benefits gained from disaster mitigation measures and deducts the investment from the total loss avoided. If the result is positive, the disaster-mitigation measures are worthwhile.

This CBA method is widely used, but it has limitations. Because the data is insufficient, we need to use our imagination. Moreover, the social aspects of a disaster are not fully accounted for in this method. An appropriate calculation for human factors is another problem of this method.

Another approach is quantitative analysis; that is, to compare the social, economic and political influences of similar disasters that have taken place at different times in one place. The limitations of this method are that identical disasters almost never occur, and the interval between natural disasters is long.

Given these limitations, we must select disaster-prevention measures while considering other political and social structural factors. The social, economic, and political impact of a disaster is tremendous, and disaster-prevention planning should be considered as part of urban development plans. Cost-effectiveness should be considered, as should social, political, cultural, and psychological factors.

Despite its limitations, the cost-effectiveness method is considered appropriate when deciding which of the various options to adopt.

"ViSP -- A New Methodology in Urban Planning and Disaster Management"

Jukka Nieminen
Special Adviser, Data Management, United Nations Centre for Human Settlements (UNCHS-Habitat), Kenya

UNCHS (Habitat), in cooperation with the Technical Research Center in Finland, has developed a new approach to urban planning disaster mitigation. Visual settlement planning, or ViSP, incorporates visual factors such as aerial photographs, video images, slides, still pictures, satellite image, and photographs.

Ordinary desktop computers using 386 chips can make full use of this approach, and all computerized data can be shown on the special display unit. Whereas an ordinary VGA monitor displays only 256 colours, a system incorporating all our packages can display full-colour images.

The biggest problem with desktop computers is limited hard disk space; by using an optical disc drive, however, we can store a huge volume of data. One optical disc drive can store 1.3 gigabytes, equivalent to 250,000 pages of text, or 1,300 full-colour aerial images.

System and software maintenance are easy, because the system is constructed from off-the-shelf components. This system is very easy to learn, and does not require a master's degree

in computer science to operate for urban planning or formulation of disaster mitigation measures.

In comparison to the conventional measuring method, our system has the advantage of easy surveying. A new aerial picture is digitized and overlaid on an existing map to update it.

With this approach we can monitor new information in areas particularly susceptible to disasters. This is particularly useful for rapidly changing areas.

Detailed images obtained from ViSP can be used as awareness-building programmes, because the images serve as information for those who do not understand urban planning or maps.

The DXF conversion system can convert data for any geographical system package. Because it is possible to link the collected data, you can combine the databases used to make a map.

These same materials are used to make scenarios. If there is an efficient database, it is possible to estimate the volume of structural damage and number of human lives lost by overlaying digitized information.

With ViSP, we can monitor a disaster situation earlier. Therefore, this system is useful not only for disaster mitigation measures in urban planning but also for quick response to emergency situations. We can dispatch helicopters to disaster sites, take photographs, and enter the data into computers for immediate mapping so that the entire disaster situation is provided in visual form for decision-makers.

"Introduction of a Vulnerability Assessment System to Development Planning"

Andrew W. Coburn
Director, Cambridge Architectural Research, UK

Three things are needed to ensure the safety of a city: first, economic development; second, economic development; and third, economic development. Clearly, the amount of money available to spend determines the safety of a city. This fact leads to the gap between developed and developing countries. We therefore need to implement measures suited to a city's circumstances.

After the 1985 earthquake in Mexico City, we studied Mexico City's master plan to consider how to avoid urban disasters and found that poverty is a big problem. Disaster mitigation is not an option for the poor, so government initiative is important. We must carefully study the costs and benefits.

We can use computers for cost/benefit analysis to formulate space plans with which we can control the use of land incorporated in urban planning as well as the density and locations of residential areas.

In the past, a planner's level of influence in most cities was not very high. The greatest influence was exercised by the civil engineers in charge of city planning. They are the ones who go to a construction site and determine whether a building is strong. They would be ineffective if they did not have the authority to order any building not satisfying the standard destroyed.

Communication is also important, particularly how we convey necessary information to the people who need that information. Words alone may fail, whereas drawing a picture may

be effective.

It takes a long time to make people aware of our efforts. It takes about ten years for people to hear our message and adopt our ideas, so perhaps designating an international decade is the most realistic approach.

"Disaster Vulnerability in the Formal and Informal City: Lessons from Istanbul"

Ronald S. Parker
Consultant, The World Bank, USA

Development planners the world over are confronted by rapidly growing numbers of squatter communities.

Turkish cities are becoming more crowded every year. Farmers have been massively migrating into cities. The population of Istanbul increased eightfold between 1950 and 1990, from 1 to 8 million. Insatiable demand for urban land and a shortage of housing have resulted in low- and medium-income groups living in illegal zones known as *gecekondou*. Houses are built literally overnight and almost everywhere, both on public and private land.

In 1957, there were 50,000 *gecekondou* units. In 1990, the number rose to 1.75 million. The population in the same period went from 250,000 to 10 million. Looking at all of Turkey, we see that 33 per cent of urban dwellers live as squatters. These illegal dwellers are a serious problem for urban developers.

The disaster vulnerability of *gecekondou* is not shown in urban planning. Any disaster prevention measures that do not include these squatters would not achieve its goals.

There are several options for reducing disaster vulnerability and curbing the squatter developments. One such measure is to legalize the squatter dwellings, which would improve their living conditions. However, legalizing and improving living conditions in squatter communities would create further incentives for informal settlements. This is the dilemma that Istanbul now faces.

In order to promote urban disaster reduction measures, we need to cover wide geographical areas and cope with every kind of hazard. This is expensive.

There are no comprehensive disaster prevention measures. Urban planners are introducing new rules and regulations, but it is very doubtful whether they are effective in reducing illegal squatters. The risk potential of a squatter zone is very high, but it is very difficult for the government to carry out disaster-reduction measures effectively. Squatters in many major cities in the world already violate many laws. When voluntary compliance is unlikely, there is a need for effective education that helps them understand the importance of disaster prevention and teaches them how they should react when disaster occurs.

"Control of Construction Activities for Disaster Mitigation in Metro Manila"

Ulpiano P. Ignacio, Jr.
Associate Professor of Civil Engineering, University of the Philippines, Philippines

The Philippines was hit by a magnitude 7.8 earthquake in July 1990. The intensity measured in Manila was between 6 and 7. The death toll was 2,000, due mostly to collapsed buildings.

Manila's metropolitan area has a population of 8 million in an area of 600 km^2, so the density is very high. One important point to note is that a typical house is a single one- or two-storey house with light roofing material and wall structures. This type of structure is the most favourable for earthquakes.

The American procedure is used in the construction method. The standards of the American Concrete Institute, the American Institute of Steel, and other such standards are applied.

Construction engineers carry out the supervision. Systematic inspection methods such as guidelines and detailed checklists are not used.

There is a shortage of qualified staff for buildings. There are overlapping functions and jurisdictions, as is often seen in developing countries. Our filing system is disorganized.

The licensing of civil engineers is insufficient. Strict requirements for civil engineering have not been established. There is no adequate screening.

The implementation of the inspection and management system is slack. Sometimes there is collusion between the owner, contractor, and inspector. No systematic method has been established for inspections. The training of inspectors and supervisors is insufficient.

After the major earthquake in Luzon, efforts were made to improve disaster mitigation measures. For example, the building structure is now being reviewed by the government authority. Manuals and guidelines for earthquake-resistant structures are being introduced. The AssAssociation of Structural Engineers held several seminars to disseminate earthquake-resistance methods. Public works and highway authorities are improving their management systems so that construction follows the drawing and specifications.

A new system was established for civil engineers. They need to upgrade their skills through a continuous education programme to renew their licenses. Conflicting codes in various construction standards should be adjusted and penalties should be applied. Standards using the latest technology should be established.

In developing countries, there is a discrepancy between standards and actual methods. We need to have standards suited to our actual situation. Qualified structural engineers should be involved in a structure's design. Using ordinary civil engineers is not enough. Training for inspectors, building engineers, engineers, and planners should be institutionalized.

Comment by **T. Onishi**

The first principle in avoiding disaster is not to live in a high-risk area. The Japanese, however, have no choice but to live in high-risk areas. Awareness of danger differs from person to person; some think that a dangerous area is still livable, and others have an attachment to a particular area. So how a nation determines an area is vulnerable is problematic.

People have a right to live where they wish, and modern law stipulates the right of property. Therefore, it is very difficult for a public authority to say that a particular place is too dangerous to live in or to make a plan based on such an assumption unless there is a compelling reason. It is very important to convince them that an estimate of damage or danger is accurate.

Even when a scientific damage estimate is obtained and reported through public organizations, specific references become generalized and a rather ordinary estimate is publicized that does not result in residents being forced to accept measures. We need to enhance the tools and methods used to obtain accurate estimates.

When we have better risk and damage estimate methods, we can improve corresponding urban planning measures. Urban planning has two aspects: projects and restrictions. Both are needed for urban disaster prevention.

Restrictions are more difficult because they tend to run counter to the rights of individuals. As to how many specific restrictions can be suggested and implemented in response to damage estimates is a grave challenge for future urban planning.

Professor Zupka referred to the importance of cost benefit analysis (CBA) in obtaining a quantitative understanding of the benefits of measures. This approach should be used when comprehensively assessing such measures and establishing priorities.

Although disaster preparedness measures are not easy to implement in times of order, it is important that we recognize disaster reduction measures on a daily basis. For example, buildings in Japan have earthquake-resistant designs even though earthquakes do not occur very frequently. Clearly, we construct such buildings when the threat is not imminent.

Nevertheless, disasters hit unexpectedly. Although we prepare for disasters with our scientific risk and damage estimates, disasters are bound to exceed our estimates. We always need to prepare emergency measures in case of disaster.

Discussion

Following Onishi's comments, the chairman commenced with the floor discussion. The session coordinator, six speakers, and commentator participated as panelists. Questions were collected from the floor during the coffee break period for discussion. Details of the discussion were as follows.

Shiono

Generally speaking, developing countries do not consider investing in disaster prevention if it will lead to surging construction costs. What can we do in response to this situation?

Andrew W. Coburn

It is important to motivate them to be responsible for disaster prevention and to make sure they understand the idea that we are responsible for protecting our own lives.

Hideki Kaji

It was pointed out from the floor that disaster problems specific to Africa were not discussed at all. Such issues as drought, desertification, and insect plagues have been included among the natural disasters that IDNDR has targeted. These problems will be our next agenda items since they were not covered by the speakers today.

Sonoda

I personally surveyed the Olmok district in the Philippines that Dr. Nieminen referred to. Several thousand poor people living on a riverbed in this area were swept away by the flood. When I later returned, many people had moved back to this risky area. The city government has a disaster-prevention organization, but they did not take effective measures. People often say that problems with disaster-prevention measures in developing countries are due to lack of citizen awareness. But I feel that there is a lack of awareness on the part of local government decision-makers, as was the case in the Philippines.

Raymundo S. Punongbayan

What you said is true. Policy makers make plans with only narrow viewpoints. Problems with disaster-prevention planning are seen worldwide. We need to present the situation regularly and we need to persuade them repeatedly.

Sudo

What does the term "human risk" refer to? How much does it cost to conduct risk assessment in developing countries?

Itsuki Nakabayashi

The term "human risk" is not a good expression. It means to assess how many people are in what part of a city during the day and night; how much a building vibrates during an earthquake; and how many casualties there are, including those suffering from psychological stress.

In Japan as well as in developing countries, it is very difficult to take such surveys in places other than in major cities. The biggest problems are the cost and how to improve the quality of the data.

To lower the cost, we need to develop new technologies that, if developed by advanced countries, would be applicable to developing areas and newly industrialized regions.

Sudo

How can we raise the awareness of policy makers and citizens regarding disaster prevention? What is needed to measure vulnerability and enhance awareness?

Dusan Zupka

A very important way to make IDNDR a success is to present specific ideas to aid donors and decision makers regarding how much our lives would be improved if disaster mitigation measures were implemented, how these measures can be implemented, and what the social and economic impact of a disaster would be. All of us and the IDNDR should work to improve various methods, including cost and benefit assessments of disaster mitigation measures.

Ronald S. Parker

We need to consider the political situation when we ask policy makers to participate in the disaster mitigation process in developing countries. Political responsibility and political merit should be considered when we approach politicians.

We can make a map of risk areas or we can forecast disasters using computers, or we can build cyclone shelters. However, we don't know how to move people. How to issue warnings and how to explain cyclones to people are difficult jobs. We need to focus on these problems during the latter half of the IDNDR.

Ulpiano P. Ignacio, Jr.

For illegal squatters, finding the next meal is a more pressing problem than preparing for earthquakes or floods that may or may not occur. It is not very realistic for them to prepare for an earthquake that will happen next year or ten years from now. Donor countries and organizations should consider this point.

SESSION 2

POTENTIAL LOSS OF URBAN INFRASTRUCTURES FROM NATURAL DISASTERS

Coordinator/Rapporteur:
Hiroyuki Kameda
Professor
Disaster Prevention Research Institute, Kyoto University, Japan

Focal Point of the Session by **H. Kameda**

Naturally, disaster-prevention measures in major cities should address citizen safety in view of the overcrowding caused by the concentration of population in today's urbanized society. Disaster-prevention measures are very important for other infrastructural items that support urban political, economic, administrative, informational and cultural activities.

Functions of major cities are supported by the lifeline systems -- specifically, supply, disposal, transportation, and communication facilities -- that cover the wide geographical areas of cities. Because these facilities form extensive networks, their vulnerability to disaster should be addressed. Schools, hospitals, and other important public facilities serve as bases for evacuation and rescue when a disaster occurs. They will play an important role in a city's early reconstruction from disaster.

With this fundamental recognition, this session will discuss disaster prevention for urban infrastructures that support urban functions.

Session 2-1: Protection and Early Restoration of Lifeline Facilities, Including Transportation Networks

Chairman:
Fusetsu Takagi
Professor
School of Engineering, Nagoya University, Japan

Commentator:
Masami Kobayashi
Associate Professor
Faculty of Engineering, Kyoto University, Japan

Focal Point of the Sub-session by **F. Takagi**

Ensuring the functioning of lifeline systems during an emergency is very important. Various measures should be taken to avoid destruction of the system and to minimize the impact of such an event.

Besides concrete measures, we need to make systems whose functions can be assured, and we must avoid chain reactions to rebound more quickly from a disaster. We will discuss a wide range of topics including design, concept development, research agendas, and disaster countermeasures.

Paper Presentations

"Lifeline in Urban Areas: To What Extent Can Their Importance during Disasters Be Justified"

Tsuneo Katayama
Director, International Center for Disaster-Mitigation Engineering
Professor, Institute of Industrial Science, University of Tokyo, Japan

An earthquake does not always lead to a disaster. There is no risk unless people live in the affected area. If people do not have a water supply system, they will not be affected by a suspension of their water supply due to an earthquake. Even if we have the latest, most accurate typhoon information, it is useless unless we have a tool for disseminating this information to citizens.

These facts show that it is not possible to quantify natural disasters. They can only be generalized; in other words, countermeasures vary from region to region.

The urban risk from natural disasters is a complex problem. A city highly dependent on lifeline systems may be more sensitive and thus more severely affected. It was found in Japan that preliminary planning and prevention were extremely important in the wake of the Niigata earthquake of 1964 and the Miyagi earthquake of 1978. For this reason, damage estimation is essential. It is also important to consider the ground situation, particularly the potential for liquefaction, when estimating damage.

Lifeline systems are networks covering a wide geographical area. Regional variations in the soil features of supplied areas and network priorities are quite significant. How we locate each place in an area is a central issue to earthquake engineering of lifeline systems. The effects of lifeline failures on users are studied, rather than the construction of the networks, which has not resulted in solutions.

In most underdeveloped countries, it is more important to construct lifeline systems that function well during normal periods than to consider damage to a city or lifeline system. Mitigation of damage is a matter of money, people, and policies before it is a matter of engineering. When we undertake international cooperation, we need to examine methods, combining new information on new areas with existing knowledge, or combining structural and non-structural measures. It is clear that structural measures are more effective, but because they are costly, non-structural measures may be more appropriate. However, minimum structural measures are necessary to ensure effective functioning of the non-structural measures.

It is wrong for developed countries to overemphasize the importance of lifeline systems during a disaster. Japan's lifeline system makers began to understand the importance of integrating prior, in-process, and post-disaster prevention measures. They began to integrate maintenance, renewal, and improvement into the disaster-mitigation measures. These efforts probably suggest that research into mitigating lifeline damage is not research into lifeline earthquake engineering, but rather that of lifeline engineering in a wider sense.

"Lifeline Seismic Disaster Mitigation: Research and Implementation"

Masanobu Shinozuka
Sollenberger Professor of Civil Engineering, Princeton University, USA

Currently, implementation is the focus in the United States. In research, it is possible to make further improvements in both the concrete and policy aspects of mitigating earthquake risks. However, in implementation, economic, social, and political cost-effectiveness should

be considered. Therefore, lifeline systems need to be judged from the social aspect, and this determination may differ from region to region.

In Memphis and in New York City, the water supply system is made up of extremely old equipment and facilities. Their vulnerability to earthquakes is increasing. However, countermeasures have not been taken for economic reasons.

It is possible to improve lifeline performance from an earthquake engineering viewpoint. Likewise, raising public awareness regarding problems that arise during an earthquake and facilitating public understanding of countermeasures will be a risk-mitigating factor.

Probability of System Failure (P) x Cost of System Failure (C) = Risk of System Failure. To lower P, a traditional earthquake engineering approach is pursued to enhance the physical performance of the system. To lower C, non-structural measures are needed. The product of P and C reduction is the reduced risk.

When I conducted research on the Memphis water supply system, I carried out analysis of connections as well as standard flow analysis. Also, demographic distribution, the layout of police stations and hospitals, and other social information was obtained. As a result, we can estimate how much the water supply is suspended when a magnitude 7.5 earthquake occurs and the system is blocked and what the social impact is.

We are conducting joint research with social scientists at the national institute. Recommendations for improvement have been presented by the administrators of the Memphis water supply. When we conduct the same analysis according on this recommendation, we can know how much the water supply reduction can be mitigated.

So far, this research has not been enough. By examining the actual results of the research from a social viewpoint, we can pave the way for future implementation.

"Seismic Damage of Lifeline Facilities and Disaster Prevention in China"

Sun Shaoping
Professor and Senior Engineer
Municipal Engineering Research Institute of Beijing, P. R. China

I will talk about the major earthquake damage and countermeasures based on the experience of the 1975 Haicheng earthquake (magnitude 7.3) and 1976 Tangshan earthquake.

Water purification treatment plants, pipelines, water resource wells, and power transmission stations were damaged. To prevent damage, we need to formulate plans that consider the potential of earthquake generation, fault distribution, the ground situation, and underground water. Multiple water sources should be adopted, and water purification plants should be dispersed over wide areas. Intake gates for surface water should not be built in muddy areas, liquefaction areas, on slopes, mantle rocks, steep riverbeds, or at the foot of mountains.

Pipelines should be built in a circle so that they can be supplemented even if part of the line is destroyed. If we increase the number of valves, we can repair the pipe separately. We need to have prior analysis of the minimum required water supply a day after an earthquake occurs.

All gas tanks and gas supply reservoirs were broken. As a preventive measure, we need to establish multiple gas resources and disperse them. Related equipment should satisfy

earthquake resistance standards. The gas supply network should be circular. Valves should be increased and rationally distributed. To avoid gas explosions when a supply unit is damaged, disaster-prevention equipment should be installed.

On the highways, some cracks on the road surface and beams occurred and bridge crossbeams fell. To prevent such damage, we need to reinforce existing bridges and ensure that new bridges satisfy earthquake-resistance standards. Risk assessment of existing bridges is necessary.

Quay walls, piles, and protection banks were destroyed. To prevent such damage, the sites of quay walls should undergo ground probes and surveys. Anti-earthquake reinforcement work should be added to existing walls and emergency measures should be established.

As for power transmission facilities, telecommunication company buildings were severely damaged and exchanges were destroyed. We need to take preventive measures such as adopting multiple exchanges, constructing buildings that meet earthquake-resistance standards, and fixing primary communications equipment to lower the centre of gravity.

Looking at power generation facilities, power stations, generators, and boilers were broken and transformers were toppled. Preventive measures need to be taken, such as reinforcement of earthquake-resistant structures in existing buildings and securing the main power generating equipment. Construction of power stations should strictly follow the earthquake-resistance standards.

To prevent earthquake disasters, related local government agencies are formulating voluntary earthquake and disaster-preparedness measures according to each specific case. Yantai City in Shangdong Province and Xuzhou City in Jiangsu Province are designated as experimental cities, and earthquake disaster-prevention projects are being implemented.

There are thirty-seven administrative guidance measures and fifty national and local regulations for disaster prevention. Of these, eighteen are designed to protect lifeline systems.

"Seismic Monitoring and Emergency City Gas Operating Systems"

Yoichi Yoshikawa
Senior Manager, The Center for Disaster Management and Supply Control
Tokyo Gas Co., Ltd., Japan

Earthquake countermeasures of city gas suppliers are based on the three principles: prevention of secondary disasters; establishment of areas of assured supply; and swift repair of the system. My talk will focus on the establishment of areas of assured supply.

To avoid secondary disasters, suspension of all supply is acceptable. Yet because this has a serious impact on the public, we need to develop a system that minimizes the number of areas with suspended supply.

Our system can stop gas supply at four points. First, a micro-computer built into home gas meters automatically halts the gas supply when an earthquake of magnitude 5 hits the area. A pressure reduction unit for reducing medium-pressure gas for home use is equipped with an earthquake sensor that automatically stops the gas supply when the magnitude surpasses a predetermined scale. If the upstream medium-pressure pipe is damaged, a regional block valve is operated by the supply centre and head office via remote control. As the ultimate step, we can stop the gas supply to the plants by wireless signal when there is serious damage due to an earthquake.

A major point is how to determine whether the earthquake caused damage. Right now we use a seismometer to monitor earthquake motion. We intend to establish a system to quickly respond to earthquake damage by estimating damage generally from monitored data.

The seismometer-based information collection system that we are now using can estimate the epicenter and magnitude of the earthquake by transmitting maximum acceleration and SI value from thirty-one medium-pressure blocks and waveforms from five bedrock seismometers by wired and wireless signals; it also enables us to determine the extent of liquefaction at twenty locations. We have developed GM networks to ensure stable access to information even in an earthquake. We can obtain information from multiple sources.

As the extent of damage is influenced mostly by the ground conditions and not by the epicentral distance, we intend to increase the number of seismometers to 300 so that we can monitor further detailed ground conditions when we conduct damage estimates. We are now developing sensors to measure liquefaction.

To prepare earthquake damage estimates with the information obtained, we are developing a system for estimating damage to the block and for estimating comprehensive block damage. We hope to develop a system that can estimate the liquefaction damage as well as a system by which we can change the pressure of supplied gas and determine the suspension of gas supply using information provided from the disaster site.

"Damage of Highways and Effects on Passengers/Goods Flow in Disaster Emergency"

Manuel M. Bonoan
Assistant Secretary for Planning
Department of Public Works and Highways (DPWH), Philippines

I would like to talk about the lessons we learned from the central Luzon earthquake in 1990 and the eruptions of Mt. Pinatubo in 1991.

The earthquake that occurred on 16 July, 1990 seriously damaged the road system. The road transportation system was completely paralyzed. The Cagayan Valley Region (population 2.2 million) and Bagio City (population 480,000) were completely isolated. Emergency efforts to open up damaged roads were started immediately but these actions encountered severe difficulty due to subsequent damage from subsequent typhoons. It took six months for the highways to become fully operational. Not only was the movement of people and goods suspended, but emergency activities were impossible.

The Philippine Government established a three-stage programme to repair this earthquake damage. The first stage continued for two weeks and encompassed rescue and relief operations, including emergency relief of destroyed facilities, ensuring access, shelter construction, and provision of food and medical supplies. The second stage continued for one year and involved initial rehabilitation and recovery, which mainly targeted rehabilitation of infrastructure systems. The third stage was reconstruction and development, a long-term reconstruction programme with a three- to five-year execution period.

The eruptions of Mt. Pinatubo resulted in huge financial loss. A large volume of pyroclastic material was spewed over an extensive area, and it will take several years to clear that material from the road system. As deposits continue to be added, we must continue clearing. Simultaneously, roads have been raised 2 m to prevent them from being inundated due to heavy rain. Temporary bridges were soon carried away by the volcanic mud flow. Permanent bridges could only be constructed in stable areas where repeated damage was unlikely.

The government rehabilitation programme was based on the following priorities.

(1) to keep the transportation system open by clearing volcanic mud flows away from the rivers and bridges to provide uninterrupted movement of people and goods and to achieve quicker recovery and rehabilitation;
(2) to protect human life, property, communities, agricultural production, and infrastructure from damage caused by flood waters;
(3) to renovate and reconstruct public facilities. Schools and educational facilities located outside the areas affected by mud flows have been provided for people in the affected areas; and
(4) to provide resettlement programmes and other livelihood programmes as rehabilitation and reconstruction operations.

In the Philippines, the primary emphasis has been expansion of road length at minimum cost. Many of the roads constructed were not strong enough to withstand the ravages of the environment. As a result, roads have been repeatedly damaged by natural disasters, and the cost of repairing damage has been high. With what we have learned from this experience, we need to construct alternative roads in important areas, build stronger roads, strengthen existing bridges, and provide temporary movable bridges.

In recognition of the importance of road disaster prevention measures, the government has established the following strategies.

(1) development of strategic road networks that aim to provide alternative routes in areas of strategic importance;
(2) promotion of a road disaster-prevention programme that applies road disaster-prevention measures to critical areas;
(3) reconstruction of bridges as earthquake-resistant structures; and
(4) development of immediate-response systems against natural disasters through, for example, procurement of portable bridges for emergency use.

Comment by **M. Kobayashi**

The problem was pointed out that lifeline systems differ according to the standard of living of a given country. In some cities, they are highly complex and intricately organized. The fundamental question is whether we can discuss this issue uniformly for those cities that have a very simple infrastructure.

The objectives of lifeline engineering vary widely according to social, economic, and political factors. Terms such as "social-scientific approach" and "lifeline engineering" have been used as keywords to indicate our future course. In lifeline engineering, natural disasters are regarded as risks. If so, the concepts of probability and cost-effectiveness can define their economic implications for society. Also, by measuring the impact of natural disasters, their implications from the viewpoint of engineering can be defined. Particularly, such tangible elements as social infrastructure and intangible elements such as social organization are correlated. So, the permissible level of risk differs according to a nation's level of development.

Developing countries require materials suitable for their regions, technological assistance suitable for the labour force, and government financial support, as was referred to in the case of the earthquake in India. On the other hand, in areas such as New York, it was pointed out that the present infrastructure is worn out, increasing vulnerability. Perhaps the same situation exists in other countries.

The fundamental requirements for the improved safety of lifeline engineering were clearly introduced in the presentation on China. For example, linear networks in China's infrastructure should be reconstructed as loops, valves should be employed to separate damaged areas into blocks, and redundancy should be introduced, in addition to increasing structural strength and following the other important points raised. A sounder administrative system is also required.

Specific examples of the engineering-oriented approach to gas supply were presented. Systems should be divided into groups. Shutdown valves with district regulators that respond in emergencies and other such measures are needed. It is necessary to make backup systems for systems operating with computerized information; also supervisors are needed.

There is no end to safety assurance. So, the question of defining how long such redundant loop systems should be extended remains.

Fundamental requirements were also presented as part of the Philippines' measures regarding highway damage. Alternative roads should be constructed, bridges should be strengthened, and portable bridges should be made available.

Now that global depletion of resources and environmental degradation have been pointed out, we need to reexamine how we develop infrastructure. Under the present circumstances, we might not be able to improve our living standard further if we must rebuild present facilities. How we can equally enjoy a good standard of living will be a problem to be solved.

Discussion

Following Kobayashi's comments, the chairman commenced with the floor discussion. The coordinator, five speakers, and a commentator participated as panelists. Questions were collected from the general participants during the coffee break. Details of the discussion were as follows.

Fusetsu Takagi

I received a question from the floor – from Mr. M. Ameen – about non-structural measures. His question is: "Everyone is apprehensive towards a strong man and this also applies to nations. This can be referred to as a mental disaster, and its influence is apparent in developing countries. The ratio of occurrence of such a disaster is higher than that for natural disasters. What risk calculation method, equations or the like do you think is needed to solve this problem? What disaster prevention measures are needed?" I'd like to ask Professor Shinozuka to comment on this question.

Masanobu Shinozuka

Structures are designed to respond to a certain level of safety, while engineering reliability is used to define the resistance of a structure to a risk. When we design a structure, we take the risk capacity of a society into account.

The idea that a weak country fears a strong country is quantitatively immeasurable, and the level of apprehension may vary from person to person. However, this concept deserves due consideration. We need to obtain a social consensus.

Fusetsu Takagi

Professor Shinozuka mentioned "social consensus," and I think this correlates with the social system and way of life.

Kubo

During the past two decades, awareness of lifeline earthquake engineering has been mounting and progress has been made. What needs do experts from each nation see in the urgent establishment of urban disaster prevention and lifeline systems?

Sun Shaoping

In China, the earthquake in 1976 made us recognize the need for lifeline engineering, and the study of lifeline earthquake engineering began.

The government policy was for each agency or corporation to formulate individual disaster-prevention programmes. For example, when an earthquake occurs, we first determine how to mitigate damage; second, we strengthen access to lifeline facilities to overcome poor access to lifeline facilities; and third, we establish standards of lifeline systems within each local government. Now there are thirty-seven administrative standards and eighteen action guidelines. The government also conducts inspections of certain soils, pipes, joints, and materials.

Manuel M. Bonoan

Awareness of what kinds of impacts buildings will receive and the economic ripple effect after the construction of lifeline systems has been mounting in the field of lifeline engineering in the Philippines. The government has established programmes to upgrade design parameters for the construction of lifeline systems and for upgrading buildings and facilities, with great emphasis on comprehensive maps concerning observation equipment, earthquake faults, and hazardous areas.

The government is working to organize emergency operation units and to establish a system that ensures quick response in an emergency by modifying various agencies. Safety assurance measures are incorporated in plans to strengthen the facilities themselves. The present task is to enhance the added value of a structure by increasing the strength of a building when it is reconstructed, with the aim of achieving sustainable economic development.

Jamilur R. Choudhury

I think one problem in developing countries is that they cannot invest the same amount of capital as developed countries in disaster mitigation programmes. My question to Mr. Yoshikawa is, in laying the supply network of Tokyo Gas, what is the difference in investment between areas with earthquake-resistant measures and those without them? In other words, earthquake countermeasures account for what percentage of the total investment?

Yoichi Yoshikawa

I understand your question in this way. Instead of the cost of countermeasures such as earthquake monitoring, is it advisable to replace old conduits with new and what is their effectiveness? The cost of the earthquake monitoring system is fairy high, given that there are 356 seismometers as well as wireless equipment. As wireless systems are essential, we have omitted them from the discussion. As to other systems, we have invested ¥3 to 4 billion. This is far lower than the cost of replacing old pipes, which is almost one-third the cost of extending pipes. At less than 1 percent of this cost, we can respond to an emergency.

Fusetsu Takagi

Simulations are used to clarify problems that exist before and after the disaster, to formulate plans, and to carry out countermeasures daily. How can we make use of the result of these simulations?

Masanobu Shinozuka

Simulations are psychologically useful because we can estimate the situation at the time of earthquake. They are used as educational exercises both for public authorities and the public. Also, they are useful for establishing optimal strategies for reconstruction and rehabilitation following an emergency.

The reliability of simulation systems depends on whether the system can incorporate much information. If we can enter parameters such as the number of rescue staff we can provide, the results we obtain will be enhanced. It is not costly to run simulations based on various scenarios in preparation for an emergency and subsequent rehabilitation. It is effective to use these results.

Tsuneo Katayama

The important point is to face reality. Regardless of whether a country is developed or developing, we need to determine the most serious matters.

I would like to point out that terms related to disaster prevention are used without clear definitions.

Nevertheless, there re is a clear target in lifeline engineering, and that is to ensure the endurance of main roads and alternative roads, to strengthen bridges, to build portable bridges and other very realistic and specific targets. It is important to have abstract terms but concrete objectives.

Comment from the Floor

To solve the problem of vagueness in lifeline engineering, we need the cooperation of social scientists. Also, I would like social scientists to quantify as much as possible. If not perfect quantification, at least the categorizing of major and minor issues is necessary to bridge social science and lifeline engineering. We need this approach when thinking of lifeline assurance and substitution measures.

Fusetsu Takagi

In session 2-1, we discussed problems related to structural and non-structural measures; how pre- and post-disaster measures should be predetermined; formulation of plans; design; rescue and rehabilitation; block separation and networking of lifeline systems; the need for multiple systems and substitute systems; assurance of services in an emergency; simulation technology; future infrastructure; and other themes. In the summary discussion, I will report on them in a summary statement.

Session 2-2: Disaster Management of Public Facilities, Including Schools and Hospitals

Chairman:
Naotsune Taga
Professor
School of Engineering, Nagoya University, Japan

Commentator:
Michel F. Lechat
Professor
Catholic University of Louvain, Belgium

Focal Point of the Sub-session by N. Taga

In this session, we will discuss the problems surrounding schools and hospitals, which are important urban public facilities.

Lifeline systems serve as concrete facilities that mainly aim at maintaining the conveniences of urban life. In this session, the problems surrounding citizens during emergencies are expected to be discussed. Specifically, emergency evacuation, medical treatment, and schools and hospitals in each country will be discussed. Particularly, we want to focus our discussion on such points as the functioning of schools and hospitals in an emergency, assurance of safety, and improvement of facilities as a disaster prevention base.

Paper Presentations

"Hospital Function after an Earthquake Disaster"
Masanori Izumi
Professor, Tohoku University, Japan

Most of Japan's hospitals are built to earthquake-resistant specifications. They are totally resistant to strong earthquakes of 7 to 8 on the modified Mercalli scale. However, we cannot eliminate such problems as falling items or collapsing shelves. Buildings are designed to withstand earthquakes of an intensities of 9 to 12. But breakage, falling items, and loss of functioning are likely. For hospitals, lost functioning of lifeline systems is problematic.

Earthquakes may hit during surgical operations or examinations. Earthquake-resistant designs should avoid swaying and vibration. If electricity, gas, or water supply is suspended due to a huge earthquake, a hospital would be in serious trouble. These functions must be sustained. Emergency treatment functions should be expanded.

Earthquake-resistant hospitals are technologically possible, but due to economic constraints, they are not built. Reinforcement of ceilings and windows and improvement of fittings could be economical. Structural reinforcement is rather easy, so those hospitals not designed as earthquake resistant can be upgraded.

Reducing vibration is difficult, however. Theoretically, it is possible to build hospitals that withstand vibration. Seismic resistance is feasible, but not on soft ground. Usually, underground floors are less susceptible to vibration. So patients' rooms should be on the upper floors, while inspection rooms, operating rooms, and central processing units should be situated on the lower floors.

If a lifeline system fails, all the functions of a hospital come to a halt. Suspension of communication systems may block information transmission with the hospital. This problem can be solved if a hospital is equipped with an electrical power generation capability, its own water supply, or gas storage facilities, but these are costly. With the same investment, we can build three ordinary earthquake-resistant hospitals. This is another problem.

Patients' rooms serve as relief centres when a disaster occurs. Some hospitals need to have a spacious area for a heliport and open-air tent hospital. Light injuries should be treated at nearby clinics.

Hospitals that take earthquakes into consideration should pay attention to lifeline and investment benefits. In countries where the mortality rate of young people is high, it is better to build two regular hospitals than one earthquake-resistant hospital, because many more lives could be saved. Cost-effective measures vary according to a country's circumstances.

Due to population increases, the numbers of affected people and buildings will increase. Among other things, economic pressures inhibit disaster-prevention measures. Therefore, population increases should be curbed by all means.

After all, disaster prevention and control depend on education and the economy. We can only improve these factors by ourselves. Depending on national requirements, the plans for earthquake-resistant buildings and maintenance of functions should be carefully considered. We need to proceed slowly but steadily.

"Hospital Disaster Mitigation in Latin America and the Caribbean"

Claude de Ville de Goyet, M.D.
Chief, Emergency Preparedness and Disaster Relief Coordination Program
Pan American Health Organization (PAHO), World Health Organization (WHO), USA

Hospitals in Latin America are not at all earthquake resistant. When hit by a hurricane, hospitals either collapse or remain inoperative for several weeks. Volcanic eruptions have also affected hospitals seriously.

Why are hospitals in Latin America not designed earthquake resistant or windproof? Most hospitals are very old. If not already collapsing, they are old enough to collapse in an earthquake or hurricane. These points are often overlooked. There are many experts and architects in Latin America who have much knowledge in this field. If they are given the opportunity, they can apply their expertise.

Shortage of capital is a problem; however, huge sums are not needed to build new facilities that can withstand earthquakes or other disasters: the investment is only an additional 2 per cent; with measures to protect TVs from falling, the cost increase may still be only 2.3 per cent.

Economically, the use of existing buildings takes precedence. However if we provide disaster-proof equipment for extremely old buildings, the cost will be very high. For example, renovation costs account for 20 to 25 per cent of initial construction costs. We have to expect loss of invested capital if we include construction costs as well as total costs. Hospital operations would be suspended and revenue would not come in. These three factors would be involved.

The earthquake-resistant design of hospitals should be better than that of ordinary buildings. The first reason is that if a hospital is closed right after an earthquake, the minimum medical treatment necessary for survival will not be provided. Second, patients who are normally weaker than healthy people are entitled to special protection.

A Costa Rican hospital renovation project was undertaken. If this renovation work had been done before the earthquake hit, we could have saved a sum exceeding the total renovation budget of all hospitals in the nation. This is the lesson we learned.

Organized efforts and upgrading of existing facilities are needed. To achieve this, related engineers and architects should cooperate and hospitals should participate in these efforts. Standardization is also needed. A shortage of capital may certainly be a problem for us, but this IDNDR project can lead to the promotion of regional level IDNDR.

"Cyclone Shelter and Its Multipurpose Use"

Jamilur R. Choudhury
Professor of Civil Engineering
Bangladesh University of Engineering and Technology (BUET), Bangladesh

We implemented a new cyclone shelter programme during the past year in Bangladesh.

The high tide caused by a cyclone can reach as high as 4.5 to 7.5 m. We cannot know where they will strike. During past thirty years, thirty-five cyclones have struck the country. In 1970, a cyclone with surges of 6 to 9 m hit the country, killing half a million people and causing extensive damage. The coast of Bangladesh stretches 700 km, and any part of it can be affected by a cyclone.

We studied high-risk areas and the areas requiring protection against storm surges. The high-risk areas are now home to 5.2 million people. The master plan for this programme targets the year 2002, when the number of people in high risk areas will increase to 6.35 million, with buffalo increasing from 1.26 to 1.41 million and goats and sheep increasing from 850,000 to 1.13 million.

We need to evacuate people from high-risk areas. It is difficult to do this because they need to move about 20 km. It is possible to protect them by building embankments, but these are costly because they must be 6 to 7 m high. We will build embankments for areas where infrastructure exists that must be protected by every means. For other areas, such as agricultural areas, this is not economically feasible. It costs US$2,500 to build a sturdy room in a home; this is equivalent to three years' income for the average person, an impossible sum.

For these reasons, community shelters must accommodate people and livestock. We have already built several shelters costing US$750 per m^2. Economically and socially, it is almost impossible for us to build them now.

The community shelters we now have in mind are very expensive. A multiple-use design is necessary, because use once or twice every four to five years is uneconomical. We found from questionnaires that the shelters could be used as elementary or secondary schools during normal times, and that they should be located within 1.5 km of residents or evacuation would not be possible; moreover, we need to build shelters for livestock. It was found that a shelter called a *killa* that is built on raised ground for use as a primary school and accommodating 1,750 people is the most effective. The livestock remain on the hill and the people go into the shelter.

Inside the shelter, we need water and toilets. Electricity is provided from solar energy. TV is provided to facilitate communication. It is also necessary to develop a warning system as well as to establish a network of emergency volunteers.

We need to raise awareness of disaster prevention, so training should be provided. We are considering providing financial support in the form of loans for house renovation.

Increasing individual incomes is also necessary.

We hope to implement this programme by the year 2000. Then, 6.4 million people will be protected against cyclones and one-third of the total population will use community shelters.

"Disaster Protection of School Buildings"

Badaoui M. Rouhban
Natural Hazards Programme Specialist
United Nations Educational, Scientific and Cultural Organization (UNESCO), France

Schools present a specific value. In developing countries in particular, they are the largest public buildings in a community, so their social value is very high. Since many social and cultural activities take place in them, schools in disaster-prone areas should be given special consideration.

For the long-term growth and development of a country, existing schools should be reinforced. They should be designed as safe for the future. The purpose of disaster-proof and earthquake-resistant architecture is to secure the safety of those accommodated and to provide them with a refuge as well. These two objectives should be incorporated in the design of schools.

In Bangladesh, nearly 95 per cent of the schools are used as relief medical centres. Communities can consider countermeasures in the simplest ways. One such way is to put schools on raised ground or to raise their floors.

As risk mitigation measures in schools, teachers and students can promote disaster preparation; opportunities to consider disaster-prevention education should be provided.

Existing buildings should be reinforced. For new school construction, the following should be considered: earthquake-resistant design, preservation of scenery, appropriate construction forms, and use of quality materials. Cantilevers and balconies should be removed. Materials must be tightly fastened together. These are not costly measures.

As to the technological aspect of cyclone-resistant design, we can draw lessons from Viet Nam. It is necessary to designate wind zones; train and educate engineers; examine construction sites; pay attention to scenery preservation; use local quality materials; observe construction codes; reinforce fittings and joints; use reinforced concrete beams; put supports in long external walls; and select building materials with low maintenance costs. Existing educational facilities should be rebuilt to earthquake-resistant designs to ensure easy maintenance. These are the lessons learned from Viet Nam.

A chain of collaboration from the community to the administrative level, administrators, engineers, the community, and emergency planners is most important. With this collaboration, we can raise the awareness of people in various fields. If Japan has been successful in disaster mitigation, communities have been successful in facilitating communication among many partners.

The size of typhoon-resistant school buildings should be considered. In Viet Nam's case, many guidelines are regulated at the administrative level, and they should be disseminated at the community level. These guidelines are also used for building maintenance.

The whole community should think about the protection of schools that are not well protected against disaster.

"Seismic Damage and Reconstruction of Tangshan City"

Xie Zongfu
Advisor, Tangshan Construction Committee, P. R. China

In 1976, Tangshan was hit by a magnitude 7.8 earthquake. Transportation, electricity, communication, and water supply were totally blocked. The death toll was 148,000, and damage amounted to 3 billion yuan. Ninety-four per cent of non-industrial buildings collapsed and 80 per cent of industrial buildings collapsed or were damaged.

The lesson we learned from this earthquake from the viewpoint of urban planning is as follows:

(1) Earthquake resistance measures were not applied to many buildings.
(2) In Tangshan, a city of 1 million, the buildings and structures are close together, with a construction density of 70 per cent and population density of about 15,400 per km^2 in the Lunan district at the epicenter. The rescue vehicles could not approach because of narrow streets that impeded relief activities.
(3) The distribution of the city was not rational and the sites chosen for structures lacked a scientific basis and reliable geological engineering data. The main buildings in Lunan were distributed along both sides of the fault.
(4) The structure of many buildings was not rational, with poor construction quality evident.
(5) The importance of vital engineering for hospitals, water, electricity, communication and transportation systems was not understood correctly. No earthquake resistance measures were taken to protect them from damage.

During the post-quake reconstruction, from project design to reconstruction, we implemented a policy of putting disaster prevention first in earthquake-resistant structures. All earthquake-resistant projects had been carefully thought out and all buildings and structures were built according to national regulations. Now Tangshan has been rebuilt as a new earthquake-resistant city.

Building layout and functions are allocated rationally. Factories and citizens mainly in the old district were moved to other places.

Sufficient greenery and open space necessary for refuges should be planned in housing projects. To provide safe and swift evacuation and relocation, the construction density of these residential areas should be rationally determined.

From the selection of construction sites to the design of structures, earthquake-resistance should be provided. Where construction on soft ground is unavoidable, ground reinforcement should be provided. Earthquake-resistant designs for buildings must observe the state-regulated earthquake resistance standards for an earthquake of magnitude 8. Earthquake-resistant structures should be reinforced if they are important buildings.

Earthquake resistance programmes for municipal facilities should incorporate an earthquake-resistant water supply. We have adopted a looped water distribution system with four water sources. A failure in a source or supply pipe will not disrupt the water supply. Exclusive water-supply sources should be made available in the factories of volume users, so that they can have a supplementary supply.

Urban electricity transmission should be based on a layout with multiple power sources and loop transmission circuits. Electricity is transmitted through underground cables to central main roads and important factories. Some factories and structures have adopted dual-circuit power transmission systems.

To prevent network failure, earthquake-resistance measures for communication facilities should be provided and a radio network should be established. Earthquake-resistance measures should integrate communication facilities and buildings.

"Island of Civilization: Key to Urban Disaster Mitigation Due to Large-Scale Lifeline Functional Failure"

Haruo Hayashi
Associate Professor, Hiroshima University, Japan

The powerful Typhoon No. 19 hit the Old City of Hiroshima on 27 September 1991. This area spreads from the mouth of the Ohta River, where most of the city's 1.08 million residents live. Strong wind blacked out 390,000 of the 399,000 homes in the service area. Although recovery went smoothly, the power failed again on 30 September in 62 per cent of the households in the Old City because salt infiltrated the power distribution facilities. This salt was brought up from Hiroshima Bay by the stormy winds. A power failure did not occur in the urban centre of Hiroshima, however, so I would like to call this area an "Island of Civilization."

Most of the electricity in Hiroshima is supplied through above-ground distribution facilities. Salt adhering to them began to dissolve in the rain on 30 September, causing scattered leakage. This was the cause of the 30 September power failure. The blackout did not occur in the Island of Civilization thanks to the CAB system, which is a system of putting distribution lines in underground cable boxes. High voltage lines as well as terminal transformers and receivers are housed in the underground boxes, which prevented salt damage.

Nearly 70 per cent of the volume consumers are located in this cultural island. Specifically, public facilities are supplied 220,000 kw. City Hall, universities and prefectural hospitals suffered no blackouts. Four department stores and two shopping malls were also undisturbed. The lifeline systems centre, Hiroshima Station, the bus station, and the headquarters of electric power, gas, water, and sewage, and newspaper companies were also unaffected. Although the areas affected by the power failure were rather large, such important urban structures as the Central Wholesale Market, Hiroshima Bank as well as various services to the citizens remained functionally sound.

We conducted a survey of Hiroshima citizens on how the cultural island influenced the lives of the surrounding citizens. People living in detached houses experienced an average of three days of blackout; those in complexes suffered from both power failure and suspension of water supply because no power was available for the water tank pumps.

As to the question of when the blackout became unendurable, the peak was the third day. A high percentage felt anxiety about the future and their experience with this disaster. Anxiety about whether hospitals functioned was rated lower.

Why did they feel this way? Because minimum service was provided in the Island of Civilization, and people were somewhat assured they would manage.

We have discussed the strengthening of individual facilities so far. These examples teach us that we need to transcend each block or area facility when we think about enhancing disaster-prevention functions.

According to the power company, the CAB system is somewhat susceptible to floods and their earthquake resistance is unknown. Other means of disaster prevention in flat areas, such as separating the area into blocks will be needed to maintain urban functions, at least in one location, as a precaution against disaster.

Comment by **M. F. Lechat**

When we selected the theme of the IDNDR several years ago at the IDNDR Science and Technology Committee (STC) for the United Nations, we placed priority on the protection of children at school. What influence does a school have on the public when disaster strikes an area? We selected speakers keeping in mind that disaster prevention and mitigation should be discussed from a wider perspective for facilities such as hospitals.

First, it is important to protect such essential public buildings as schools and hospitals from collapse. For this purpose, we need to apply earthquake-resistant engineering, perform case studies, determine countermeasures for the future from past lessons, and carry out case studies of Latin American earthquakes. Computer databases are useful for categorizing the vulnerability of hospitals and can be applied to other buildings. Moreover, we need input from hospital management. These points are not fully recognized in many countries.

Reconstruction is certainly costly. It is not a matter of designing a structure that will not collapse, but rather making a flexible structure that allow people to remain safely in a partially collapsed building. Since this problem is addressed in the projects of the IDNDR, we can provide cooperation.

Second, public facilities, including schools, are designed for use as refuge centres in the wake of a disaster. Also, a school can be used as a forum for providing disaster-preparedness education from the viewpoint of disaster management, and the disaster awareness of teachers, students, and their families should be enhanced in school.

It is impossible to prevent the disasters themselves from occurring. We are able to mitigate a disaster in certain ways, but not to prevent a large-scale disaster.

Bangladesh presented us with a new outlook, in that they don't use schools as shelters, but rather build shelters and use them as schools during normal times. We need to conduct an analysis of the vulnerability of public facilities, to regard a shelter as part of daily life and to integrate the participation of local citizens in the concept. Then school teachers, for example, can become disaster managers, and shelters will be used as schools. This concept is also applicable in other countries and for other type of disasters.

Discussion

Following Lechat's comments, the chairman commenced with the floor discussion. The coordinator, six speakers, and a commentator participated as panelists. Questions were collected from the general participants during the coffee break. Details of the discussion were as follows:

Masanori Izumi

A question from Mr. Kishigami, a member of the Committee for Natural Disaster Prevention of the Japanese Association of Hospitals, concerns the emergency evacuation of medical institutions, of which there are two scenarios: one is evacuation from natural disasters; the other, evacuation from fires. For safe evacuation of patients, many helping hands and appropriate evacuation tools are needed. Good cooperation with local citizens and repeated training of helpers are needed, otherwise evacuation may not proceed smoothly. What is a good way of doing this? Mr. Kishigami's other comments were: "When patients are evacuated from a hospital to the outdoors or to other facilities, many problems arise, such as providing meals for patients, continuing medical treatment, readying hygienic facilities and so on."

Let's do what we can do now. We should make sure that we are following the right

path. As to evacuation from natural disasters, I believe Japanese hospitals would not collapse, although I would like them to be stronger. So, mostly disaster-relief measures will be needed.

For fires, initial planning is important. For example, high-rise hospitals should be built in designated fireproof areas.

The difficulty of daily training means that local cooperation is not always available. For this, my suggestion is "give-and-take" relations with local residents. In other words, hospitals should offer neighbouring families medical services without making them wait too long.

It is very difficult to build medical institutions, considering cases in which patients are evacuated from other facilities. In an emergency, we need to survive together in cooperation with other patients. As Dr. Goyet mentioned in his presentation, what is most costly in hospital construction is the facilities, not the reinforcement of fire resistance. There are many kinds of flammable gases and chemicals in hospitals, so strict management of these chemicals is required. First, we need measures to prevent fires, and second, we always need to be prepared for a fire.

Claude de Ville de Goyet

I agree that local cooperation is important. Latin American hospitals cannot always have redundant facilities.

Kishigami

My question refers to how hospitals can respond to emergencies. As to evacuation, fire extinguishing is only a means of evacuation. Hospitals need to protect patients' lives first; fire extinguishing comes second. However, administrative authorities think it is important to extinguish fires. They don't provide much guidance concerning evacuation tools. For understaffed hospitals, we want them to consider evacuation tools; for example, a tool to lower patients quickly from the upper floors, or tools such as gas masks for secondary helping hands and those who cannot evacuate quickly enough. I learned that a universal evacuation tool for descending the stairs was developed, but such tools are too expensive to adopt right away.

Naotsune Taga

We tend to think that a hospital is a place to get treatment for injury or as a safe refuge. However, now we know and agree that a hospital's priority is to treat in-patients daily and to evacuate them safely to other places in an emergency. Problems confronted by hospitals are very complicated because of these aspects and because of priorities; specifically, which comes first, fire extinguishing or evacuation.

In the wake of the earthquake that occurred in Hokkaido in January 1993, the medical association of Kushiro conducted a survey of medical institutions. The case of the Kushiro earthquake was not as serious as to require patient evacuation. The magnitude was 7.8, representing a seismic intensity of 5 to 6. How to evacuate in-patients from a hospital is a big problem we need to tackle in the future.

Jamilur R. Choudhury

I have received four questions from Mr. Amin. The first concerns statistics on houses, hospitals, and schools located along coastal zones prone to storm surges. The area of this district is 9,182 m^2, calculated from an average 13 km-wide shore belt area. The public buildings have a capacity of 500,000 people. In addition, fifty private buildings over two storeys can accommodate 100,000 people. Another 451 detached buildings can also accommodate people. These details are input into a computer database and integrated with a geographical information system.

The second question is that, as the government constructs hospitals and educational facilities with a five-year plan, do local governments consider storm surges caused by

typhoons when a new facility is constructed? The answer is that we take shelter plans into consideration. Public facilities to be constructed as part of the local government's plan are to be at least two storeys, particularly those built in high-risk areas.

The third question is about whether it might be better to reduce costs by improving existing hospitals and schools for use as shelters. We have noted all the hospitals and schools that can be used as shelters, and they are designed as multi-purpose facilities. Schools can provide 2 m^2 per person as refuge shelters. Schools, desks, and chairs can be cleared away so many people can be housed in classrooms. In other public facilities, it is difficult to clear away equipment.

The last question is about whether measures to improve facilities located along the coast have been provided. The answer is yes.

Badaoui M. Rouhban

I have some questions from Mr. Yokota of Nagoya University: "How about establishing earthquake-resistance standards to fully apply them to existing schools?" "We need staff to inspect buildings for conformance to standards." "What is UNESCO's response to this matter?"

To raise the awareness of citizens and prepare them for disasters, we need to provide education. This is related to maintenance of existing buildings and future architectural design. If a building is constructed well under normal standards, it can achieve 80 per cent earthquake resistance. Sound construction may be 70 per cent earthquake-resistant. The remaining 20 or 30 per cent can be achieved through earthquake-resistant reinforcement.

It is important to watch whether the standards are actually followed. However, the top-down approach is not desirable. We need to start raising awareness at the community level, and community participation is needed.

As to UNESCO's role, as UNESCO is one of the United Nations' agencies in charge of science, we have provided technical assistance. We provide information on disaster-stricken countries and other information necessary for establishing building standards. In this regard, we have made available publications on educational literature, as well as provided aid for training.

Haruo Hayashi

Mr. Hamajima asked, "I heard that in many European countries, electrical cables and telephone cables (CAB) are laid in underground pipes. How does this compare with Hiroshima's CAB system? What is the difference in earthquake resistance?"

Although we do not have comparative research specifically, we have standards designated by the CAB System Research Institute for laying the CAB system throughout Japan, which I think you can refer to. In this material, statistics are cited concerning the greater use of underground cables in European and American cities.

The CAB system in Japan began in 1983 under the supervision of the Ministry of International Trade and Industry and the Ministry of Construction. The reasons for this work include beautification, reducing traffic congestion, and disaster prevention. Fire ladders are hampered by elevated cables. Also, snow removal presents a problem in snowy regions. In addition, utility tunnels allow workers to enter, but CAB do not. This system is widely used in major cities, but in Hiroshima it covers only 40 km. We have now established this system in the "Island of Civilization" as well as in small parts of the city. The earthquake-resistant design of this standard is entitled the "CAB System Draft."

Claude de Ville de Goyet

Regarding how to implement construction standards or earthquake-resistant design standards for hospitals, I think the top-down approach is workable. Or is it better to take the bottom-up approach, as with schools? What is a better system, to let hospitals implement construction standards or establish earthquake-resistant design standards?

Even on the same continent, conditions differ from country to country. Environmental and cultural factors should be considered when we implement disaster-prevention measures. I'd like to have comments on the experiences of Latin America.

Badaoui M. Rouhban

The bottom-up approach is doubtful for hospitals, because all hospitals are managed by the government. So it sounds difficult to enforce something at the community level. The point here is whether it is acceptable for public buildings constructed by the government to be destroyed in a disaster.

Caribbean coastal states do have construction standards but they don't have any legal weight. They should be made into binding legislation. Then the government can legally enforce them through the top-down approach. It is required that the international community apply some kind of pressure on each government to adopt earthquake-resistant designs and construction standards that take cultural differences into account.

Naotsune Taga

Am I right to say that the bottom-up approach refers to local communities building the structures they need themselves?

Badaoui M. Rouhban

Right. Japan's experience would be useful. It appears that Japan takes the community-support, bottom-up approach. Not all support is given from the government. Am I correct?

Masanori Izumi

It is quite difficult to define which approach Japan takes. For example, an earthquake occurs only once in several dozen years. After ten years, people forget about earthquakes and the bottom-up thrust weakens. So in Japan, the minimum requirement is the top-down approach, with other things accomplished through the bottom-up approach. The Government of Japan also recognizes this. When the earthquake-resistance code was revised several years ago, many people suggested that standards be multiplied with an importance coefficient and be incorporated into legislation. They wanted to make important facilities stronger than ordinary ones. But the government refused to incorporate them, saying that the law is the minimum code and the importance coefficient would not be incorporated. I would like to remind you that Japanese construction laws have binding force.

Naotsune Taga

Laws are designed to regulate the strength of materials that can sustain a specified earthquake intensity. Whether a building is designed to withstand a large earthquake is totally dependent upon the builders.

Comment from the Floor

I am a civil engineer in Pakistan. We hope you will provide developing countries with a variety of information and that we can have your assistance so that we can strengthen our lifeline systems.

SESSION 3

LOCAL DISASTER MANAGEMENT AND PEOPLE'S PARTICIPATION

Coordinator:
Hiroshi Higashiura
Deputy Director General
Disaster Relief and Social Welfare Department, Operation Sector
The Japanese Red Cross Society, Japan

Rapporteur:
R.B. Singh
Associate Professor, Department of Geography, University of Delhi, India

Focal Point of the Session by **H. Higashiura**

In session 3, we would like to focus our discussion on local administrations and public participation in disaster prevention. When a city is struck by a disaster, effective local government aid is very important, and a spirit of cooperation among local communities and the initiatives of corporations, volunteers, and NGOs is important as well.

It is difficult, however, to make a practical local assistance network because a loss of solidarity and a diminishing sense of initiative in urban areas has led to the fragmentation of community networks, and many people are unfamiliar with their surroundings. Under these circumstances, it is very important to disseminate information on the disaster potential to citizens in order to raise their disaster awareness and preparedness.

Disaster-prevention management, information strategies, public participation, disaster prevention, and volunteer roles will be discussed. Local governments should be responsible for administering disaster prevention programmes and should prepare for disasters. They also need to distribute information on current risks to citizens and private enterprises. With the lessons learned from the experience of past disasters, we will discuss effective strategies, information strategies, public vigilance organizations, NGOs, and volunteer activities. The Japanese Red Cross Society, an authorized public organization, has emphasized volunteer activities, particularly for disasters, trains leaders, and plays a role in organizing volunteer activities during an emergency.

Session 3-1: Information Control and Disaster Management by Local Administrations

Chairman:
Keizo Okabe
Professor, Teikyo University, Japan
Professor Emeritus, University of Tokyo, Japan

Commentator:
Robert M. Hamilton
Special Assistant to the Chief Geologist, United States Geological Survey (USGS), USA

Focal Point of the Sub-session by K. Okabe

Local governments should formulate disaster-prevention measures that are better suited to local areas. There are many challenges facing major cities when they ask for public cooperation. For example, their population density is very high, with high demographic mobility and fewer permanent residents.

Besides administrative efforts, problems such as damage estimations as well as hazard maps should be made available to citizens to deepen their understanding before their cooperation is sought. Problems related to information dissemination will also need to be addressed. Information makes us think of evacuation orders or warnings of imminent disaster. In line with this information, we think that exchanges of information in our daily lives to deepen understanding of disasters are also important.

Paper Presentations

"The Development of Urban Disaster Prevention in Nagoya City after the Ise Bay Typhoon"

Nobuyoshi Tsuji
Commissioner, Chief Executive, Fire Department, City of Nagoya, Japan

The Ise Bay Typhoon struck Nagoya on 26 September 1959. The storm surge eroded reclaimed land and the bordering residential areas. At the same time it destroyed many banks along rivers and the seacoast. There were about ten timber storage basins that stored 183,000 m^3 of timber, and nearly half of this was washed away. In the city, 1,900 people were killed or missing, and more than 40,000 were injured. Casualties were concentrated in specific areas. Insufficient information, such as evacuation warnings, and a lack of refuges were contributing factors.

The characteristics and factors of the damage were as follows: (1) coastal and river embankments that were built according to expectations based on experience were not strong enough to block the storm surge; (2) citizens were not aware that they lived below sea level; (3) refuges were scarce and distant, and their locations were not known to citizens; and (4) disaster-prevention planning and land-use planning did not cover the rapid urbanization of reclaimed land that was below sea level.

Many post-typhoon reconstruction efforts were made: (1) the Transport Ministry built a 6.5-6.8 m high, 8,250 m long storm surge break in the Port of Nagoya. The Port of Nagoya is now equipped with seventy-one wave-protection walls and doors; (2) a specialized port for timber storage was made, located far from residential areas; and (3) the Disaster Prevention Committee, a volunteer organization, was established. The role of this committee is to conduct surveys and report daily on hazardous areas, to improve the residents list, to conduct research

on emergency food, and methods of allocating relief goods, evacuation guidance, and management of refuges. Some 5,150 people are involved in these jobs. We are now emphasizing development of voluntary disaster-prevention organizations in which each person cooperates with their neighbourhood. We have now 3,500 such organizations with a 73.8 per cent participation rate.

Meteorological forecasts can predict precipitation for three hours ahead. Predictions of abnormal weather have never been wrong. The relationship between precipitation near a river source and rivers flowing across more than two prefectures or those covering a wide area are analysed. From these analyses, predictions of river flooding are disseminated to related organizations as flood predictions or flood warnings through national authorities. As to small and medium-size rivers in Nagoya, the city authority collects data from twenty-eight precipitation observatories and twelve water-level observatories established by the city. When river levels show an abnormal rise, a warning is issued and data on river water levels is made available to related disaster-prevention organs as necessary. We have made public the following general disaster-related information: (1) rivers, ponds, and other bodies requiring caution; (2) groundwater and land subsidence; (3) landslide-prone steep slopes; and (4) lists of firms storing large volumes of hazardous petrochemicals. Information needed in an emergency is collected and transmitted via cable or radio to the city office and each ward office.

"Experiences, Strategies, and Courses of Action for the Prevention and Management of Emergencies in Mexico City"

Efraín de Gyvés
Director General of Civil Protection, Department of the Federal District, Mexico

The General Direction of Civil Protection was established in 1983 to protect Mexico City and support its reconstruction. This office is still small, but it has formulated a basic approach to disaster prevention.

The major lesson learned from the 1985 earthquake was that we need to provide all available information from national authorities via the mass media. In particular, it is important to disseminate earthquake assessments within one hour of an occurrence.

The lesson learned from the 1992 Guadalajara incident is that it is important to conduct permanent monitoring of facilities that deal with highly hazardous substances such as hydrocarbons or petroleum. Also, smooth communication between the General Direction of Civil Protection and decision-makers working at disaster sites is necessary.

The lesson learned from fires in Minabela is that we need clear-cut strategies. First, it is important for us to emphasize disaster-prevention activities, particularly where structural risk assessments, assurance of lifeline systems in urban areas, and voluntary disaster-prevention organizations are required. Second, we need cooperation between citizens and public disaster-prevention organizations. Third, a system for immediately assessing a disaster is required. Fourth, effective collaboration with aid donors is necessary.

There are 108 accelerographs in Mexico City that precisely monitor the distribution of earthquake motion. Regulations were established for every topography and for all structural behaviour of buildings to analyse a building's earthquake resistance. The responsibilities of the public sector, private sector, administration, lessors and facility owners were defined.

The private sector implements a weekly inspection of 408 km of oil and gas pipelines. With the cooperation of federal authorities and national petrochemical corporations, inspections have been performed at 242 gas stations. Transportation of hazardous and toxic substances has been restricted with the cooperation of the government and the National Chamber of Processing

Industries.

It takes fifty to sixty seconds for seismic waves to reach Mexico City from an earthquake occurring along the coast. From this time lag, we have begun design of a new earthquake alarm system that will increase awareness of civil protection. We have also made a family protection plan that is to be followed by families before and after an earthquake.

The Operations Center of the General Direction of Civil Protection took the initiative to establish a system of immediate earthquake assessment. Tying up with the administrative division and federal government, information was disseminated within one hour of the 14 May 1993 earthquake.

As to cooperation among relief organs, members of the city government gather every week to discuss issues. People outside the city government also participate in this meeting. Many measures are discussed there, including an inter-agency joint group for monitoring and warning high-risk areas during the rainy season.

"Seoul City's Approaches and Problems in Preventing Metropolitan Disasters"

Cheong Heung Soo
Disaster Prevention Planning Officer, Ministry of Home Affairs, Republic of Korea

About two-thirds of Korea's annual rainfall is concentrated in the rainy season from June to September. Annual precipitation is about 1,200 mm. In Korea, naturals disasters are mainly caused by floods and typhoons. Seoul and Inchon are major cities along the Han River. The population living alongside the river is 25 million. There are several dozen dams along the Han River.

The major challenge of metropolitan disaster-prevention is flood control. The drainage area of the Han River is 34,473 km^2, and 15 per cent of this is within the territory of North Korea. Records of metropolitan damage caused by floods include the 1925 floods that recorded a peak flow of 37,000 m^3, and in the 1990 flood, a peak flow of 30,000 m^3. Large-scale floods have occurred in recent years. A characteristic of the Han River flood is that its hydrograph shows a sharp peak. Property damage caused by the flooding of the Han River has been extensive in recent years. Property losses of US$562.5 million in 1990 were caused by collapsed embankments.

The lesson we learned from the 1925 flood was that people shouldn not live in disaster-prone areas. On the other hand, extensive construction and afforestation continued from 1945 to 1969. Afforestation was also carried out from 1970 to 1989. Multipurpose dams were constructed to adjust the flow level. Furthermore, an early-warning system was established. Flood-prediction accuracy was improved and various activities for raising awareness have been carried out. However, the 1990 flood made people uneasy again and further effective measures were called for.

The problem is that population increases in urban areas have led people to begin living in the river flood-control channels, and roads began to be constructed for recreational activities. As a result, the rainwater retention capacity fell and the risk of flooding increased. River flows should be controlled from upstream. For instance, more dams and new waterways are needed in the channels.

From a socioeconomic viewpoint, there are problems regarding local governments. Who is responsible and who bears the construction costs of dams or spillways? Other problems are that people live along spillways and buildings are constructed there.

To sum up Korea's future course, Korea's present problems are common to other countries. Construction of dams or embankments is a common problem. Appropriate laws and regulations as well as disaster-impact assessment programmes are considered one solution.

"Recent Earthquake in Maharashtra, India: Uncertainty, Existing Reality, and Task Ahead: A Report"

R.B. Singh
Associate Professor, Department of Geography, University of Delhi, India

Maharashtra on the southwest Indian Peninsula is not an earthquake-prone area. As past monitoring and prediction were mainly focused on the Himalayan area, Maharashtra did not prepare for an earthquake and no prediction was made.

It has been said that there is a fault where the Maharashtra earthquake occurred. Drifting of the India plate put pressure on the Tibet plate, which in turn put pressure on the centre of the Indian plate, resulting in this earthquake. Scientific analysis of earthquakes occurring in the past 100 years showed that though an earthquake might occur due to aftershocks or energy released from an earthquake, the magnitude would be less than 4.5. The National Geophysical Research Institute (NGRI) has conducted monitoring and prediction in response to a request from the Parliament.

It was found from a survey conducted in the Northern Himalayan belt that the Indian plate is being pushed northward, releasing energy along the fault. The southern fault was in a fixed state, but the northern fault was still very volatile and energy had not been released. Past earthquakes have proven that crustal stability is very relative, and that earthquakes may occur far from a tectonic plate.

This earthquake was very large, causing ground fissures for a radius of 100 km. The reasons for the large death toll were that the earthquake occurred at night and the buildings were not designed as earthquake resistant. The Maharaja provincial government announced that 140,000 people were affected. Houses made of concrete, sugar cane, and bamboo were sturdy, but those made of mud were destroyed. The houses of the poorest and wealthiest withstood the quake, but those of the middle class and worker class were badly damaged.

Relief and reconstruction was initiated by the Indian Army. The Citizens Relief Corp., voluntary relief organizations, and students provided aid to those affected. Also, medical teams conducted relief operations. Relief supplies were offered both from home and abroad. Medical supplies were airfreighted. Aid equivalent to US$4 million will be provided. The Telecommunication Agency of India immediately rebuilt telecommunication facilities.

A lack of coordination among various agencies was a problem. Refuges should have been built first. Disaster rehabilitation meetings should have immediately determined the overall disaster situation. There was no one in the central government who could manage the situation.

The World Bank promised to build 32,000 houses within a few months. It is estimated that US$4 billion is needed. The Indian government established a committee that conducted a review of disasters and revised its earthquake prediction network to carry out impact assessments and earthquake engineering research. We will include areas of the Indian Peninsula apart from the Himalayan area in the earthquake hazard map.

Special Speaker

"Indonesian Experience in Coping with Natural Disasters and the Flores Earthquake"

Soesanto Mangoensadjito
Director of the Disaster Preparedness Programme, Indonesian Red Cross Headquarters
Indonesia

Indonesia is a country of 13,000 islands formed from volcanic mountains on an east–west axis. Heavy rains and many rivers cause floods every year.

The Government of Indonesia established a national disaster–prevention organization called the National Disaster Mitigation Adjustment Bureau, known informally as "Bakarinasu." At the regional level as well, an agency in charge of disaster mitigation was established. In a disaster, the military falls under the command of the local government. Materials are supplied from the public sector. In preparation against extensive damage from occurrences such as volcanic eruptions and explosions, the government has constructed erosion control dams and has established monitoring stations. The deputy commander of the local government has conducted disaster–preparedness training for citizens living near volcanoes, and has repeated training of various warnings and evacuation orders. Local boy scouts and the Red Cross are also cooperating with the local government.

The Indonesian Red Cross conducts disaster prevention activities, but the critical period is the two weeks following a disaster and there are not many tasks for us after that. High schools also organize a Youth Red Cross. Disaster prevention materials are stored in their warehouse so necessary supplies are immediately available.

The Flores earthquake caused tidal waves and resulted in the most serious damage in the history of Indonesia. Most of the 2,000 deaths were from tidal waves. Entire cities were destroyed, and local governments immediately started relief operations. National NGOs also worked to collect relief equipment and supplies. We have received the cooperation of various Red Cross Societies worldwide, including that of Japan. Reconstruction efforts are continuing.

Flores is not as developed as Java. The local government and the local Red Cross Society have not been well trained. Because they were underequipped, post–disaster reconstruction did not go well. Flores is located 1,850 km from Jakarta. Its transportation network was disorganized. All the necessary supplies had to be transported from Java. The Indonesian Red Cross volunteer organization was sent to Flores to provide aid and received much help from Red Cross headquarters. The main job of the volunteers was to encourage the self–support of those affected.

The lessons learned from the disaster were that we need to improve our disaster–prevention plan and that we must train young volunteers. Deputy commanders should be stationed in disaster–prone areas, and evacuation training should be conducted repeatedly. To NGOs such as the Red Cross and Boy Scouts, clearly defined jobs should be assigned to focus their participation on the disaster–prevention exercises. Furthermore, we should store sufficient emergency equipment and supplies in the warehouse, and regular inspections should be made. Also, in Indonesia we require smaller, portable clinical equipment rather than large equipment.

Comment by **R. M. Hamilton**

We need to think about information control and disaster administration, focusing on the information flow following a disaster. The pre–, mid–, and post–disaster information flow is important.

Before a disaster occurs, the location of risk areas, vulnerability analysis, and a disaster scenario should be clarified to plan and formulate disaster countermeasures. After a disaster strikes, damage assessment should be carried out so that it can serve as a foundation for formulating countermeasures. By assessing and analysing the damage, necessary countermeasures are clarified for the reconstruction of disaster-stricken areas. We need to draw lessons from a disaster and revise the response plan to react better in the future. This process should be continued as part of a cycle.

The necessary functions of an information system are disaster prevention and management. More important points are (1) mechanisms for obtaining information; (2) information processing for easy analysis; (3) analysis; and (4) distribution.

The kinds of information to be provided for this system include characteristics, size, scale, and distribution of impact. It is important to clarify what areas are affected and who is to take charge. Structural, socioeconomic, and political impacts should be assessed by government agencies and by organizational units. Coordination mechanisms will be necessary. Also needed is a system to assess lifeline systems, transportation, the traffic network, communication systems, and important facilities such as petrochemical tanks, schools, and hospitals. Access to affected areas should be identified and the impact of the disaster on access points should be examined. Also to be clarified is what kind of information should be included in the government's disaster declaration and designation of specific disaster-affected areas.

After analysing the impact, the next step is to prioritize the necessary resources and countermeasures.

Let me talk about information systems, citing various examples from the presentation. For Nagoya, a shortage of warning systems and relief information prompted the establishment of an advisory system for rapid information dissemination. Disaster prevention awareness is not cultivated in the public. It was found that citizens were vulnerable to emergency. Climate prediction and weather prediction capabilities should be improved. This implies that different levels of information should be incorporated into the system.

The case in Mexico shows that predictions and forecasts are conducted. With some estimation capability, it is possible to predict what area would be most seriously affected, and a level of response and allocation would be possible. It was also pointed out that the development of an early alarm and warning system is necessary. A further improvement in response and preparedness is possible.

The case in Korea refers to the mitigation of or reduction of potential flooding. Improvements in data prediction and estimation were pointed out. This is important from the viewpoint of information resources and particularly for preparedness. Enhancing awareness among the public was also touched on.

The presentation by the delegate from India referred to earthquakes and problems in inter-plate areas. The potential of an earthquake disaster in such an area was not recognized by normal monitoring.

The Indonesian presentation touched on the specific conditions of that country. For example, transportation and traffic issues were raised. For them, disaster response entails specific requirements. People relocate in high-risk areas in Indonesia. When they move from risky areas, a completely new set of information is needed. It is therefore necessary in this area to convince the public, through sufficient educational programmes, of the necessity to relocate only after potential hazards have been evaluated.

Discussion

Following the comments by Hamilton, the chairman commenced with the floor discussion. The coordinator, five speakers, and commentator participated as panelists. Questions were collected from the general participants during the coffee break. Details of this discussion were as follows.

Keizo Okabe

Allow me to present the questions submitted. Mr. Tsutargee of Indonesia had a question for Mr. Tsuji of Nagoya. His question is whether there is any financial support from participants of voluntary disaster prevention organizations.

I'd like Mr. Tsutargee to raise the next question directly. Also, this is a question for Mr. Cheong, "What is the reason for the declining annual death toll?"

Tapasuna Tsutargee

I'd like to ask a question to the delegate from Nagoya. You said that there are many volunteers who work for disaster-prevention operations in Nagoya. What kind of support do they give you? Do you get financial support from the volunteers or in the form of labour?

Nobuyoshi Tsuji

I understand that your question is about those involved in volunteer organizations. In this regard, I am going to comment on the kind of support we get from them.

The largest objective of these organizations is defence against earthquakes. First, fires must be prevented when an earthquake strikes suddenly. "Initial fire extinguishing" is their first priority. Then they help evacuate the elderly, handicapped, infants, and children to safety. Third, they cooperate with the neighbourhood to gather information and transmit it to disaster-prevention authorities. Fourth, they procure food and other supplies. This is the support they extend to us.

Your second question was about financial support. We do not receive any financial support from these volunteer organizations. On the contrary, we donate funds of about ¥100,000 to these organizations.

Keizo Okabe

The next question is from Mr. Iwama. "I heard that the Indian government didn't accept aid, other than money donated for self-help activities. Was it possible to cover this by yourselves?"

R. B. Singh

We received various forms of aid in the wake of the earthquake, some financial, and some in the form of supplies, from the United Nations, Europe, Japan, America and others. It would not be right to refuse aid. Aid cannot be refused. However, the Indian government thought it important to encourage self-support efforts first. We could do this because we had domestic resources. In particular, we have an IDNDR domestic committee, and disaster prevention funds have been set aside by the prime minister. However, we did receive much technical knowledge and aid from various organizations. For example, we received potable water from UNICEF. The World Bank gave us technological aid.

We feel that there are other countries that are more in need of this kind of aid than India. We have our own resources so we can survive such earthquakes. Of course, we welcome technological assistance.

Keizo Okabe

Mr. Cheong, would you give us the reason the death toll has decreased annually?

Cheong Heung Soo

We have suggested the humanitarian approach to mitigate and prevent disasters. We have also suggested new policies. As a result of implementing early prevention measures before the disaster occurred, the number of people killed or missing in disasters had decreased to sixty-five by early October. The number was reduced from over 220 in the past to 200.

Keizo Okabe

Mr. Fujii, the earthquake disaster prevention manager of the National Land Agency of Japan has a question for Mr. Gyvés as follows.

Concerning the earthquake warning system that can forecast an earthquake fifty seconds before it occurs and issue warnings, my questions are as follows: (1) Is the correct scale or magnitude of the earthquake transmitted? (2) If you have conducted any surveys on the reaction of disaster prevention organizations and citizens toward the earthquake motion information before the first shock arrived, do you have the results of the survey? (3) Please tell me of any improvements made to the system following the 24 October earthquake.

Efraín de Gyvés

Technological problems were later improved. Clearly, to make the system workable, more social organization is needed. In other words, the system should be made so that people can evacuate a building within sixty seconds. How this fifty seconds can be exploited is a most pressing issue among authorities.

Fujii

My other question is whether the scale and size of the earthquake of 24 October were correctly transmitted to the Mexico City authorities.

Efraín de Gyvés

The magnitude of the earthquake was 6.7 on the Richter scale. This earthquake occurred at 2:00 a.m. As few people were listening to the radio, the earthquake warning system did not work well.

R. B. Singh

Mr. Hamilton raised two or three important points regarding disaster mitigation and risk management. I'd like to clarify other important areas, in particular, improvements to the monitoring system.

First, we need to improve the monitoring system. I'd like to stress the role of satellites and remote sensing, specifically the remote sensing IRS-1A, 1B used for earthquakes in many other countries. This monitoring system is used to take photos of actual earthquake image. These satellites and remote sensing are needed for the collection of earthquake data and improvements in monitoring.

Second, I think they will influence human activity, such as land use and public education. These factors will play an important role. In developing countries, where illiteracy due to poverty prevails, they can play a more important role.

Robert M. Hamilton

Scientists and land-use policy makers often suggest very logical conclusions for influencing human activity, but none have been realized because human beings lack the will to change behavioural patterns.

Almeida

I have a question for Dr. Singh: in responding to disasters, many experts often overlook cultural differences of specific societies. I think responses should consider cultural differences.

R. B. Singh

For this, a multidimensional study is necessary. We must pursue a comprehensive approach. Promotion of disaster mitigation is needed. India and other developing countries are characterized by highly diverse cultures. The Indian government has decided to use relief supplies and to accept reconstruction operations that are unique to India. Cultural differences and diversity should be considered.

Keizo Okabe

I would like to conclude this session. The summary of this session will be presented by Dr. R. B. Singh at the summarizing session, 4 November.

Session 3–2: People's Participation and Disaster Management

Chairman:
Yoshiro Yanagawa
News Commentator, Japan Broadcasting Corporation (NHK), Japan

Commentator:
Naruko Takanashi
Senior Researcher, The Institute for Future Technology, Japan

Focal Point of the Sub–session by Y. Yanagawa

Nagoya and Aichi Prefecture in general are disaster–prone areas. This area was hit by the Nobi earthquake 100 years ago, which led to today's earthquake engineering and earthquake–resistant engineering. More than 1,000 people were killed in the Tonankai earthquake in 1944. The area surrounding Nagoya was the centre of Japan's aircraft industry at the time, and it is said that the total collapse of the plants cost most of Japan's ability to continue the Second World War. Furthermore, 2,300 people were killed in the Mikawa earthquake that occurred the following month. The Ise Bay Typhoon in 1959 claimed 5,000 lives due to storm surges.

Japan achieved high economic growth during the thirty years without a major disaster. Aichi Prefecture became Japan's top–ranking prefecture in terms of industrial output. However, we must keep in mind that this was partly due to luck.

During the past three to four decades of high economic growth, the environment has undergone dramatic changes. Shinkansen bullet trains, petrochemical complexes, skyscrapers, and underground shopping malls have never been subjected to large–scale earthquakes. Urbanization, which is the theme of this conference, has proceeded quite rapidly during the past

three decades, and population concentration in urban areas, particularly in coastal zones, is quite conspicuous. The same trend is seen in other prefectures as well as in other countries. Adding to the situation, the aging of the population has increased the number of those vulnerable to disasters. The increase in nuclear families is causing the rapid loss of opportunities for verbal transmission of disaster experience. In other words, our society -- both in tangible and intangible aspects -- has become increasingly vulnerable to disasters, and this fact is forgotten. It is extremely important that we take note of this.

Also, there is a strong tendency among citizens to rely on the local administration. For instance, questionnaires reveal that most families do not store emergency water. Most people polled answered that they did not have to worry, as their ward office would distribute water using a water-supply vehicle. But the best disaster countermeasure is to face it head-on rather than to run away from it. At the same time, although self-preservation is supposedly a fundamental principle, reality does not confirm this. Residents overcome disasters together with their neighbours. How do other countries deal with the need to overcome a disaster through public participation? What are the problems in such a system? I'd like to welcome active discussion on these issues.

Paper Presentations

"Aichi Prefecture's Efforts against the Tokai Earthquake and Approaches to the Residents"

Hideji Aoyama
Director-General, Department of General Affairs, Aichi Prefectural Government, Japan

As a result of the Tokai earthquake theory made public in 1976, a special law was enacted. We have implemented countermeasures against the Tokai earthquake following this law. The location and scale of the Tokai earthquake have been estimated, but when it will occur is unknown. Various organizations in the country have established an observatory network to determine when.

Over a decade has passed since the damage estimation survey was conducted. In the interim, changes in lifestyle and in urban structure, rapid aging of the populace, the liquefaction phenomenon, and other new challenges have emerged. Therefore, beginning in 1991, a comprehensive revision of the damage estimation survey has been conducted.

We have made several damage estimates: predictable, unpredictable, and those involving three different factors of season, time, and climate. Damage to property and loss of human life, countermeasures for this damage, as well as the public impact of damage to lifeline systems were reported. Results of surveys of natural phenomena were revealed in June 1993. Damage estimates will be available in 1994.

A general media news embargo will be lifted thirty minutes following the committee's decision regarding information dissemination on the Tokai earthquake. Aichi Prefecture has introduced a system for summoning 300 staff members for deployment during an emergency and for emergency communication within thirty minutes by combining NTT telephone lines and computers.

In March 1988, we improved the Aichi Prefectural General Radio System for Disaster Prevention Administration, which includes a high-speed facsimile transmission between the prefectural government and disaster-prevention organizations, including all municipalities. The most effective method for municipalities to disseminate information to residents is to use the Doho Disaster Prevention Administrative Radio System, which can target home receivers or outdoor speakers. Financial support has been extended to municipalities.

It is important to prevent secondary disasters. We have organized a women's firefighting club, because women often use fire in the home, and we have also organized a similar club for boys. We have promoted the establishment of voluntary disaster prevention groups to protect their own residential areas through neighbourly cooperation during an emergency. Since 1978, we have continued supporting these activities by providing necessary equipment; since 1990, we have provided educational activities and training. In 1990, the initial year of IDNDR, we held the first Aichi Prefectural Voluntary Disaster Prevention Organization Promotion Convention. At mid-point and in the final year, we will hold the second and third of such conferences to expand the organizations and to foster leadership.

In 1983, we established a system to register volunteers. Its purpose was not only for the protection of one's own home but also to encourage transregional cooperation. However, due to the absence of large-scale disasters, no results were achieved. Activities include assisting in disaster-relief operations and in other activities that are not dangerous. They are covered by volunteer insurance to compensate them for any accidents they may have while carrying out these activities. Social awareness of volunteer activities remains low in Japan. The method of accepting volunteers should be improved. I hope to take this opportunity to learn the situation in other countries.

It is important to begin disaster prevention education and training in early childhood. Recognizing this, we have continued efforts at raising awareness among all citizens, by distributing brochures to school children, by providing opportunities for experiencing earthquake simulations, and by other such initiatives.

"Disaster Relief Activities and Problems of Civil Protection Organizations in the World"

Sadok Znaidi
Secretary General, International Civil Defence Organization (ICDO), Switzerland

During the twentieth century, the world population exceeded 1 billion and is now reaching 10 billion. This fact is often overlooked. The increased risks of natural disaster and man-made disasters have mounted at an unprecedented rate.

The civil protection movement is contributing to the mitigation of the national disaster rate. ICDO, at the forefront of this field, has emphasized the important role of civil protection authorities in each nation. In particular, we have emphasized the importance of disaster preparedness, relief, mitigation and particularly their necessity in developing countries. Effective measures can also contribute to the economy. So we must see the economic impact of a disaster.

The twentieth United Nations General Assembly was convened in 1965. It was suggested that each state formulate an optimum, integrated relief system, and the suggestion was adopted as *Resolution 2034*. Consequently, state-level civil protection organizations were established in each state.

The mission of the organization is to strengthen, organize, and make policies on relief activities. Disaster prevention schemes are also included in emergency planning, which is part of the civil protection activities.

The international community must note that natural disasters have had adverse effects on many regions in the world, with a particularly severe structural impact on the economies and societies of developing countries.

From the beginning, the ICDO has made efforts to instill international recognition of the concept of civil protection and safety, and has advocated concepts that concurred with the UN

resolution. The National Civil Protection Committee has been established in which all the cabinet ministers participate under the leadership of the prime minister and the government. This committee can formulate a civil protection bill and action plans for the mitigation of disaster damage.

In many parts of the world, civil protection organizations have ensured tie-ups and affiliations on a bilateral or multilateral basis with other countries to ensure internationally or regionally organized support.

Besides bilateral and multilateral agreements, we have created guidelines that have three objectives to facilitate communality among EC nations: (1) Establishing guidelines; (2) People in charge of civil protection support the organizations by mobilizing the resources of the twelve member states so that they can react to risks; and (3) Assessing the needs of disaster-stricken countries through the guidelines.

There are three major keywords to describe the regional approach of disaster prevention plans: harmonization, cooperation, and communication.

Civil protection is long-established in my country. But some countries are hesitant, and civil protection is sometimes low on the list of development priorities.

One of the reasons is that the term civil protection does not necessarily have a universal definition. Another reason is financial difficulty. Also, recognition of civil protection organizations differs greatly due to differences in history, cultural background, political options, level of reception, and economic requirements.

ICDO thinks that this civil protection organization should be given substantial authority that is adequate for day-to-day and emergency requirements.

Although civil protection has a cost, a disaster could cause a nation serious economic loss. If the nation had invested in disaster-prevention measures, the investment could become a positive factor for that nation's economy.

ICDO believes that civil protection organizations should direct their activities in such a way that they can fully meet their responsibilities in disasters of socioeconomic and human significance.

"The Disaster Reduction Role of Government in Enhancing People's Participation"

Lei Zhiyan
Vice-chief of Section, Disaster Relief Office of Sichuan People's Government, P.R. China

A variety of natural disasters occur frequently and widely in Szechwan Province, and losses are heavy. To mitigate losses from disasters, the government has established a set of policies, and much money and many personnel and material resources have been applied to disaster reduction. Our resistance to natural disasters has been greatly improved.

Millions of volunteers, citizens, and military personnel organized under the leadership of the Szechwan government have participated in disaster damage mitigation activities. Several hundred thousand cooperative relief teams have been set up, and their ability to limit disaster damage has been strengthened.

Szechwan Province, which has a varied topography and climate, is vast and is one of the most severely disaster-prone provinces in the country. The cost of damages reaches an annual average of 300 million yuan.

Unique geographical conditions and climatic features have resulted in six disaster characteristics:

(1) Many kinds of disasters occur, such as floods, rainstorms, heavy snow, drought, earthquakes, mud flows, storms, hail, and forest fires. Sometimes two to three natural disasters occur concurrently.
(2) Vast areas are struck by disaster. According to informal statistics compiled over the past ten years, more than 100 regions have been struck by natural disasters annually, and 2.577 million people are affected by disasters every year.
(3) Damage to agriculture and industry is particularly serious. The impact on agriculture is great and relief operations must be made mainly in agricultural areas. Those affected are the poor who cannot withstand disaster damage.
(4) Drought and floods are the most common disasters.
(5) Two different disasters can occur in one area concurrently or consecutively.

The power of society and the government is more important than the power of an individual in disaster prevention. The Szechwan government has implemented the following measures to promote awareness of disaster prevention.

(1) Formulating disaster reduction policies such as the "Szechwan People's Government Notice of Strengthened Earthquake Forecasting and Disaster Relief Work."
(2) Disaster mitigation authorities analyze the status quo and make efforts to introduce disaster-resistant facilities.
(3) Establishing the Disaster Prevention Committee to promote activities of public organizations as well as to facilitate exchanges of scientific research. Advice is provided to citizens.
(4) Investing large sums on construction of disaster installations to rescue those affected.
(5) Establishment of a command system for disaster reduction.
(6) Promoting the practical application of scientific research.
(7) Establishing an emergency summoning system for the military and police for swift reaction to disaster.

To raise citizen awareness, we have continued the following activities.

(1) Increasing public knowledge of natural disasters.
(2) Presenting awards to model individuals and units for successful disaster reduction.
(3) Individuals from various circles are urged to associate with those affected through various social activities.
(4) Publishing disaster prevention measures in Szechwan Province.
(5) Training qualified persons.
(6) Establishing disaster insurance and mutual aid funds for humanitarian reasons.

"A review of Volunteer Relief Activities in San Francisco Following the 1989 Loma Prieta Earthquake"

Frank T. Blackburn
President, Portable Water Supply System Co., Ltd., USA

Before reviewing the volunteer activities that followed the Loma Prieta earthquake in 1989, I would like to look farther back into history.

San Francisco has experienced large earthquakes for many years. This fact has convinced us that it is important for a society to conduct volunteer activities. Volunteers made a major contribution to the city's firefighters after the San Francisco earthquake and subsequent fires in 1906. There have been changes in the city's administrative laws that have organized

volunteers into a semi-public firefighting organization.

From this lesson, the city officially established an organization called the Fire Reserve. This is a citizen volunteer firefighting organization whose job it is to help the Fire Department during a disaster. They work only in emergencies and without pay. If they are injured, the city pays their medical fees and rehabilitation expenses.

It is very important to define the job assignments of these volunteers. It is also necessary to identify their functions in an emergency as well as their communication method with the public authorities.

We must ask only for realistic assistance from volunteers, and we must be sure to specify tasks that interest them. We must avoid requesting very complex jobs of them.

We have asked them to control traffic during disaster prevention exercises. This enabled us to perform large-volume water supply exercises for several hours, which give us invaluable experience. What also deserves attention is that we have the participation of several other volunteer groups.

In the 1989 San Francisco earthquake, an extensive area along the bay was damaged. The San Francisco area as a whole received serious damage. More than twenty fires broke out in the city.

Volunteer activities are divided into two stages: the actual emergency and the post-disaster stage.

Volunteers assisted firefighters on the morning following the earthquake. Firefighters were exhausted because they continued relief operations for three days in succession. The volunteers' assistance was of great help to them.

There are many volunteer organizations in San Francisco. Emergencies have occurred more than 300 times a year in San Francisco County alone. There are small but well-trained volunteer groups. They are trained well enough that we can rely on them in an emergency. That is the situation of volunteer activities in San Francisco.

The 1989 San Francisco earthquake proved the importance of citizen volunteer organizations. They contributed greatly to mitigating a large-scale disaster. Volunteers are there to help or supplement full-time firefighters who are unable to do everything when faced with an overwhelming disaster.

"Activities of Volunteers in Disaster Management in the Philippines and Their Problems"

Lourdes C. Masing
Director, Disaster Preparedness and Relief Service, Philippine National Red Cross Philippines

We are considering the issue of citizen participation from the viewpoint of disaster-vulnerability in the Philippines.

The most important issue to face is that of the problems of metropolitan and urban areas. The recent and continuous influx of many people to metropolitan areas has been pointed out, and environmental problems are being aggravated.

I would like to present an explanation of various volunteer activities in the Philippines and I would also like to offer some suggestions.

What are volunteers? The important thing is that they help those affected find a way of living. Volunteers have participated in disaster prevention and mitigation efforts by working as organizers in their communities. However, the government is responsible for encouraging people to participate in disaster prevention systems in local communities.

How to organize local citizens is a crucial problem. New people are moving into cities and living in crowded slum areas, squatting illegally in landfills and so on, and increasing their exposure to disasters.

Organizational activities are important in communities and volunteers often visit people in their communities.

Volunteers participate in disaster management teams and get training. We need to note that disaster prevention management is not performed by the government alone, and the volunteer plays a particularly important role in the management and training of the disaster prevention administration.

The following are the roles of volunteers: (1) rescue, first aid, and nursing; (2) providing public information; (3) relief operations; (4) search and rescue; (5) forming communications groups; (6) forming volunteer medical and nursing groups; (7) food services; (8) psychiatric counseling and social work; and (9) driving, general labour, and clerical work.

Volunteers have been regarded as being well-trained and very experienced, and they comprise a disaster management organization that functions well. However, at the same time, volunteers are always being faced with restrictions and regulations. Particularly in urban n areas, there are the following problems: (1) the diversity of those affected; (2) inadequate coordination among government agencies; (3) insufficient medical and welfare infrastructure; (4) rivalry and competition among government agencies; (5) competition among NGOs and among other private aid organizations; (6) problems between NGOs and beneficiaries; (7) political intervention; and (8) rapid influx of people from rural to urban areas.

Comment by **N. Takanashi**

The difficulty of increasing disaster prevention awareness is a problem common to many countries. A great interest was shown in the problem of how we should develop or rebuild the system of disaster prevention involving private volunteers. Behind such mounting interests, there are two different approaches to disaster prevention initiatives; namely, one is driven by highly specialized administrative systems, such as that of Japan; and the other is a system centred around private volunteer groups. I'd like to have your comments on how we can develop these systems and solve these problems.

As a disaster prevention initiative, we have established a mutual support system in which neighbours lend a helping hand. This kind of system has been put into practice to some degree in every community, because this is very necessary to halting the spread of a disaster. However, voluntary aid activities from outside the affected area are insufficient.

There are two ways to give aid from outside the community. One is indirect aid by way of donations of money and materials; the other is direct support through human contributions of special skills. I would like to raise these two points mainly about Japan.

Mr. Aoyama of Aichi Prefecture pointed out that the spirit of volunteerism in Japan is rather low. However, the situation has changed significantly from the past, when support was in the form of money or supplies. Nowadays, many people give support as volunteers. While volunteers help enhance the administrative response, in some cases they might be serious

obstacles. In the case of Okushiri Island, many volunteers rushed into the small office of the Okushiri local authority, without arranging their own water or food or lodging. Lack of ethics in volunteers could also become a problem. Although their goodwill and initiative are laudable, such volunteers beg the question of whether they are really helpful.

Let me cite an example of effective volunteers. One was a transportation company that donated helicopter time. The other was an organization that offered special skills such as effective site clearing and sorting supplies effectively, or the religious group that arranged the relief supplies and cleared the disaster sites with effective organizational abilities.

The basic principle of Japan's disaster prevention has been to exclude private volunteers because of the fear of injuring ordinary citizens, or their uncertain availability. A different tendency is now emerging, and Aichi prefectural disaster prevention volunteers are a typical example. The movement is spreading to Kanagawa and Kyoto prefectures, which are now beginning to organize volunteers. The importance of well-organized volunteers with expertise and sufficient training had been pointed out by the Chinese and Philippine presentations.

How to deal with the issue of private-level disaster prevention is our first challenge. In the midst of changing circumstances surrounding disasters, we need to identify demands. On the other hand, how we integrate volunteers with initiative into the disaster prevention administration is our challenge. How we manage such volunteers after a disaster is another challenge. There is a report that, in the case of the Mississippi floods, personal computers were used to summon volunteers very smoothly. So, use of electronic media is an option. We also have the challenge of how to maintain an organization, such as through countermeasure meetings or operational centres for coordinating private disaster mitigation groups and facilitating their smooth operation. We need good advice on management skills.

The second challenge for us is distribution of aid money, supplies, and personnel. As Ms. Masing of the Philippines reported, a similar trend is emerging in Japan. For example, ¥17 billion was raised for relief of the earthquake off southwestern Hokkaido. Also, people sent in a total of 240,000 boxes of aid supplies to the island, which was about 100 boxes per home, too much for one home to accept. On the other hand, awareness of more common disasters such as landslides remains low and very little is donated. A feeling of inequality is mounting among those affected. This is our big challenge.

Unequal media coverage may be behind such unequal distribution of aid. To solve this problem, we need to formulate a disaster relief law that covers fundamental disaster aid. Volunteer activities should be omnipresent. Volunteer activities are based on free will, so psychological factors affect them. Media coverage needs to be reexamined.

Discussion

Following Takanashi's comments, the chairman commenced the floor discussion. The coordinator, five speakers, and commentator of session 3-2, participated as panelists. Questions were collected from the general participants during the coffee break. Details of the discussion were as follows.

Yoshiro Yanagawa

It became clear from several presentations that relations with citizens differ greatly according to historical background, traditions, and climate. What differs most is the issue of volunteers. In fact, there is no Japanese equivalent to the term volunteer. There is no Japanese translation for volunteer, nor has the spirit of volunteerism existed in Japan. Having said this, it cannot be said that a sense of helping others is lacking in Japan. But giving of one's own labour

has not been practiced. To be sure, during the past few years, volunteer activities have become popular to some extent. However, the perception is that volunteer activity -- providing assistance to someone at the expense of oneself -- has not become entrenched in Japan yet. I'd like to have comments from each country about volunteerism. First, I'd like to invite Mr. Higashiura of the Japanese Red Cross, an expert in the field of overseas aid.

Hiroshi Higashiura

Volunteer activities during emergencies have become rather popular in Japan in recent years, but I have found various problems. One is the uneven relationship between NGOs and government agencies. Japan's voluntary self-defence organization is mostly led by government agencies. For example, many voluntary defence groups such as flood-fighting and firefighting groups are created on the orders of the government.

Some people even misunderstand that voluntary defence organizations and disaster prevention volunteers should compete. Voluntary defence organizations are very important in the sense that people should help each other right after a disaster, but one or two days later, it is more important that we have outside people. For example, the disaster countermeasure headquarters needs to be staffed, but outside people can substitute in this role. People from outside the community who have common perceptions should be more involved. For this purpose, some prefectures are trying to organize disaster prevention volunteers. But we need to build a trans-prefectural volunteer data bank, from which volunteers with expertise are summoned, as with the computer data bank used in the Mississippi flood.

The second point concerns the so-called volunteer nuisance. We need to establish a system to accept unorganized spontaneous volunteers who go to disaster sites without water, food, or lodging. Organizations to facilitate communication between such volunteers should be established.

What kind of compensation is given to volunteers if they get injured or sick in other countries? How is this financed? I'd like to know about the situation in other countries.

We are in an age when we need aid supplied by corporations but not by individuals. For example, 240,000 boxes representing 8,000 kg of aid supplies were donated to Okushiri Island, but one third had to be incinerated. Many staff were needed to organize the supplies. The mass media, the Ministry of Posts & Telecommunications, JR, and related organizations should review the problem of aid supply.

Unequal financial distribution is an issue to be solved. For example, we can establish a system such as a mutual fund.

Yoshiro Yanagawa

I'd like to ask a question of Mr. Blackburn. Recently, in the United States, poor social safety, high crime rates, drug addiction, and many other problems prevail. After the Loma Prieta earthquake, we were worried that looting, violence, and arson would occur. However, on the contrary, crime rates at the time were lower than we expected. Instead, many volunteers protected the city. During the Mississippi floods, many volunteers drove a few hundred or a thousand kilometers to the disaster sites. What is the driving force behind volunteerism in the United States?

Frank T. Blackburn

I am surprised to hear of the volunteer problem in the Hokkaido Okushiri earthquake. In the United States, basically, there is a spirit of Christianity behind the volunteers. Volunteer activities and cultural activities are based on the Christian spirit. Americans learn the spirit of volunteer service and helping others while they are raised.

The reason for the low crime rates after the earthquake was that the city police took certain countermeasures against crimes. As a result, crime rates remained low and people

helped each other. This shows a cultural characteristic.

Volunteer activities are limited to certain areas in San Francisco because of previous experience.

In the United States, with its federal government system, each state and county has a self-governing authority which encourages local-level activities. It is possible to manage the volunteers because they are working at the local level. Volunteer groups know each other well so communication among them is smooth.

We need to prepare good organizations. Volunteers must know what to do. Police, fire-fighters, and other official organizations need to know how they can use the volunteers. We know from experience that volunteers will function well if we can do this. In fact, we use volunteers regularly. In San Francisco, there is the Red Cross Emergency Corps that serves food to firefighters and police staff, or provides temporary housing to people who have lost their homes. There are 400 such events per year, so they have vast experience. Even small groups perform their duty, teaching inexperienced members. Fire and police departments supervise these volunteer groups well. For a large fire, firefighting support corps drive to the site and help the firefighters. The same members go to the site every time to acquire skills. Even volunteers are gaining experience.

Volunteers may have to overcome cultural gaps. In organizing them, the points I raised would be necessary and training is important.

Yoshiro Yanagawa

I'd like to make a comment to Ms. Masing. I think the volunteer activities in the Philippines were better than those in Japan. As an Asian country, what do you think is different in the driving force of volunteers in the Philippines and that in Japan?

Lourdes C. Masing

Our country is vulnerable to natural disasters. For centuries, people have maintained a spirit of cooperation. Culturally, we have a volunteer spirit. This is interpreted as cooperative spirit, mutual help, or neighbourly help. The spirit of helping others is nurtured at the community level.

Another factor is the activities characterized by the Red Cross. Particularly in the 1990 earthquake, the Red Cross dispatched 7,000 volunteers for relief operations at the site. Among them, there were well-trained experts in relief medicine, rescue, home nursing, and distribution of supplies. When reports are submitted to chapter administrators, volunteers are dispatched. Well-trained people are mobilized and obtain their assignments. People get satisfaction from helping others. Many people, especially the young, participate in the Red Cross volunteer activities.

We have organizations for youth. Actually, most of the volunteers dispatched to disaster sites are young people. They go there spontaneously. For example, if a young man comes from southern Mindanao Island to the central Philippines, he registers with a local authority such as the Red Cross volunteers. When a report comes to the disaster site, he knows that many volunteers from various parts of the country participate in the operation and this gives him tremendous motivation. If he can obtain self-satisfaction through volunteer activities, he would like to participate more.

Yoshiro Yanagawa

To Mr. Znaidi. Would you give us some advice on Japan's volunteer activities?

Sadok Znaidi

Government should be responsible for and should assign roles for civil defence organizations and civil protection. But the definition of the term is not clearly established. One

thing that I can say is that civil protection includes all possible measures and means. Civil protection is a service to be provided in every country. But in reality, it is a service provided by the government in most countries.

Yoshiro Yanagawa

Governments in Japan, including local authorities, are fairly well established. So the administration is apt to come to the fore. Conversely, citizens tend to rely upon the authorities. I think it is somewhat risky. I'd like to ask Mr. Aoyama how we should consider the relations between the local administration and citizens.

Eiji Aoyama

Private enterprises both within and outside the prefecture gave tremendous volunteer support following the Ise Bay Typhoon and Obara Flood.

It is important for us administrators to integrate the volunteer spirit into the disaster prevention system. For this reason, the Aichi prefectural government established a system for registering volunteer groups comprising at least five members. Many people from varied occupations have registered, from amateur radio operators to suppliers of transportation and emergency relief and even civil engineers. They are requested to participate in regular disaster prevention exercises and are trained for emergency rescue. These people are few and we will continue further efforts to develop this system.

Yoshiro Yanagawa

Mr. Lei from China, would you give us some comments?

Lei Zhiyan

In China, the citizens are supposed to participate in the relief or reconstruction activities performed by the government. The government and people work together in reconstruction operations. People participate in operations under the guidance of the government.

Yoshiro Yanagawa

I'd like to open the discussion to the floor. We have a question from Mr. Kobayashi.

Kobayashi

In order to act in an emergency, I feel that volunteers need sufficient training. Apart from what was described about San Francisco, what kind of training is provided?

When authorized organizations are deeply involved in relief operations, I wonder if ordinary people might be a nuisance to them. For example, we have flood-fighting corps, but basically they are to protect their own villages and they do not travel to other places.

Lourdes C. Masing

Volunteers need to be organized first and obtain training. It is difficult to go to a disaster site to help someone, so they need training.

Another important thing is that a volunteer should have a certain special skill. For example, if the area is susceptible to a specific disaster, we should prepare volunteers who are trained for that specific disaster. I understand that they should protect their own area, but many volunteers come from other areas.

Volunteers are motivated by self-satisfaction as well as some spirit of adventure when they go somewhere to help people.

Yoshiro Yanagawa

Please give us a comment on the Red Cross, Mr. Higashiura.

Hiroshi Higashiura

For three years, we have made efforts at creating volunteer leaders in nationwide branches of the Red Cross. With the recognition that it is important to organize well-trained volunteers, we hold study meetings with would-be volunteer leaders from all over the country at the head office. Then they return to their prefectures to train assistant leaders.

There are volunteer groups in the Red Cross. They participate in serving food and providing first aid in emergencies. This should be promoted. Other groups and individuals who wish to join in emergency activities can be trained in advance and organized. Also, we will establish a communication window for accepting people who wish to participate after the disaster.

There are various problems. How can we associate volunteers with the administration? The demand for volunteers in the administrative division is rather small. What can we do to raise the social recognition of volunteers? These are the problems we are facing.

Many Japanese volunteers do not come to the site spontaneously; instead, they come on pre-arranged routes arranged by administrators. So how we can nurture motivation? It is also important for us to think of ways to lessen the financial burden of expenses such as transportation and accommodation. Even half the amount could be borne by the administrators.

I'd like to know the compensation paid to volunteers in other countries. The basic principle is to protect oneself. But some people ask, "Would you pay my medical fees if I get injured?" If we provide them with inexpensive insurance, they ask, "Would you pay the premium?" This kind of dependence dies hard. So some cities pay the premium instead in the form of paid volunteers This kind of treatment is influencing the activities of NGOs. We need to think more seriously about solutions to this problem.

Yoshiro Yanagawa

There are many problems that we should seek solutions for. Should they be paid? What about insurance? These problems differ from country to country. I heard that the remuneration the volunteers in the Mississippi floods received was food, beverages, tetanus shots, and band-aids, period. I was impressed with the difference between the United States and Japan. I wanted to discuss whether this is workable in Japan or in other countries, but to my regret our time is almost running out.

I think that the reason volunteer activities became rather popular is that they were stimulated by the volunteer activities in the United States following the Loma Prieta earthquake, which was extensively reported by the Japanese mass media. I hope that the situation will improve if we continue to exchange views on the status quo and the problems of each country while stimulating discussion through such international conferences.

SESSION 4

RECENT RESEARCH ON DISASTERS AND REDUCING DISASTERS

Coordinator/Chairman:
Takao Takeda
Professor
Institute for Hydrospheric Atmospheric Sciences, Nagoya University
Japan

Rapporteur:
Zhao Bolin
Professor
Peking University, P. R. China

Focal Point of the Session by **T. Takeda**

This year, many natural disasters have occurred worldwide. In Japan, there have been several natural disasters, including earthquakes and heavy rains, from north to south.

In session 4, six speakers presented information about forecasting techniques and about efforts being made to forecast natural disasters and understand the phenomena that cause natural disasters, all of which are very important to disaster prevention.

Paper Presentations:

"Probability Forecast for Disaster Preparedness"
Ryozo Tatehira
Professor, The University of Electra–Communication
Former Director–General, Japan Meteorological Agency, Japan

Among natural disasters, heavy rainfalls and storm winds can be predicted to some extent using state–of–the–art technology. For predictable natural disasters, stopgap or efficient disaster prevention measures can be taken.

However, with the present level of technology, a perfect warning system is not yet feasible even for such meteorological phenomena as heavy, concentrated rainfall, leaving room for false alarms or detection misses. Since detection misses may affect lives, warnings tend to be issued even when there is only a slight possibility of an occurrence in order to avoid such failures. However, unless technology is improved, such a tendency inevitably increases the number of false alarms, and has the effect on the public of the boy who cried, "Wolf!," making people so familiar with warnings that they pay little heed to them.

A practical way of solving this dilemma, and of enabling warnings involving some degree of error to be used effectively, is to introduce probabilistic expressions into the warnings.

Although concrete disaster–prevention countermeasures include providing disaster prevention staff, reinforcing embankments and buildings, and evacuating inhabitants, allowances for countermeasures in terms of time and cost must be clarified from the view of probability forecasting. Countermeasures taking a long time to implement need be forecast with a long lead time. The lead time indicates how much time should be allowed before a

forecast is issued before an occurrence.

For instant measures such as evacuation, warnings issued just before the occurrence of the phenomenon can be useful. Since the occurrence can be predicted with high accuracy, the forecasting of such an event is virtually ideal, allowing forecasting at accuracy levels of near 100 per cent. That is, almost no difference can be seen compared to conventional warnings using decisive expressions.

On the other hand, the longer the lead time, the lower the accuracy of the forecast, prompting concentration on climatic occurrence probability. That is, whether time-consuming countermeasures should be put into practice must be decided according to probability forecasts using various values.

The issue of which rules should be used to provide effective measures differs according to each case, and involves some complexity. Nevertheless, the cost/loss model is considered effective as the first approximation.

Here, "cost" represents the cost of taking measures, and "loss" represents the loss that can be reduced by taking measures. According to the cost/loss model, the following conclusion can be reached: It becomes more efficient to take countermeasures when the probability of the occurrence of the phenomenon is forecast as higher than the cost/loss ratio.

In order to make the best use of state-of-the-art technologies, the cost/loss model should be clarified, and a probability forecast used. Moreover, the introduction of doppler radar is a very significant factor at present as a way of improving the accuracy of a meteorological forecast.

"Observation and Forecasting of Heavy Rainfall in China"

Zhao Bolin
Professor, Department of Geophysics, Peking University, P. R. China

Heavy rainfalls occur in China due to typhoons, storm fronts, cyclones, and the like. The heavy rainfalls are characterized by seasonal variations in affected areas, such as the southwest area in spring, the central area in summer, the northern areas in July, and the southern areas from autumn to winter.

A forecasting and observation system for heavy rainfalls has been built and put into use with approximately 2,000 surface observation points and radar of various wavelengths.

Typical observation instruments and radars include the following:
Radiometer: Concentration of clouds
Radiometer with microwave: Improved observation accuracy
Doppler radar: Imported from the US
FY-1 Meteorological satellite: State of clouds and oceans
FY-2 Stationary meteorological satellite: Typhoons and the like

From the heavy rainfalls of the summer of 1991, it was learned that rainfall areas generally result in central China due to fronts approaching from Indochina in June and July that blow from the north but encounter warm wind blowing from the south, resulting in rain in central China. The rainfall indexes taken from 1951 to 1991 show that twice as much rainfall as usual was observed in central China in 1991. This resulted in flooding.

Damage from this disaster in 1991 took the form of unharvested crops, collapsed buildings, and at least 7,000 deaths. This amounted to an economic loss twice that of 1990. (Slides showing the observation instruments.)

Microwave radiometer (at Beijing University)
Doppler radar (UHF radar to measure wind velocity, and course and velocity of typhoons)

"Remote Sensing and Heavy Rainfall Disasters"

Takao Takeda
Professor, Institute for Hydrospheric Atmospheric Sciences, Nagoya University, Japan

Most heavy rain systems are composed of deep connective clouds. These occur unexpectedly in many cases. Since remote sensors can observe phenomena over wide areas and can be used to observe the inside of such phenomena from afar, they are very useful for studying, researching, forecasting, and providing warnings of heavy rainfalls and related disasters.

There are two kinds of remote sensors: active sensors -- radar, doppler radar, and the like -- and passive sensors -- infrared or microwave radiometers and the like mounted on satellites.

Heavy rainfalls causing disasters can be divided roughly into two groups: concentrated rainfall in a few hours, and heavy rainfall continuing over more than one day. The difference between these originates naturally from the characteristics of the phenomena that cause heavy rainfalls; moreover, the types of disasters vary and include landslides and floods. Recently, disasters due to heavy rainfalls occurring within one hour have been increasing due to urban development. Consideration should also given to changes in the frequency and scale of heavy rainfalls in response to global environmental changes.

Heavy rainfalls are caused by hurricanes, cyclones or the frontal activities accompanying them. However, very heavy rainfalls are caused by high clouds called cumulonimbus clouds or clouds in similar clusters. By quickly detecting such cumulonimbus or clustered clouds, remote sensing techniques can be used to gauge the likelihood of disastrous heavy rainfalls.

Doppler radar enables us to understand changes in air currents in addition to rain distribution. However, it has various limitations: it is only useful for the observation of limited areas, and several units must be installed to measure wind. In the US, a network of doppler radars highly suited to monitoring meteorological disasters has been built. In this way, the forecasting of heavy rainfalls using remote sensing equipment has become practical to some extent.

I would also like to mention a few topics concerning heavy rainfalls. One is that scientists are connecting abnormal heavy rainfalls with various phenomena, such as global warming, El Niño events, and global-scale phenomena. In reality, we can find a gradual tendency toward heavy rainfalls over the past two decades, with the first-, second- or third-heaviest rainfalls in 100 years being recorded at the observation points. In other words, record-breaking heavy rainfalls have been observed in the last two decades in particular.

Apart from this, disasters due to relatively minor heavy rainfalls have been caused by recent urban development. Forecasts using numerical models developed recently allow rainfalls caused by cloud clusters of over a few hundred kilometers to be forecast to some extent by narrowing grid intervals.

In reality, phenomena causing heavy rainfalls differ according to area. Observation of the phenomena that cause disasters in various areas must be made at the individual sites in the future with remote sensing, satellite, radar, and doppler radar devices.

"Toward the Global Seismic Hazard Assessment"

Domenico Giardini
Global Seismic Hazard Assessment Program (GSHAP), Instituto Nazionale di Geofisica
Italy

The following points will be discussed in relation to the Global Seismic Hazard Assessment Program (GSHAP): (1) What is a seismic hazard? (2) What is the uncertainty accompanying a seismic hazard? and (3) What can be done by groups formed by international scientists?

Potential hazards must be clearly delineated in order to prepare disaster prevention policies. In this connection, we must (1) integrate conventional databases related to earthquakes; (2) make clear seismic centre models; (3) clarify the effect of earth tremors and crustal deformation; and (4) quantify seismic damage, among other things.

Cooperation among stratum scientists, seismic scientists, engineers, and others is necessary in order to make probability forecasts of earthquake disasters available to all; moreover, disaster prevention is impossible if land-use planning and earthquake-resistant designs are not consolidated. Clearly, such "crosswise links" are important.

If earthquakes occur only rarely in a specific area, the politicians in that area will not understand the importance of taking earthquake disaster mitigation measures. On the other hand, if an earthquake did occur, it would cause buildings to collapse; this situation remains a problem.

The GSHAP is a multi-sector oriented cooperative effort that tries to integrate activities normally carried out an individual basis.

At the IDNDR, the International Council of Scientific Unions and the International Association of Seismologic Technology have been requested to assemble world-class scientists to work out disaster-prevention measures.

The concept is to share guidelines for disaster assessment at the national, local, and international levels.

The targets are (1) to undertake technological transfers with developing countries that lie along highly active seismic zones and that do not have sufficient disaster-prevention programmes; and (2) to provide information on procuring international funds and relief funding, and to inform the countries of the situation regarding funds collected and relief measures from the viewpoint of global balance.

GSHAP is considering improving coordination rather than generating global maps. That is, GSHAP will gather information on the affected areas and information on different localities and countries while several regional centres work on a central role.

When compiling disaster-prevention plans, it is important that one not rely on a single individual or body, but rather assemble as many people as possible and allow them to hold discussions in order to encourage the creation of more accurate forecasts. I believe that this would be the shortest route to disaster prevention.

Special Speakers

"Doppler Radar Network Observation in the USA"

Yoshi K. Sasaki
Director, International Center for Disaster Research
Cross Professor, Meteorology, University of Oklahoma, USA

Rainstorms, when generated over cities, can cause damage on a vast scale. When available, forecasts will help to control disasters in the future. In such cases, it is important to detect small-scale rainstorms quickly and accurately. Although the public is aware of the importance of the development of technology, people tend to ignore it.

I would like to present a new development in disaster prevention technology and its importance in the industry by taking an example from the USA.

The NEXRAD Network is a next-generation network of meteorological observation radars that incorporates a network of advanced doppler radars. This network was developed on the grounds of the University of Oklahoma over the past three decades, and a network of 137 doppler radars is now being installed across the USA.

A budget of US$4,100 billion has been allocated to this project by the US Congress, and a company called UNICESS is being established. Approximately forty units have been completed to date, distributed near Washington and Florida, with Oklahoma as the centre of the network.

This large-scale project was begun in the USA because statistical studies of doppler radar begun around 1981 revealed that the radar is very useful in forecasting disasters. Congress decided in 1988 to introduce the radar, and installation is proceeding.

The radar itself is called RWSR-88D.S The R88S represents 1988, and RDS represents doppler. RWSRS stands for weather surveillance radar.

The doppler radar is thought to be extremely useful in forecasting disasters because it affords an approximately 92 per cent accuracy in warnings, whereas ordinary radars have only a 50-60 per cent accuracy.

The features of the WSR-88D include improved resolution and highly enhanced sensitivity.

Conventional radars allow us to observe events only if at least 15 DBZ are provided; however, the new radar allows us to clearly detect the violent wind created by rainstorms.

Urban disasters involve various aspects, including social and economic problems. With the development of NEXRAD radar, we felt strongly that technological development helps greatly to solve such problems. In addition, the success of the NEXRAD development has allowed the modernization of meteorological equipment to begin. This is something that scientists and other concerned people in Japan should note.

"The POSEIDON Project and Its Possible Contribution to Seismic Hazard Reduction"

Yoshio Fukao
Director/Professor, Earthquake Research Institute, University of Tokyo, Japan

POSEIDON (Pacific Oriented SEIsmic Digital Observation Network) is a project to deploy broad band high-performance seismographs in the Western Pacific and in East Asia to observe the whole globe, at the same time observing Japan from a global viewpoint.

As part of an international cooperation project, POSEIDON uses a network covering areas in countries around the world in which France (GEOSCOPE), America (IRIS), Japan (POSEIDON), Italy (Mednet), and others participate.

Observation points -- land-based as well as those on the sea bottom -- are thought important. I will discuss the usefulness of this network from the point of view of disaster prevention.

In the earthquake southwestern shore of Hokkaido, on 12 July 1993, we analysed the earthquake records accumulated in the POSEIDON and other networks to discover that the earthquake caused a tsunami in this way: the earthquake occurred in a shallow fault that subsequently reached the surface of the earth, greatly deforming the sea bottom, raising the level of the sea, causing a tsunami.

From the point of view of the tsunami occurrence, it is crucial to know whether the fault penetrates the sea bottom in this manner. If this can be established just after the occurrence of the earthquake, rather than one or two days later, it will be possible to forecast whether a tsunami will arrive and what its magnitude will be. In this way, a tsunami disaster may be reduced.

A large-scale tsunami sometimes occurs without being accompanied by an earthquake. Issues related to detection of such tsunami, or to the detection of volcanic activity if the volcanic islands concerned are located far away in the Pacific Ocean, could be handled in the POSEIDON network in a promising way.

This is because there is an underwater sonic wave called a RTS phase that can be used to learn of volcano activity on the sea bottom. The POSEIDON network deployed over the West Pacific Ocean is thought to be useful in detecting such volcanic activity and the tsunami that accompany these activities.

From the viewpoint of disaster mitigation and prevention, it is important that data be collected promptly from all observation points, gathered, analysed, and delivered to the organizations concerned in real-time. It is also a primary issue that the POSEIDON project be approved now as a national project.

In addition, using data gathered from the global observation network allows us to determine the magnitude of a tsunami more clearly than before. It would also be possible for us to issue a warning that the coming earthquake would be small but the tsunami would be very big.

As mentioned before, since this POSEIDON project involves seismographs installed on the sea floor and on oceanic islands, using the RTS phase detected by these meters would allow us to monitor any volcanic tremors, and thus to forecast a submarine volcanic eruption.

Discussion

After the coffee break, the chairman commenced with the floor discussion. The session coordinator, and six speakers including the two special speakers participated as panelists. Questions and comments were collected from the general participants during the coffee break. Details of the discussion were as follows.

Domenico Giardini

I have participated in building a Mediterranean network over the last seven years. It is important that we perfect this type of advanced seismic network.

However, since national priorities differ from country to country in terms of absolute needs, local communities must be involved in planning in the future.

Yoshio Fukao

Professor Domenico Giardini will implement a global programme under which seismic hazard maps are generated to permit forecasting of the risk of seismic disasters. The biggest problem for this programme, I think, will be found in cases where there is a large gap between neighbouring countries, with some countries having very good data from observation of seismic hazards, and other countries having no observation network or accumulated data. This kind of situation is the primary reason for the promotion of this kind of project, but on the other hand, it is also one of the biggest difficulties.

Kawata

I think that there are some limitations in trying to put such a grand project into practice at the university level. Issues of disaster prevention should be managed not only at the university level, but national government agencies should also be involved from the start of planning.

Yoshio Fukao

At present, the POSEIDON project is being managed not only by the Ministry of Education but also by the Science and Technology Agency, the Ministry of Construction, and the like.

Takao Takeda

In his comment a little while ago, Professor Domenico Giardini emphasized the formation of multi-sector organizations and cooperation among those organizations. This applies not only to global environmental problems but also to natural disaster prevention. That is, an important issue will be how to promote cooperation among multi-sector organizations.

Domenico Giardini

In the IDNDR, technological transfer is the key to many problems. We have seen several programmes put into practice in a number of areas, only to watch the results disappear when those programmes ended. A central organization capable of maintaining the results must be established.

Takao Takeda

Apart from scientific research such as the monitoring and forecasting of phenomena, especially those which may result in heavy rainfalls, Professor Singh has commented on the importance of viewpoints that consider how environmental problems, such as forestry disruption and urbanization causing disasters due to heavy rainfalls, are caused. This session should clarify to what extent and in what manner environmental problems are caused.

Zhao Bolin

In China, disasters due to floods occur every year. A significant issue is how to mitigate damage due to such disasters and how to utilize water resources. Consideration must be given to the cycle of water and energy. These are also the objectives of the WCRP project.

Takao Takeda

The "Global Energy/Water Circulation Observation Plan," or "GEWEX," has been drawn up. This is an international project through which changes in water circulation and water resources caused by global warming or changes in the global environment are clarified, allowing accurate forecasting of heavy rainfalls and droughts in different areas. Under this project, various organizations and agencies throughout the world are cooperating and varied

joint research is being considered.

Questions have been addressed to us about (1) the protocols and procedures with which heavy rainfall warnings are conveyed to the public in Japan, and (2) the ways in which the Japanese public respond to such warnings and translate thought into action.

Another question concerns the criteria according to which warnings or cautions are issued. What were the criteria for the more than forty warnings and cautions issued this year?

Ryozo Tatehira

The criteria for the timing of cautions or warnings vary from prefecture to prefecture. The prefectures apply different criteria when precipitation reaches dangerous levels. These criteria are established according to the characteristics of particular areas, such as whether they have mountainous or flat terrain. The criteria are set out following consideration of an area's mechanisms of disaster occurrence following one day, three hours, or one hour of precipitation. If there is any possibility of establishing such criteria, we detect the possibility two or three hours before occurrence, and issue warnings or cautions.

These warnings and cautions are directly conveyed to the organizations in direct charge of disaster prevention and to the mass media. Therefore, the Meteorological Agency has two means of informing the public.

When a great hazard is anticipated, or when people must be evacuated due to imminent danger, disaster-prevention information in the form of an evacuation counsel for disaster may be conveyed to the public through the local authorities.

Takao Takeda

After receiving cautions or warnings from the Meteorological Agency, the local authorities convey information to the people after the situation has been verified and an appropriate decision has been made. However, although the local authorities convey such information by television, wireless telephones, and the like, the public's psychological readiness and the way in which they receive such information have recently become problematical.

Ryozo Tatehira

To supplement the explanation of the previous commentator, I would like to mention that information is conveyed in addition to warnings or cautions issued as required by the Meteorological Agency. The public's attention is drawn to such information; and expressions that are intuitively understandable are added and conveyed to the people when a large-scale hazard is anticipated.

Yoshi K. Sasaki

As part of the process of conveying information to the public, the state of Oklahoma is itself building a network to ensure observation, as this network will serve to perfect radar observation. TV stations as well are so liberalized that each TV station conveys, to some extent, information on possible floods and rainstorms. One of the broadcast stations itself, as I mentioned, has doppler radar, and about five specialists analyse the extent of the hazard and broadcast the result.

Each TV station is building a system in which the public can retrieve information by telephone.

One of the biggest issues these days is how to convey information to people who are riding in cars but not listening to the radio.

Takao Takeda

In this session various efforts have been mentioned, including technological issues and issues concerning organizations. A common theme running throughout the presentation is that

urban disaster prevention must be carried out from a global viewpoint.

When thinking with a global viewpoint, however, we must consider differences in local cities.

Since state-of-the-art technologies are not always adapted to the needs of every area, and since the phenomena in each area differ, the application of technologies suitable to each area must be worked out through international cooperation.

SUMMARIZING SESSION

Opening Remarks

Coordinator/Chairman:
Shinjiro Mizutani
Conference Chairman
Professor, School of Science, Nagoya University, Japan

I would like to ask the representatives to report to us about the matters discussed at the plenary session and sessions 1 through 4, and then I would like to propose some issues for the concluding remarks at this international conference.

The Japanese Islands lies between the Eurasian Continent, the world's largest land mass, and the Pacific Ocean, the world's largest ocean. It is also called a "nest" for earthquakes, since the earth is active and, at the same time, there is much volcanic activity. It is also situated on the path of typhoons that travel north along the Japanese Islands. The Japanese people have therefore experienced several large-scale natural disasters, which is why we are so interested in disaster prevention.

The Nobi earthquake was one such disaster. It had just been determined that earthquakes and faults were directly interrelated causes of such phenomena. The Neodani fault, along which the Nobi earthquake occurred, appeared in leading world textbooks on geochemical science.

The Ise Bay Typhoon was another of the very large-scale disasters that we experienced relatively recently. It is the subject of very keen interest among local authorities and people concerned with disaster prevention.

The first IDNDR conference was held in 1990 at Yokohama and Kagoshima. At this conference, serious debate was held on volcanic countermeasures. The second IDNDR conference, called the "Summit Conference on Earthquake and Natural Disaster Countermeasures," was held in Tokyo and provided a forum for discussions on earthquake-related problems. The third IDNDR conference, held in Chiba last year, discussed meteorological disasters, floods, rainstorms, and local severe rains. Finally, when it was decided to hold the fourth IDNDR conference in Nagoya, Aichi Prefecture, natural disasters and the issue of disaster management in metropolitan areas, which have recently experienced disasters on an enormous scale, were chosen as themes.

Report of Plenary Session

Carmen Almeida-Biggart
Executive Vice-Director for Operations
Disaster Service Liaison, American Red Cross, USA

Raymundo S. Punongbayan's presentation:

The advantages of an early warning system were focused on, as this is important in allowing us a reasonable amount of time and attainable targets.

There are similarities between the nineteenth and the twentieth centuries in terms of crustal deformation and the frequency of earthquakes.

Although tsunami warnings are insufficient, it was mentioned that tsunami arrive twenty minutes after seismic waves occur under the sea.

To ensure evacuation of inhabitants, the mass media should be used to educate the people fully and issue warnings.

Brian E. Tucker's presentation:

As far as risk and reduction of urban earthquake disasters are correlated, developing countries have the greatest risks and face serious problems due to concentrated populations and the vulnerability of their infrastructure.

It was pointed out that there are some cases where cities in developing countries are no longer "developing" but are fully developed. There is thus a difference in levels of development between the countryside and cities in developing countries, and between the levels of development in cities in different developing countries.

In the matter of earthquake hazards, it was pointed out that some cities lie near faults, and reference was also made to the earthquake risk that exists in places where faults are not apparent, as with the earthquake in India.

A few specialists from developing countries have been attending international conferences such as for the IDNDR. Attention was drawn to the gap between countries in which the earthquake hazard in reality is high and those in which various disaster-prevention measures and various efforts to mitigate disasters are being implemented.

The UN has not been fully meeting the increasing need to develop various overseas relief agencies and the like since the end of the Cold War. Also, there is not enough aid to keep up with the needs of the rapidly growing world population. I would propose the establishment of private charity funding.

Tadateru Konoe's presentation:

Various requests have been arriving at the International Red Cross Society at the rate of one per week.

Twenty per cent of the global population suffers from malnutrition, and the people concerned are, at the same time, squatters in cities. Such poverty is being transferred from Africa to Eastern Europe.

It was pointed out that aid is offered during the period of severest suffering, but is withdrawn when the time for rehabilitation, "the most important period", arrives.

For complex emergencies, we considered whether the scale of disasters is increased by disputes or aggravated by insufficient maintenance of infrastructure due to disasters occurring in areas where various disputes exist.

When we discussed aid for rehabilitation, it was pointed out that all sorts of materials are sent to developing countries without the cultural circumstances of the countries concerned being taken into account, resulting in many inappropriate materials being left stockpiled.

The needs of each country and the needs of the international community must be mutually clarified.

Since natural disasters affect everyone, every country must educate and increase the awareness of its people, and put in place systems for disaster prevention.

Report of Session 1

Yasuo Nishiyama
Associate Professor
Nagoya Institute of Technology, Japan

It is impossible to avoid natural disasters. In the process of urbanization, we must implement urban development schemes that always consider the mitigation of disaster damage, and endeavour to keep damage to controllable levels.

The tendency is for the disaster risk to increase during the enlargement and development of cities; we must lay down clear guidelines on how to recognize the reality of

disasters.

We discussed the question of how to put into practice urbanization plans that incorporate disaster risk evaluation.

The enlargement and development of cities, including rapid urbanization and the development of many mega-cities, have greatly changed the social significance of natural disasters and the damage situation.

Yoshiaki Kawata's presentation:

A hypothesis telling us that there is a definite relationship between average life span and risk to life was presented.

Thereza Lobo's presentation:

We heard about urbanization issues in Rio de Janeiro, and the fact that the destruction of the ecosystem is proceeding under the guise of disaster prevention.

Yoshio Kumagai's presentation:

Issues were presented regarding experience gained during international cooperation between Japan and Peru; the progress of urbanization in relation to assessments of vulnerability to disaster hazards, positioning of primary projects, and enforcement of disaster prevention measures in historical urban districts in Lima, Peru.

Mohammad A. Mohit's presentation:

Taking an integrated flood prevention project in Dhaka as an example, a presentation was made about how a disaster-prevention project that affected the whole course of the nation was implemented and how the construction of huge embankments affected social and economic systems and the ecosystem.

Sherif H. Kamel's presentation:

The Cairo earthquake of October 1992 occurred directly under the metropolitan area, damaging historical buildings, bringing down old buildings, and highlighting the existence of illegal buildings. Related damage, such as the collapse of brick houses in farm areas, was reported in connection with the urban structure.

Yoshiteru Murosaki's comments as commentator of session 1-1:

Session 1-1 was concluded as follows. In today's rapid urbanization process, traditions such as avoiding living in areas that have experienced disasters are no longer observed.

Since damage to mega-cities in third-world countries can affect the economy of the country concerned, urbanization planning incorporating disaster prevention has an enhanced social significance. That is, disaster prevention measures that take account of the characteristics of the area, the actual circumstances of the country, and the like must be established.

When drawing up urbanization plans incorporating disaster risk assessment, the disaster risk must be accurately analysed and shown in a manner that is easy to understand. In this connection, calculation techniques for damage assessment, data analysis, estimation techniques for hazard assessment, and the like were presented.

Itsuki Nakabayashi's presentation:

With the Tokyo metropolitan area presented as an example, Tokyo's urbanization

planning based on disaster risk assessment was discussed. Reports were made on the level of hazard in each area and on estimated damage.

Dusan Zupka's presentation:

In an attempt to mitigate damage from disasters, it was proposed to critically measure the possible effect of investment using cost-benefit analysis (CBA) in order to provide a choice of more effective policies in future.

Jukka Nieminen's presentation:

A unique approach -- "Visual Settlement Planning (ViSP)" -- was introduced, in which a computer is used to easily make a map with satellite images, aerial pictures, slides, and video information. Unique techniques for forecasting disaster hazards were also introduced.

Andrew W. Coburn's presentation:

The concept of "safety culture" was presented, emphasizing the necessity of disaster-prevention education for the urban poor to enable them to incorporate safety awareness into their daily lives.

Ronald S. Parker's presentation:

Mega-cities were taken as involving two different urban structures from the viewpoint of disaster prevention, with emphasis on the importance of disaster prevention measures for informal areas urbanized without planning.

Ulpiano P. Ignacio, Jr.'s presentation:

A report was made on the state of overall administration, including precise assessment of foundations and the like, the existence of disaster prevention-oriented thinking, systematic disaster-prevention plans, and appropriate operation of daily building administration.

An area in which a possible disaster hazard exists is a "taboo" area where urbanization must be controlled. How we incorporate land-use control into disaster prevention is important.

Session 1 focused upon the following four points: (1) It is important to think about disaster in relation to amenities; (2) Underlying the increasing disaster hazard in cities when a disaster occurs, there exists a large class of urban poor; (3) Practical and concise disaster-assessment techniques rooted in localities and national characteristics must be developed and popularized; and (4) Improved administrative knowledge of disasters, increased disaster awareness, self-help efforts by inhabitants, and the enlightenment of inhabitants are important.

Urban planning incorporating disaster-prevention measures gives hope to the people and promises them better lives.

Report of Session 2

Hiroyuki Kameda
Professor
Disaster Prevention Research Institute, Kyoto University, Japan

Session 2 focused upon the issue of facilities: how to ensure the functioning of urban infrastructural facilities when disaster occurs and how to minimize losses possibly incurred by non-functioning infrastructural facilities.

Tsuneo Katayama's presentation:

For disasters affecting lifeline facilities, first it must be noted that there is a difference between lifeline disasters in developed countries and those in developing countries as well as a gap in disaster recognition.

Also vital is integrated risk management from a broad perspective using both structural and non-structural engineering methods, engineering and non-engineering strategies, and pre-, mid-, and post-disaster time factors.

It was pointed out that the research and study fields established to date as "lifeline disaster-mitigation engineering" should be changed into "lifeline engineering."

Masanobu Shinozuka's presentation:

Attention was drawn to issues involved in lifeline studies, and to the various problems that occur when putting them into operation.

Any gap between studies in the lab and application to the realities of life would stem not only from engineering problems but also from techniques with which political, social, and economic problems are solved. Evaluation of cost-effectiveness precisely reflecting local realities is an important point.

Risk assessment must be made from a comprehensive point of view. The risk of system disruption is the product of occurrence probability and cost of system disruption. It is important for us to know how to connect each factor to integrate quantitative evaluation with evaluations from other fields.

Sun Shaoping's presentation:

In China, the Haicheng earthquake of 1975 and the Tangshan earthquake of 1976 were typical disasters. Strengthened construction, improved networks, backup assurance, and the like must be systematized through comprehensive engineering methods to improve reliability when an earthquake occurs.

In order to improve lifeline resistance to disasters, the governmental support structure is important. That is, appropriate criteria must be established. For lifelines, ultimately, it is improved everyday reliability that matters, and this is closely connected with improved reliability when a disaster occurs.

Yoichi Yoshikawa's presentation:

We heard that seismic monitoring is being installed and an earthquake emergency operation system targeting lifelines during emergency shutdown is being built in a city gas supply system in Tokyo.

A basic concept underlies these actions: Installed seismometers are used in this system to collect local information, perform accompanying information processing, and carry out decision making, enabling us to prevent secondary disasters and to separate affected areas from unaffected areas.

Manuel M. Bonoan's presentation:

When a road network is isolated, aid activities for affected areas and material transfers to affected areas may be jeopardized. This situation varies according to the seriousness of the road damage, whether it be slope collapse, land liquefaction, volcanic eruptions, or any other event.

We learned that alternative routes, roads resistant to disasters, and strong bridges that are portable in emergencies are effective. Strategies for putting these items into practice are necessary; specifically, strategic disaster-prevention measures for the road network, reinforcement, and systems that can cope with emergencies must be built.

Masami Kobayashi's comments as commentator of session 2-1:

We must consider the problem of what infrastructures we should put in place to support the urban structures and lifestyles of the next century. At the same time, maintaining a common technological and planning base without losing sight of regional diversity would allow us to create the groundwork for international cooperation in the future.

Masanori Izumi's presentation:

In disaster prevention for hospitals, engineering and science and engineering theories and technologies are clear, but they also involve comparisons between cost and benefit in reality, making discussion difficult. In today's earthquake-proof structure, we have established most criteria under which a "strong earthquake" is considered to cause no damage, and a "disastrous earthquake" or "very disastrous earthquake" is considered to cause no local collapse, provided no fire occurs.

The key to disaster prevention in hospitals is: (1) earthquake-resistant structural design; (2) structures must retain complete functional capability during an earthquake; and (3) hospital functions should be enlarged in emergencies.

Claude de Ville de Goyet's presentation:

Reports were made on disasters in Latin America and the Caribbean area, their impact on hospitals, and the countermeasures being taken.

When comparing the cost of increasing hospital resistance to disasters in terms of new construction and reinforcement, the latter costs considerably more than the former. When increasing hospital resistance to disasters, public and political awareness and technology and education are important.

Jamilur R. Choudhury's presentation:

Areas in which the cyclone disaster hazard is high in Bangladesh are populated by five per cent of the entire population, or 5.2 million inhabitants. In such a situation, various-disaster prevention measures are taken and attempts are made to increase the effectiveness of shelter construction as a wide-area countermeasure. Instead of using the shelter simply as such, it can be made effective if it is used and maintained as schools, family welfare centres, passengers' terminals, health clinics, community centres, offices or the like if it is constructed as a multipurpose structure.

Badaoui M. Rouhban's presentation:

Various advisory activities, including UNESCO activities, targeting schools located in areas where disasters frequently occur emphasize the multipurpose use of schools -- specifically that schools should be used as accommodation and relief centres in emergencies. The multipurpose use of schools is also effective in that disaster-prevention education and training are performed as a matter of routine.

As an example of this protocol, design guidelines in the form of technological and administrative recommendations on floods, earthquakes and cyclones were provided to Viet Nam.

Xie Zongfu's presentation:

Distribution in the city, land-use plans, and earthquake-resistant design were explained for the earthquake that struck Tangshan city on 28 July 1976.

Haruo Hayashi's presentation:

The concept of the "Island of Civilization" was presented. An electrical blackout occurred in Hiroshima city during Typhoon No. 19 in 1991. At that time, only the centre of Hiroshima city escaped power failure, creating the "Island of Civilization" zone that was helpful in enabling the city to recover its functions and in the psychological effect it had on the inhabitants around the centre of Hiroshima city. In this way, it was proposed that increasing the resistance of specific areas, especially significant facilities rather than individual disaster facilities, could be effective as a disaster-prevention measure in the future.

Michel F. Lechat's presentation:

Naturally, we should build schools, hospitals and the like that will not be destroyed during a disaster. Although reinforcing such structures is expensive, this must be done on the basis of strategic decisions, taking into account the importance of such facilities.

Facilities and equipment for countermeasures against disasters should be multipurpose to make them more effective in terms of cost and operation.

Since we cannot reduce the disaster hazard to zero, we should pursue a balance between nature and the means of communication.

Report of Session 3

R. B. Singh
Associate Professor
Department of Geography, University of Delhi, India

We must encourage people to participate at the grass-roots or local level.

For disaster prevention, strategies suited to the society must be worked out. Disaster mitigation must be of practical value in developing countries, and efforts must take each country's unique culture into account.

Comprehensive disaster prevention plans for Aichi Prefecture and the City of Nagoya were presented.

The rapid increase in the numbers and density of populations are highlighting significant issues for each segment of the metropolitan area in terms of disaster-prevention strategies. In this connection, specific cases in Mexico City and Seoul were presented.

For the mapping of seismic zones, and the education and enlightenment of inhabitants regarding hazards, specific cases were presented, taking as examples the Loma Prieta earthquake in the USA, the Flores earthquake in Indonesia, and the Maharashtra earthquake in India.

The role of NGO-independent disaster-prevention organizations and volunteers in disaster relief and mitigation activities was discussed. The function and degree of penetration of information systems at various levels were also covered.

Information-conveying systems capable of allowing disaster-prevention agencies to act must be provided in order to convey information effectively.

When disaster-prevention plans are prepared, decision-makers and planners at NGOs and local authorities must be involved. Plans must be drawn up and made known on the basis of experience. Economic, cultural, and political aspects must also be focused. Again, volunteer activities for which training is necessary are important.

Information systems and disaster-observation networks must be maintained at local levels. This will allow us to use local observations, GPSs, remote sensing, geographical information systems, and the like to generate comprehensive hazard maps.

Volunteer activities must be used effectively while organizations such as independent disaster-prevention systems, relief bodies, the Red Cross, and others play a primary role as coordinating teams in emergencies. Volunteers must also be appropriately trained so that they can deal with complex situations on the spot.

We have an important role to play in the area of policy enforcement, such as in the

preparation of hazard maps, especially those concerned with the control of human behaviour.

The importance of education was focused upon in particular. The importance of penetration of disaster plans was considered.

Report of Session 4

Zhao Bolin
Professor
Department of Geophysics, Peking University, P. R. China

Explanations were given of probability forecasts, observation of heavy rainfalls, strengthened systems for forecasting, remote sensing, data collection concerning disasters due to heavy rainfalls, earthquake networks in South Pacific and Southeast Asian countries, and the Global Seismic Hazard Assessment Program (GSHAP).

It was pointed out that warnings and cautions are important in disaster prevention and preparedness. Various warnings models exist.

Remote sensing, observation by satellite, numerical forecasting techniques, and the like are important when issuing warnings for heavy rainfalls, and effective when a wide area is targeted.

Activities such as the monitoring of earthquakes in Southeast Asian and East Asian countries, entering the results in a network, and generating hazard maps of Asia as well as the globe are especially useful in mitigating earthquake disaster damage.

In the monitoring of severe local rainfalls in East Asian countries, international cooperation is necessary, and this will be an issue for the IDNDR in future. Areas such as China, Japan, and Southeast Asia experience very severe local rainfalls. Monitoring, forecasting, and research into severe local rainfalls must be carried out over wider areas than before in order to gain a better understanding of the mechanism of heavy rainfalls and to increase forecasting accuracy.

GEWEX helps to prevent disasters due to heavy rainfalls. One of the main projects of the WCRP, it also is an important international project that reveals global energy and water cycles and changes in weather.

Comments from the Floor

Following the reports, the conference chairman opened the discussion to the floor for comments or questions regarding each session. Details of the comments and/or questions were as follows.

Tesfaye Gissila

In Ethiopia, natural disasters followed by large-scale famines occur five or six times a year, causing severe damage especially through repeated drought.

Since 1980, there have been very serious droughts that have killed many people. An early warning system was thought useful, and it has provided good results up to now.

Monitoring of rainfalls and yields is being carried out using satellites. In this way we hope to be able to avoid large-scale disasters.

Dusan Zupka

I think that the economic and social aspects involved in disaster management have not been adequately discussed.

I think it is important to consider whether the governments of countries prone to natural disasters are putting sufficient financial and human resources into disaster prevention.

Through my experience at Habitat, I recognize that international donor countries are providing very important aid for disaster prevention; however, I believe that only a part of such

aid is allocated to disaster prevention.

Watanabe

JICA emphasizes improving the standard of living of the poor, as it believes that it is important to distribute wealth and knowledge worldwide. When constructing cyclone shelters in Bangladesh, we want to do this in a way that will serve to educate people at the most basic levels of society. We do not want to limit ourselves to constructing concrete buildings.

Carmen Almeida-Biggart

Investment in hard science always costs 100 times more than investment in soft science. How about a little more emphasis upon social science? Since buildings are meaningless if people do not use them, it is important that people participate in the programmes.

Comments by the Two Commentators

Claudia H. Candanedo
Member, Scientific and Technical Committee, IDNDR
Head, Department of Hydrometeorology, Development and Engineering Division
Instituto de Resoursos Hidraulicos y Electrificacion (IRHE), Panama

The social aspect of disaster prevention is important. In disaster prevention, engineers and scientists must encourage policy makers to emphasize this aspect to the public as well as to social and economic bodies.

The Scientific and Technical Committee (STC) recognizes that the important missions of the IDNDR not only emphasize scientific aspects but also clarify goals for these ten years, and take measures for disaster prevention while consolidating the knowledge we already have.

Since there will be many mega-cities concentrated in developing countries in the next century, local communities must learn about the methods of disaster prevention which are available to the developing countries from the viewpoint of social communities.

Education of local communities must start with work in those communities. In order to allow local communities to participate in disaster prevention and disaster management, training must be carried out and organizations formed.

In international cooperation, knowledge transmission is important and, at the same time, international cooperation is also needed in developing and improving warning systems.

Disaster-prevention measures must be incorporated and integrated into development planning. For this, money is needed, and allocation of funds allows the creation of a safer society.

James P. Bruce
Chairman, Scientific and Technical Committee, IDNDR
Chairman, Canadian Climate Program Board, Canada

In order to minimize damage from disasters in mega-cities, appropriate countermeasures must be reflected in substantial programmes for each city during the remaining five years of the IDNDR.

Technologies such as strengthening of lifelines, forecasting of heavy rainfalls, and measurement of earthquakes are expensive, high-level technologies.

In the remaining five years it will be a challenge for scientists and engineers to find simpler, improved technologies that can be made available to developing countries.

What I would like to propose to the World Conference is that we should note the existence of vulnerability while referring to urbanization plans, land-use plans, building

restriction ordinances, and the like. We can greatly contribute to disaster mitigation if urbanization plans are established according to reliable risk assessments.

Damage from disasters must be mitigated in cities in developing countries. However, disaster-prevention plans are not, in reality, put into practice in such cities. Therefore, the technologies and techniques of the countries in which these were developed must be applied to cities in developing countries.

Among the problems faced by many cities in developing countries is the growth of informal cities in an unregulated manner. These disorderly buildings sprawling rapidly around formal cities cannot be incorporated into the mechanism of urban planning. In order to solve these problems, there must be cooperation between scientists and those with social skills.

Comments by the Organizers

Isao Tsukagoshi (Senior Disaster Management Planner, UNCRD)

In order to promote disaster assessment in megacities, the important issue of developing and popularizing simplified measures suitable for each region and country should be placed at the top of the UN agenda.

That disaster assessment in mega-cities should be carried out was the issue established by the above three targets at the Scientific and Technical Committee (STC) for the IDNDR. This is counted as a simple item that must be put into practice by 1999.

One possible issue is the method used. Developing simplified measures suitable for each region and country could become an important issue as the first step. However, developing countries cannot be compelled to implement the sort of risk-assessment techniques that are used in developed countries. It is therefore vital that we develop simplified techniques suitable for developing countries.

After simplified techniques have been developed, international cooperation is necessary in order to investigate and prepare for disasters in developing countries while implementing various assessments.

Kyohei Nishida (Japanese Government Headquarters for the IDNDR)

In the case of "complex emergencies", humanity has developed scientific technologies while spending money on wars, religious disputes, and the like. It is important to specify targets now that the Cold War is over. In this connection, we should endeavor to avoid disasters and save lives and property as a target for the twenty-first century.

CONCLUDING STATEMENT AND RECOMMENDATIONS

Dr. Shinjiro Mizutani
Conference Chairman
Professor, Nagoya University

The IDNDR Aichi/Nagoya International Conference 1993 JAPAN was held in the City of Nagoya, Aichi Prefecture on 1–4 November 1993, the fourth year of the International Decade for Natural Disaster Reduction, under the theme of "Disaster Management in Metropolitan Areas for the 21st Century." A total of 1,100 experts involved in the field of disaster prevention participated in the conference, from forty-six countries and nine international organizations, including administrators, researchers, and representatives of NGOs.

Disaster occurring in metropolitan areas can have a grave impact on other domestic and international communities and their economies as well as urban residents. Moreover, metropolitan areas have become increasingly vulnerable to disaster as a result of such developments in urban lifestyles and a lack of citizen awareness. It should be recognized that disaster prevention in urban areas is one of the most important factors contributing to sustainable development in developing countries where urbanization is rapidly advancing.

In confronting these realities, the conference participants presented reports and exchanged views on the following agenda items: disaster risks and the impact of damage in metropolitan areas; disaster countermeasures in urban planning; disaster countermeasures for lifeline facilities, schools, and hospitals; the response of local governments, and information strategies; citizen participation in volunteer activities; advance disaster research and prevention; and other topics.

It was recognized at this conference that natural disasters now lead to "complex emergencies" in which political, social, and economic turmoil in the post cold war era, population growth, poverty, environmental degradation, and other factors aggravate the effects of natural disasters, resulting in compounded damage. In developing countries in particular, population and capital inflows rapidly concentrate in urban areas. In this respect, it was pointed out that the risks of a "complex emergency" have become increasingly serious.

As well, it was recognized that the impacts of such disasters could destroy an economic infrastructure, and that ethnic, cultural, and economic diversity should be considered when extending humanitarian aid to disaster victims. Furthermore, it was pointed out that, in addition to a need for relief measures for disaster-stricken areas, there exists a need to prepare for disasters by improving methods of prediction, forecast, and prior-assessment of hazards with the latest scientific technologies.

Through the reports and discussion undertaken at this conference, specific topics and suggestions were proposed to central and local governments and researchers and all others concerned. The following major proposals were put forth:

(1) To facilitate risk assessment in urban areas where population, capital, and resources are concentrated, convenient methods which meet the current needs and capabilities of each region and country should be developed and disseminated.

(2) Planners of development projects must take into account "disaster hazards" when formulating and implementing their plans. To raise the awareness of residents,

politicians, and others, accurate data should be provided through effective presentation methods. For example, the cost of disaster damage should be estimated and methods of visual data analysis should be developed and widely used.

(3) The minimum level of functioning of lifeline systems to be maintained during an emergency and their positions in the disaster prevention plans should be clarified, taking into account the characteristics of the nation or region. It is necessary to strengthen the strategic structures of lifeline systems.

(4) Voluntary disaster prevention activities by private volunteers are important. Volunteer disaster prevention organizations and their activities should be encouraged and efficiently utilized. The conditions surrounding these activities should be improved. Particularly, the necessary staff should be assembled and trained regularly in communication, first-aid and other specialized fields, thereby encouraging their organizational activities. Their priority should be clarified in the disaster prevention plan. Affiliations with public organizations should be strengthened.

(5) To ensure the safety of hospitals, schools, and other important public facilities and to maintain their functioning as based in an emergency, effective regulations on building design should be established and disseminated. The awareness of administrators of such facilities and citizens should be enhanced through education on the importance of ensuring the security of critical facilities.

(6) The importance of disseminating information and maintaining a communications system during an emergency was pointed out. The accuracy of information monitoring systems concerning meteorology transmission of such information to citizens should be encouraged.

(7) Global networks and global projects related to disaster monitoring, prediction, and prevention technologies should be established with an emphasis on international cooperation.

(8) Adequate technologies for predicting disasters should be developed. These technologies should reflect the properties of natural phenomena as well as the geographical and societal features of the regions and cities in which they will be applied.

The International Decade for Natural Disaster Reduction began in 1990. In order to review the previous activities and to formulate future action programmes, the World Conference on Natural Disaster Reduction is scheduled for Yokohama from 23-27 May 1994. This World Conference is highly significant, as it will accelerate the progress of future IDNDR activities.

The participants of IDNDR Aichi/Nagoya International Conference 1993 JAPAN make the following appeals to ensure the success of the coming World Conference.

(1) To enhance assistance of donor countries and international organizations to disaster prevention systematically, in light of the insufficient involvement of developing countries in disaster-prevention activities.

(2) To promote the IDNDR international demonstration projects and other disaster prevention projects, which will be completed during the IDNDR and which are expected to attain significant success.

(3) To establish a network comprising of national governments, international organizations, universities and other establishments to exchange information and data

for use in the assessment and planning of disaster reduction. A centre serving as the core of such a network should be set up.

(4) Although emergency aid should be targeted at supporting self-help efforts, a system should be formulated that responds swiftly to a disaster emergency with humanitarian assistance.

We expect that the above appeals will be taken up by the World Conference on Natural Disaster Reduction and that the conference will achieve much progress.

It is impossible to prevent natural hazards from occurring; however, it is possible to minimize their damage through the application of wisdom and effort. We hope that every nation, local government, researcher, international organization, and others will make further efforts to cooperate in the proposals addressed at this conference. To achieve success, each of us must fully recognize the importance of disaster prevention.

We hope that disaster countermeasures for metropolitan areas will be swiftly and efficiently developed, with this conference as a stepping-stone, and that the damage caused by natural disasters will be steadily, if not totally, alleviated.

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ABOUT THE UNCRD

The United Nations Centre for Regional Development was set up in 1971 in pursuance of the terms of ECOSOC resolutions 1086C (XXXIX) and 1141 (XLI) which called for global action to promote regional development, and resolution 1582 (L) that provided guidelines for its establishment. The principal aim of UNCRD is to enhance the capabilities of the developing countries in local and regional (subnational) development and planning. Towards this aim, UNCRD organizes training courses, promotes collaborative research on substantive issues in regional development, extends technical advisory services, serves as a forum for exchange of experiences, and fosters exchange of publications and information on local and regional development and planning.

In 1986, UNCRD reorganized its programmes into seven major operational units. UNCRD also launched a new programme known as its Strategic Assistance Programme. Although the projects focus primarily on research and training, they also include advisory services and information dissemination components.

The seven operational units provide a framework within which UNCRD can identify, design, and manage research and training projects. These units include: (a) Urban Development and Housing Unit (UDHU); (b) Regional Development and Management Unit (RDMU); (c) Environmental Planning and Management Unit (EPMU); (d) Regional Disaster Prevention Unit (RDPU); (e) Information Systems Unit (ISU); (f) Social Development Unit (SDU); and (g) Industrial Development Unit (IDU).

The Strategic Assistance Programme provides support for specific activities in local and regional development and planning that are of demonstrated importance to the developing countries. Current projects include: (a) Development of Training Modules on the Integrated Approach to Disaster Management and Regional/Rural Development Planning in Bangladesh; (b) Transformation of Regional Economies and Modernization of Enterprise and Village Management in China; (c) JIF/UNCRD Joint Training Programme on Regional Development Planning Techniques and Management for Indonesian Local Government Officials; (d) Local-Level Planning and Management in Papua New Guinea; (e) Training Programme on Earthquake Engineering and Disaster Management for Establishing a Building Administration System in the Philippines; (f) Social Forestry and Community Development in Southeast Asia; (g) Local and Regional Development in Eastern and Southern Africa; and (h) Management of Metropolitan Living Environments in Latin America.

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