Proposals to the Japanese Government

on

Policies for the Creation of a Safe and Secure Society

in the light of

Increasing Natural Disasters around the World

May 2007

Science Council of Japan

Contents

Preface 1

I. Proposals for the Creation of a Safe and Secure Society against the Global Increase of Natural Disasters 3

II. Report from the Special Task Committee on Disaster Mitigation under Global Changes of Natural and Social Environments 7

1. Prediction of Natural Hazards in the Future 7
(1) Earthquakes and Tsunamis 7
(2) Volcanic Eruptions 8
(3) Climate Change and Global Warming 8

2. Vulnerability of Land Utilization to Natural Disasters 9
(1) Vulnerability of Land Utilization in Urban and Local Areas caused by Change in Population 9
(2) Vulnerability of Houses, Buildings and Infrastructure 10

3. Vulnerability of Social Systems 13
(1) Low Public Awareness of Disaster Risks, Dwindling Birth Rate, Aging Society and Emergence of the Nuclear Family 13
(2) Highly Computerized Society 13
(3) Organization, System and Finances 14

4. Land Utilization and Social Systems for Effective Disaster Mitigation 15
(1) Basic Concept 15
(2) Land Utilization plan and Development of Infrastructure for Disaster Mitigation 16
(3) Social Systems for Reduction of Vulnerability 17
(4) International Contribution to Natural Disaster Mitigation throughout the World 18

5. Role of the Science Council of Japan in Natural Disaster Mitigation 19
(1) Role in Research and Development (R&D) 19
(2) Proposals of Policies and Measures 20
(3) Communication with Local Communities and the Public 20
(4) Promotion of International Collaborative Research Programs 20

Members of the Special Task Committee 21

Preface

During the 20th century, the earth underwent the drastic environmental changes of global warming, deforestation and reduction in farmland, progressing desertification, coastal and river erosion and the heat island phenomenon in highly urbanized areas. These environmental changes are considered to be the major causes of large-scale storms, drought and abnormally high temperatures. Sea-level rise due to global warming has increased the risks of storm surge- and high wave- related disasters. The environmental changes and related disasters are anticipated to increase in scale and impact in the future.

On the other hand, changes in social structures such as an aging population, low birthrate and the emergence of the nuclear family, as well as changes in land utilization such as high population concentration in urban areas and depopulation in rural areas, have contributed to the vulnerability of society to natural disasters. Also, individuals' low-sense of belonging and cooperation in the community, lack of transmission of disaster experience, indifference to the natural environment, and highly computerized daily life are increasing this vulnerability. The budgetary deficit of national and local governments, delays in infrastructure development, and the decline of the construction industry in regional areas will impact on disaster relief and recovery activities.

In developing countries, poverty and poor governance are aggravating natural disasters, and natural disasters are worsening poverty in return. A vicious spiral of poverty-natural disaster has been created.

Under these circumstances, it is necessary to make a paradigm shift in prioritizing the creation of a safe and secure society over a short-term perspective focusing on economic growth. Natural disaster mitigation is a common issue for the world, and Japan, with its extensive disaster-related experience and technology, is strongly requested to play a key role in the creation of a safe world.

Considering the fulfillment of this key role, the Science Council of Japan (SCJ) has organized the "Special Task Committee on Disaster Mitigation under Global Changes of Natural and Social Environments", which consists of researchers in the fields of science, engineering, bioscience, social science and humanities. The main purpose of this committee is to recommend basic policies and measures for future disaster mitigation to the concerned organizations and the public.

Consequently, the Minister of Land, Infrastructure, Transport and Tourism requested the president of the SCJ to report on basic policies for natural disaster mitigation in the 21st. century, focusing on (1) analyzing possible impacts of future natural disasters, (2) assessing the vulnerability of national land utilization and social systems, and (3) making recommendations for land utilization and social systems resilient to natural disasters. The SCJ assigned the Special Task Committee to respond to this request from the minister. This report summarizes the committee's recommendations based on the comprehensive discussions held in multidisciplinary academic fields of science.

It is important to continue to pursue the discussions, and include in these discussions not only researchers in the disaster mitigation field, but also administrators engaging in

disaster mitigation operations and infrastructure management, citizens and the mass media. It is the hope of the members of the special task committee that this report will provide an opportunity for society to realize the risks of natural disasters and to consider disaster mitigation for the future. The Science Council of Japan is expected to play a key role in disaster mitigation and prevention in the global community.

Masanori HAMADA, Dr. Eng.
Chairperson
Special Task Committee

I. Proposals for the Creation of a Safe and Secure Society in the light of the Global Increase in Natural Disasters

Proposals for Policies and Measures

(1) Paradigm shift for creation of a safe and secure society

Against a background in which the natural environment is changing, and land utilization and social systems are becoming vulnerable, the government should make a paradigm shift in policies for natural disaster mitigation, away from a short-term perspective focusing on economic growth and towards the long-term creation of a safe and secure society.

(2) Development of Infrastructure

Tax revenues should be properly allocated for infrastructure development focusing on natural disaster mitigation. In determining an appropriate level of investments in infrastructure development, the impacts of future natural disasters should be assessed and evaluated by taking into consideration not only the loss of lives and properties but also decline in the nation's power, degradation of landscape and psychological damage to the people.

(3) Rearrangement of National Land Utilization

National land utilization should be more balanced for natural disaster mitigation. To achieve that, the following measures should be realized: decentralizing the population and assets from the mega cities, movement of residence of people from disaster-vulnerable zones to resilient areas, establishing backup systems for maintaining the function of the capital, Tokyo, and developing transportation systems for recovery and reconstruction activities.

(4) Application of "Hardware" and "Software" Countermeasures

For successful mitigation of large-scale natural disasters, in addition to "hardware" countermeasures like reinforcement of buildings, houses, levees and embankments, "software" countermeasures should be substantially developed such as disaster education, dissemination of disaster-related knowledge and experience, development of comprehensive systems for emergency information, evacuation and rescue, and medical treatment.

(5) Assessment of Vulnerability and Potential Risks of Depopulated Areas

Isolated islands, coastal zones and mountainous areas have become vulnerable to natural disasters due to decreasing population and aged nuclear families. The vulnerability of those areas should be assessed for emergency relief and rescue operations.

(6) Establishment of Integrated Disaster Management Policies and Strategies by Central and Municipal governments

Each ministry and agency involved with natural disaster mitigation should establish and implement integrated disaster management policies and strategies in mutual cooperation. In the meantime, municipalities should establish disaster management systems and countermeasures, and then build cooperation and coordination with their neighboring municipalities. For the municipalities' efforts, the central government should provide financial and other support. In the event of a large-scale disaster, which may cause serious impact on wide areas of the country, the central government should take the initiative in operating rescue, restoration and reconstruction activities.

(7) Development of Public Awareness of Disaster Risks and Preparedness

Hazard maps should be prepared for public reference. Through this effort, public awareness and concern regarding natural disaster mitigation can be enhanced. The government should also educate the public to acquire proper disaster awareness by showing the nation's vulnerability to natural disasters following changes to social environment such as the aging society and low birthrate, the increase of nuclear families highly computerized daily life and internationalization of society. In collaboration with the public and municipalities, the government should establish a "disaster-aware society" which will be able to respond resiliently to the attacks of natural disasters.

(8) Education on Natural Disaster Mitigation

Education should be strongly promoted in teaching geography, geology and other subjects related to natural disasters in schools so that younger generations can acquire fundamental knowledge of natural phenomena and the mechanisms of disaster occurrence, and obtain the proper understanding and judgment to prepare for disasters.

(9) Promotion of Activities by NPO and NGO

In nationwide activities, natural disaster mitigation should be promoted in an appropriate combination of public works, community collaboration and individual efforts. Non-Profit Organizations (NPOs) and Non-Governmental Organizations (NGOs) have an important role in strengthening community collaboration through disseminating disaster knowledge and experience, and participating in emergency relief activities. The central government and regional public agencies should promote the development of NPOs and NGOs by financial and logistics support.

(10) International Cooperation in Disaster Mitigation

Japan, which has achieved rapid economic growth while dealing with natural disasters, has been requested to share its experience and knowledge of disaster mitigation with the natural disaster-prone countries in the Asian region in particular. Japan should make efforts to respond to the requests of these countries, strengthening its international cooperation in disaster mitigation activities.

The disaster mitigation activities should be operated from a multidisciplinary perspective including sociology, economics, agriculture, environment studies, science, engineering, and education. Accordingly, it is essential to establish close collaboration and coordination among the concerned ministries and agencies, and they should build a strategic framework for international assistance and cooperation beyond borders.

(11) Sustainable Systems and Frameworks for Natural Disaster Mitigation

Sustainable systems and frameworks should be built for the realization of appropriate disaster mitigation measures. That can be done by continually assessing the vulnerabilities of land utilization and social systems, and developing infrastructure for disaster mitigation.

Proposals on Promotion of Research and Study for Natural Disaster Mitigation

(12) Improvement of natural phenomena observation and monitoring systems

Natural phenomena observation and monitoring systems should be continuously updated so that any sign can be identified and followed to predict large-scale earthquakes, tsunamis and volcanic eruptions. The impact and characteristics of large-scale disasters, which may occur once in several hundreds or even thousands of years should be studied by geological and geophysical surveys.

(13) Development of Numerical Models for the Prediction of Climate Change

The causes of global climate change and warming should be clarified in relation to natural environmental variations and human activities. In addition, more accurate predictions should be attained by utilizing the data obtained from satellite monitoring and the results of computer simulations. In the meantime, uncertainties in the predictions should be identified and taken into account in the planning of disaster mitigation measures.

(14) Promotion of Research and Development on Improvement of National Land Utilization and Social Systems against Natural Disasters

To overcome the disaster vulnerabilities of national land utilization plan and social systems, public and private research institutes and universities are required to collaborate in conducting comprehensive researches and surveys. The government should provide them with its organizational, administrative and financial support.

(15) Dissemination of Research and Study Results and Development of Human Resources

Public and private research institutes and universities are requested to release their research results in forms accessible to the public and disaster-concerned organizations, and to take initiatives to promote human resource development and natural disaster education nationally and internationally.

Role of The Science Council of Japan in Natural Disaster Mitigation

(16) Promotion of Multidisciplinary Researches and International Collaborations

The Science Council of Japan (SCJ) is requested to present proposals for policymaking and promotion of researches on disaster mitigation. Additionally, the SCJ is expected to promote multidisciplinary, inter-organizational researches in the fields of science, engineering, bioscience, social science and humanities, and to transfer technology and knowledge for disaster mitigation across borders through promotion of international joint research programs.

II. Report from the Special Task Committee on Disaster Mitigation under Global Changes of Natural and Social Environments

1. Prediction of Natural Hazards in the Future

(1) Earthquakes and Tsunamis

The probabilities of future earthquakes are predicted to be very high in various areas in Japan. Large-scale earthquakes may occur in the Tokai, Tonankai and Nankai areas along the Nankai Trough in the Pacific Ocean, and offshore of Miyagi Prefecture along the Japan Trench. A destructive earthquake is also predicted to occur directly beneath the Tokyo metropolitan area.

In recent years, the accuracy of predictions concerning the magnitudes and source areas of plate-boundary earthquakes and earthquakes at major inland active faults has improved. However, it is still difficult to determine in advance the time of the occurrence of an earthquake within the timeframe of a few days up to a few hours. As the 2007 Noto Peninsula Earthquake showed, with regard to earthquakes of a magnitude less than 7, their source areas might not be identified accurately well beforehand.

The 2004 Sumatra Earthquake was a mega earthquake with a magnitude of 9.0. Its massive impact gave a warning to the world concerning the earthquake prediction system which relied only on past seismic data. In order to figure out the frequency of occurrence and size of mega earthquakes, the probability of which is extremely low, it is essential not only to study those seismic data, but also to conduct geological and geophysical surveys.

As for tsunami warnings, the Japan Meteorological Agency issues tsunami-related warnings including estimated initial tsunami-wave arrival times and wave heights two to five minutes after an earthquake occurs. Meanwhile, so-called tsunami earthquakes generating extremely large waves yet comparatively small ground motions have not been examined fully enough for their generation mechanism to be understood. There are still many issues concerning the establishment of tsunami warning systems and promotion of tsunami risk awareness among the residents of coastal areas.

Regarding earthquake-induced ground motions, several estimation methods have been developed based on recent studies using observational data, which have clarified the fault rupture process. Using the developed estimation methods, maps of earthquake ground motions with identified sources have been utilized in earthquake-disaster prevention planning.

Large-scale plate boundary earthquakes may induce ground motions with long-period components, and sometimes can excite sloshing vibrations of crude oil and petrochemical products in storage tanks located far away from the source areas. Long-period ground motions may also cause large dynamic responses in high-rise buildings, base-isolated buildings and large-scale structures like long-span bridges, which have long natural periods of vibration of several seconds.

(2) Volcanic Eruptions

There were few major volcanic eruptions in Japan in the 20th century. Each active volcano, however, has erupted every few hundred years. Therefore it is necessary to assess several active volcanoes that might cause big eruptions n the 21st century. Besides, huge eruptions, which can spread ash out over considerable areas of the country, occur every few thousand years. Although huge eruptions have not occurred since the Kikai caldera eruptions approximately seventy-three thousand years ago, it should be noted that there is the possibility of major volcanic eruptions this century.

In the cases where data on the past eruptions is available and observation systems have been established, it is possible to predict future eruptions quite accurately. However, some volcanoes have long dormancy periods of several hundreds to several thousands of years and their eruption patterns vary depending on the chemical composition of their magma. It is not easy to specify the time and date of a possible eruption. While it may be possible to make a short-term prediction within several days, it is sometimes impossible to predict within a few hours in relation to emergency evacuation.

In order to improve the accuracy of predictions of volcanic eruptions, the collection of data on the past eruptions is required, and volcano observation systems should be developed.

(3) Climate Change and Global Warming

The global warming phenomenon and its impact on natural environments have been investigated based on climate simulations using numerical models. According to the fourth assessment report of the Intergovernmental Panel on Climate Change (IPCC), the average global temperature is anticipated to increase between 1.1 to 6.4 centigrade degrees by the end of the 21st century. The projections of the temperature rise are influenced by carbon dioxide concentration in the atmosphere, the accuracy of climate models and computer capacity.

Sea-water expansion and ice sheet melting in the Antarctic may cause a global sea-level rise. The IPCC estimates an average sea level rise of 18 centimeters to 59 centimeters by the late 21st century, which could exacerbate coastal erosion resulting in disasters due to storm surges and high waves.

Research on the effects of global warming on typhoons and torrential rain is currently being carried out. Based on the findings of recent research, it is predicted that while the total number of typhoons may decrease, the number of strong typhoons will likely increase, and that torrential rains will occur more often than ever. In this decade, extremely heavy rain of more than 100 mm/hr has been frequently observed in mega cities and their surrounding areas. The urban heat island phenomenon is considered to be one of the causes of these heavy rains.

Thunder clouds causing torrential rains and tornadoes develop in much smaller areas than those of atmospheric pressure patterns. Thus it is now almost impossible to predict the time and place such meteorological events will hit a day in advance. Short-term predictions based on the data of local atmospheric conditions collected with weather

radar are therefore required, though it is still impossible to make a prediction within three hours.

Some concerns have arisen about future weather-related hazards such as obstructions to visibility created by yellow dust, effects of dust storms on infrastructure and human health, and salt water and wind damage in coastal areas.

In Asia , a great deal of carbon dioxide is released into the atmosphere through burning fossil fuels such as coal and oil in power stations, factories and vehicles, burning charcoal to heat houses, burning agricultural waste on farms, through agriculture, and through forest fires.

In China, India and other developing countries, economic growth will continue very rapidly. Therefore, more serious air pollution is anticipated to occur, affecting human health, food production, biodiversity, and further affecting the atmosphere in their neighboring countries. In addition, the regional dispersion of pollutants can have an impact on the entire solar radiation balance and affect climate fluctuation.

2. Vulnerability of Land Utilization to Natural Disasters

(1) Vulnerability of Land Utilization in Urban and Local Areas caused by Change in Population

① Land Utilization in Densely Populated Urban Areas

In Japan, the population, assets, economic activities including financial transactions, and transportation, are all concentrated in urban areas. In the postwar economic growth period, the government did not plan and manage infrastructure effectively to meet rapid population growth in urban areas. That resulted in these areas being allowed to become densely populated. Nowadays as many as 8,000 hectares of the highly populated urban areas, of which 60 percent are found in the Tokyo and Osaka areas, are at serious risk of being damaged by earthquakes and earthquake-caused fires. It is strongly recommended that disaster mitigation measures should be implemented in these areas.

In the urban areas, there are many old wooden houses and structures built in tiny spaces, narrow alleys, paths and narrow streets with few parks and open spaces. If there is an earthquake, it is likely that fires and extensive damage to properties will be incurred.

Many underground construction projects have also been undertaken to build shopping centers, subways and parking garages in those areas. These underground facilities are vulnerable to torrential rains, floods, tsunamis and storm surge, and might be flooded in a short period of time after such disasters occur. Recently, more floods have occurred in underground spaces in the urban areas.

Mountainous areas, flood plains and “zero-meter zones” with elevation lower than sea level in the urban areas have been developed as residential districts. This land development has increased the vulnerability of society to natural disasters. Landslides and slope failures have occurred in mountainous areas, and cut-and-fill lands have slid after earthquakes.

② Transportation Facilities

Ensuring traffic and transportation systems is essential for effective operation of post-disaster relief and reconstruction activities. However, because of severe damage to transportation facilities and traffic congestion in urban networks, the function of transportation systems may be paralyzed for a long time. Many people in the central business areas in mega cities would be unable to return to their homes due to the paralyzed transportation.

③ Depopulation in Regional Communities

The rapid increase in the urban population has induced depopulation in rural areas. Dwindling birthrates and increasing aging population are also contributing to the acceleration of rural depopulation. Declining local industries, agriculture and forestry have resulted in deforestation, reduction of farmlands, causing higher risks of floods and affecting rural landscapes.

Depopulation results in difficulties in providing residents with disaster-related information, warnings and evacuation notices. In local communities, there are not enough proper medical services available to the residents, which can create critical situations for them in an emergency. These issues concerning depopulation and aging population should be considered in isolated islands, coastal areas and remote mountain villages.

(2) Vulnerability of Houses, Buildings and Infrastructure

① Vulnerability to Earthquakes and Tsunamis

The 1995 Kobe Earthquake showed that the major causes of loss of human lives and property due to the earthquake were house/building collapse and fires. There are about 47 million houses and buildings in Japan nowadays. It is reported that 25 percent of them are not strong enough to survive future earthquakes.

Based on the experience of 1995, much infrastructure, such as railways, highways, subways, port and harbor facilities, and lifeline facilities have been reinforced against future earthquakes. The existing structures have been reinforced to withstand the ground motions caused in/around areas along fault lines predicted to cause earthquakes of magnitude 7 class, such as was observed in the Kobe area. However, the earthquake ground motions areas along fault lines that could potentially trigger magnitude 8 class earthquakes, which extend inland from the coast in the case of Tokai earthquake for example, have not been taken into consideration. In such areas, Shinkansen railways, expressways and many other infrastructure projects have been carried out. As for the anticipated Tokai earthquake, the resistance levels of the infrastructure in/around the fault lines should be assessed and reinforced if necessary. The foundations of bridges on roads and railways need to be strengthened against liquefaction and liquefaction-induced ground deformation.

Structures such as high-rise buildings, base-isolated structures, suspended bridges, cable-stayed bridges and large-scale tanks have long natural periods of vibration. The response of these structures against long-period earthquake ground motions should be analyzed, and proper countermeasures must be implemented. Additionally, high-rise

buildings in particular need to be examined in relation to the following issues: evacuation of residents and office workers, elevator control systems and lifeline systems. The safety of outer walls and glass windows should also be inspected carefully. Concerning these issues, in 2003 and 2004, a special task committee, jointly organized by the Japan Society of Civil Engineers (JSCE) and the Architectural Institute of Japan (AIJ), discussed the safety of high-rise buildings and long-span bridges, and developed procedures to examine the earthquake resistance of those structures.

Large areas along the coast of major cities in Japan have been reclaimed from the sea, and on the reclaimed areas, many large industrial complexes have been constructed. In many of these areas, seawalls have been aging and degrading without proper treatment against soil liquefaction and liquefaction-induced ground deformation. Tanks containing flammable materials and high-pressure liquefied gas constructed on such unreinforced ground may be damaged by the sloshing vibration of their contents induced by long-period earthquake ground motions. Moreover, it is possible that the contents of the damaged facilities will spill out into the sea.

The “zero-meter areas” below the mean sea level along coastal areas in/nearby major cities and river basin areas have since been developed and expanded as residential areas and business districts. Levees and embankments have been inspected and repaired. However some of them may not be strengthened enough to withstand strong ground motions from an earthquake directly beneath the major urban areas. In order to minimize future loss of human lives, retrofitting those structures should be given an urgent priority.

With regard to tsunamis, many embankments and levees have been reinforced to withstand the external force generated by such waves. However, they may not be strong enough to withstand the combined effects of earthquake ground motions and subsequent tsunamis. Such insufficiently strengthened structures may be severely damaged by earthquake ground motions, soil liquefaction and tsunamis.

There is another concern about hilly areas in the vicinity of urban areas. In hilly areas, large residential districts have been developed by cutting hills and filling valleys. Such residential areas are vulnerable to landslides due to earthquake ground motions. In the case of the 1978 Miyagi Offshore earthquake, a large landslide occurred in a huge residential district in the hilly suburbs of Sendai city and a number of houses and lifeline systems collapsed.

②Vulnerability to Storms and Floods

In the postwar period, “The Food Control Plan” was drawn up based on a forecast of precipitation probability. Since then, flood control measures have been implemented through the constructions of embankments, dams and retarding basins. Although storms and floods are not fully predictable, the country has developed effective measures for disaster mitigation and vulnerability reduction. These have been successful in reducing the number of casualties considerably compared with those in the early postwar period.

Lately, in relation to global climate change, torrential rains with over 100mm/h rainfall have occurred more often than before. The amount of rainfall tends to largely exceed

projected rainfall in small- and middle- class rivers. In recent years, the risk of floods has also been increasing in urban areas because underground space has been developed. However concrete countermeasures have not yet been realized. Torrential rains in local areas have triggered flooding due to overtopping of water and embankment failures. Furthermore, the global change in weather patterns has been causing the increased incidence of tornadoes in Japan.

③Aging Infrastructure

It has been about 40 years since the construction of much of the nation's infrastructure during the postwar economic growth period. Many examples of this infrastructure have already started deteriorating. In the US, the aging of infrastructure has caused various kinds of accidents since the 1970s. Considering these facts, without proper maintenance work and timely renewal, infrastructure will deteriorate further and this may worsen damage in the event of natural disasters.

Lifeline systems such as electricity, the water supply, the sewerage system, gas and telecommunications are essential for cities to function. If the lifeline systems are damaged, not only people's daily lives but also relief and recovery activities after disasters will be seriously affected. A number of underground pipelines are deteriorating due to aging, and some of them are buried in weak reclaimed lands and soft alluvial ground. Damages to the electric power system can spread to other lifelines instantly. Thus it is a priority to ensure the safety of electricity.

3. Vulnerability of Social Systems

(1) Low Public Awareness of Disaster Risks, Dwindling Birth Rate, Aging Society and Emergence of the Nuclear Family

The vulnerability of social systems to natural disasters may be associated with the public's low awareness of disaster risks in a society where the development of disaster mitigation measures has been emphasized less than economic growth. The Japanese people have been losing their traditional lifestyle of symbiosis with the natural environment and phenomena, which has resulted in increasing social vulnerability to natural disasters.

The decrease in the birthrate and increase of the aged population have detrimental effects on disaster mitigation operations. These trends contribute to the increase of people in need of assistance in an emergency, and weaken society's ability to overcome natural hazards. Decreases in population will weaken economic power, which will create a serious obstacle not only to the development of infrastructure, but also to disaster relief and recovery activities.

Since the end of the war, many changes have occurred in the lifestyles of the Japanese people. These changes have influenced their perspectives and attitudes towards natural disasters in terms of "community capacity". Less people have participated in community activities because they do not maintain a strong sense of belonging to their

community. It is not easy to involve such people in community-based disaster relief activities. As new residential districts have developed in the suburban areas of large cities, people have moved into these newly developed areas. They may have little contact with long-time residents in the neighborhoods. Because of an increase of nuclear families, people have fewer opportunities to learn from older generations about their disaster experiences and obtain less information to plan their disaster preparations.

(2) Highly Computerize Society

People have benefited from a highly computerized society in respect to communication and business operations. At the same time, they have become more vulnerable to natural disasters. Information systems and networks have been developing widely and rapidly and have become more complicated. As a result, if a natural disaster hits one of the major cities in the world - such as Tokyo, where economic activities are concentrated - it will affect the global economy instantly.

The people rely heavily on the Internet and cellular phones for communication in order to obtain information in daily life. Once a natural disaster hits society, system shutdowns, network disconnections and blackouts may occur. In emergency situations after disasters, various information sources should be integrated for relief and recovery activities, but serious damages to electronic information and communication systems may greatly affect those activities.

Meanwhile, the development of e-commerce, e-business and e-government continues. If a natural disaster occurs, these practices may be suspended, and information management may be disturbed seriously.

(3) Organization, System and Finances

Based on the “Disaster Countermeasures Basic Act” in 1961 Japan’s Central Disaster Prevention Council drew up the “Basic Plan for Disaster Prevention,” and in accordance with this plan, designated government agencies and public institutions formulated the ”Operational Plan for Disaster Prevention,” both of which have been implemented in Japan. Prefectural and municipal governments are requested to formulate and implement a “Local Plan for Disaster Prevention” based on the Disaster Countermeasures Basic Act.

Although the Central Disaster Prevention Council and other governmental agencies share an understanding and knowledge about disaster-related issues, their mutual cooperation and collaboration systems are inadequate. Many issues concerning comprehensive disaster countermeasures still remain unresolved and budget allocations for the implementation of measures have not been fully examined by the aforesaid council and government agencies.

The prefectural and municipal governments are requested to take responsibility for pre-disaster preparedness planning, such as establishment of relief and recovery operation systems. The leaders of these organizations bear a heavy responsibility for their communities in terms of disaster risk control. Some of the municipalities, however, have not fully developed disaster strategies. Cooperation and collaborations among the

municipalities, which are essential to deal with large-scale disasters, have not been established, either. Moreover, many of the municipalities, because of the lingering economic slump, have not been able to operate proper infrastructure maintenance, management and renewal to withstand against future natural disasters.

For preparedness before and rescue operations after disasters, for flood and storm disasters in particular, local construction-industries and their employees played a major role in rural areas. However, the decline in public investment in infrastructure development and maintenance hampers local construction industries. That may affect the ability of the local workforce to participate in natural disaster mitigation, recovery and reconstruction.

In recent years, many NPOs have operated community-based relief and recovery activities, where they share responsibility for the work with the central and regional governments. Considering the increased roles and services performed by NPOs, the government and municipalities are requested to support their activities and promote them in order for them to be utilized more effectively in disaster mitigation operations.

4. Land Utilization plan and Social Systems for Effective Disaster Mitigation

(1) Basic Concept

In order to discuss the proper levels of infrastructure development and necessary investment to prepare against future natural disasters, it is necessary to classify the scale and impact of disasters into one medium- and large-scale categories, the latter of which could have serious and long-term effects not only on a large number of lives and properties, but also on international economics and politics.

Against medium-scale disasters, the damages should be prevented basically with “hardware” countermeasures such as reinforcement, improvement and new construction of infrastructure. However, against large scale disasters, despite the low probability of their occurrence, both “hardware” and “software” measures should be implemented together.

It is an important task that the government draws up a plan of infrastructure development for disaster mitigation that is financed by tax revenues. The government is requested to establish proper standards for future infrastructure development and decide appropriate budget allocations for this. They must take a long-term perspective in consideration of the following factors: the present and future situation of the national economy, population composition and its distribution. The government should assess long-term effects of disasters such as decline in global competitiveness, degradation of national landscape and effects upon public sentiment.

To establish a consensus on appropriate levels of investment for disaster mitigation, it is important to clarify the roles and responsibilities of public sectors: the central government and municipalities, regional communities and individuals. The public sectors have the responsibility of assessing vulnerability of land utilization and social systems, to estimate future disaster risks and to release the results of these assessments including

proper disaster countermeasures and costs. The government also has a responsibility to respond to widespread and devastating disasters that are beyond the capacities of municipalities. It has to support the municipalities and to take the initiative in conducting disaster recovery and rehabilitation operations.

Furthermore, natural disasters are not a regional problem, but a global issue to be tackled with the cooperation and collaboration of all countries in the world. Japan has influenced the socio-economic development of developing countries through trading and development assistance programs. In other words, it is its responsibility to assist those countries' efforts to improve their natural disaster mitigation and environmental protection. The Japanese government has to establish strategic systems and organizations for international contributions and cooperation in coordination with its ministries and public agencies.

(2) Land Utilization plan and Development of Infrastructure for Disaster Mitigation

① Land Utilization

The government needs to maintain the function of the capital, Tokyo, even in times of disasters, taking into account the impact on the global community's economy and political activities. It should build backup systems to maintain basic functions and improve quick, smooth recovery and reconstruction operations.

Because it is almost impossible to fully implement financial measures for ensuring safety of vulnerable areas such as reclaimed land, river basin areas, hilly suburbs which have been developed as residential districts around major cities, and isolated mountainous and coastal areas, the government is requested to release necessary information on the disaster risks of these areas so that the residents would become aware of the risks and choose a more appropriate place to live through their own decision-making process.

② Reduction of Disaster Vulnerability in Existing Houses, Buildings and Infrastructure

Since the Kobe Earthquake of 1995, many municipalities have introduced support systems for disaster mitigation such as seismic vulnerability assessment of houses and a low-interest seismic retrofit loan program. In spite of these efforts, not many households have taken advantage of the system to retrofit their houses yet. In particular, there are many old wooden houses in which only elderly people live away from their children. Even though their houses need to be reinforced, the municipalities cannot force them to implement reinforcement measures on a loan considering these people's financial constraints.

The Central Disaster Prevention Council has set forth the goals for the next decade that 90% of houses in the country will have enough earthquake resistance and the number of casualties due to the collapse of buildings will be reduced by half. To achieve these goals, they need to consider more investment of public funds into the promotion of

anti-seismic retrofitting of private houses and buildings.

As for the resistance and resilience of reclaimed areas near major cities, it is necessary to collect accurate data on ground conditions and seawall structures. Necessary disaster risk mitigation and prevention measures should be implemented in such areas. In that respect, the government and municipalities are requested to create a financial support system.

Enclosed seas like Tokyo Bay, on the coast of which there are reclaimed areas where a number of industrial complexes have been constructed, are exposed to the risks of hazardous materials and high-pressure gas flowing into the sea. In these areas, maritime sea traffic should also be examined, and the deterioration of seawalls built by private companies should be investigated and strengthened as part of public disaster mitigation efforts.

The 2004 Niigata-Chuetsu Earthquake caused strong earthquake ground motions in the near field of an active fault, which caused the derailment of the Joetsu-Shinkansen bullet train. The early warning system for rapid trains, Yuredasu, are effective against plate boundary earthquakes in the Pacific Ocean, but may not be so against intra-plate earthquakes in close vicinity. In order to compensate for this, seismic hazard and risk mitigation technologies are urgently required for the reduction and prevention of future Shinkansen train derailment and consequent disasters.

(3) Social Systems for Reduction of Vulnerability

① Enhancement of Public Awareness of Disaster Risks and Preparation

To promote public awareness of disaster risks and preparation, hazard maps containing detailed hazard risks of areas are important. Based on the balanced combination of public works, community cooperation and self-support, successful disaster mitigation is achievable. The self-support is attained through individual efforts, and community cooperation is built on the ground of each community's good capacities and sense of responsibility. With a balanced combination, the government and municipalities can establish disaster mitigation policies and measures by understanding the needs of the people.

②Establishment of Communities Resistant to Natural Disasters

Community cooperation and participation have weakened owing to aging population, low birthrate and increasing nuclear families. In cooperation with volunteers, community-based organizations and NPOs, municipalities should build a network among the residents and utilize it to promote community-based anti-disaster activities. Through working together, the municipalities could strengthen relationships with the residents and promote their responsibilities for the communities and participation in disaster-related activities. The residents' participation is crucial for successful community-based disaster activities.

Since the 2004 Niigata earthquake, the importance of disaster mitigation responding to each region's social and environmental characteristics has been widely recognized. Regional physical and non-physical resources should be utilized in designing mitigation

programs. Activities such as private-sector initiated community protection, community-based rescue efforts and assistance to senior citizens, and volunteer groups' efforts in cooperation with young and middle-aged people should be further encouraged.

Each municipality is requested to set up regional medical support systems including emergency medical aid and rescue, medevac helicopter services, interregional medical transport of patients and a triage system*. A comprehensive emergency medical service program is indispensable for the municipality to smoothly operate relief operations.

*triage system: a system of sorting out and classifying patients or casualties to determine priority of need and transfer to proper place of treatment.

③ Establishment of Disaster Tolerant IT Systems

For the establishment of disaster tolerant IT systems, it is essential to build data backup systems and to improve operationability, compatibility, and system redundancy. It is very important for society not to become over-reliant on electronic information technology and to control the concentration of information in metropolitan Tokyo. For example, information management centers concentrated in urban areas should be transferred to, and network and data backup systems be constructed in rural areas. These actions can be achieved through mutual cooperation between the governments and private sectors.

To prevent network disconnection in emergency situations, underground optical cables, communication satellites, the Internet, terrestrial digital media broadcasting system (T-DMB) and other communication systems should be available together without complication.

④ Disaster Education and Transfer of Past Disaster Experience

In order to create a safe and secure society, it is necessary that people are always aware of the risks of natural disasters. For that purpose, education on natural disasters should be continuously promoted in schools and communities so as to enable people to acquire proper knowledge and understandings of disaster risks and preparation.

In primary, secondary and high schools, the mechanism of the occurrence of natural disasters and their impacts on the society should be taught in geology, geography and social studies. Students will learn the geographical characteristics of disaster-prone areas and acquire the intuitive ability to recognize unusual climatic/weather phenomena and a keen sense for natural disaster.

Higher education institutions such as universities, graduate schools and technical schools should establish a professional training program, in which students will be educated to be disaster experts. That education can also train professional engineers and international experts to enable them to work for not only regional but also for global communities.

(4) International Contribution to Natural Disaster Mitigation throughout the World

Japan has achieved significant economic growth whilst relying on natural resources and industries in developing countries. In other words, Japan and these developing countries are interdependent in terms of economic and political activities. The world has become more borderless and interconnected. It is not practical for Japan to draw a line between home and abroad by borders. It is not always appropriate to differentiate between home and foreign affairs in national administrative procedure. The differentiation could create obstacles to the country's international activities, cooperation and collaborations.

Japan has been contributing to natural disaster mitigation and prevention in the world through participating in a wide range of international discussions and activities. Its efforts have come to fruition in the International Decade for Natural Disaster Reduction (IDNDR), the United Nations World Conference on Disaster Reduction in Yokohama in 1994, where the "Yokohama Strategy" was adopted, the 2005 International Strategy for Disaster Reduction and the United Nation World Conference on Disaster Reduction in Kobe, where the Hyogo Framework for Action 2005-2015 was adopted, the World Meteorological Organization (WMO), other UN activities, and the Global Earth Observation System of Systems (GEOSS). By continuing its efforts to contribute to the global community, Japan has enhanced its international cooperation and leadership.

The country is expected to share its disaster-related experiences, engineering technology, scientific knowledge and economic power with the world. By responding to that expectation, Japan will be able to expand its leadership role in the world. In order to succeed in that, there is a need to work on the issues below:

- Contribution to natural disaster mitigation in a wide range of fields such as economics, politics, infrastructure construction, environment and agriculture. Therefore, to achieve effective and efficient international cooperation and contribution, the national ministries and agencies are suggested to build mutual coordination and cooperation through information exchange, then to establish synergy by integrating similar activities and projects.
- The Japanese government and public agencies are requested to have a sense of the borderless concept so that their contributions to natural disaster mitigation would be accepted internationally.
- The disaster vulnerability of developing countries is rooted in their poverty and poor governance. Disaster assistance should be offered together with Official Development Assistance (ODA) in a package. The low governance can be improved with the capacity building of government officials. The governments should establish systems for capacity building in which those who have obtained advanced knowledge and ability are recruited into public administration and other governing institutions.

5. Role of the Science Council of Japan in Natural Disaster Mitigation

(1) Role in Research and Development (R&D)

To minimize future disaster risks, promotion of R&D is indispensable in the fields of science, engineering and humanities in the following respects:

- Improvement of the accuracy of natural hazard predictions and development of disaster countermeasures against earthquakes and tsunamis, volcanic eruptions, global warming, and other disasters.
- Drawing up a blueprint for resilient land utilization plan and social systems
- Promotion of study on infrastructure resistant to destructive natural phenomena beyond estimations and external forces exceeding design levels
- Development of vulnerability assessment of existing low-seismic resistant houses, buildings and infrastructures, and development of effective reinforcement
- Development of disaster-resistant infrastructures utilizing new materials
- Promotion of transmission of past disaster experience and disaster education
- Enhancement of disaster risk assessment and development of observation technologies concerning pre-disaster phenomena
- Study on exchange and utilization of disaster-related information
- Development of warning systems utilizing advanced IT technologies

As for the improvement of land utilization plan and social systems for disaster mitigation, research and studies have been carried out by relevant individual institutes and researchers, but have not been integrated into a national research study yet. The possibilities of a large earthquake which may hit major cities such as Tokyo and Osaka have significantly increased. It is recommended that “National Research Programs on Natural Disaster Mitigation” with multidisciplinary approaches are established through the cooperation of academic societies from various disciplines. The SCJ must take the initiative in establishing and promoting these research programs.

(2) Proposals of Policies and Measures

The SCJ has a duty to make policy proposals based on its expertise, with the SCJ being privileged to present a panoramic opinion and advice from an academic standpoint, for the well-being of society and people. The SCJ, as a group of leading national scientists from all disciplines, has to address integrated disaster-related problems and integrated policy issues regarding disaster mitigation.

(3) Communication with Local Communities and the Public

It is important to make accurate assessments of future disaster risks and to release the results to the public. The SCJ, in cooperation with relevant academic societies, must make efforts to promote related researches and studies and provide the public with the results in an accessible manner. The combination of public works, community corporation and self-support is essential for effective natural disaster mitigation. The SCJ is required

to proactively participate in public-community-individual cooperation and obtain a public consensus on its decision regarding the future direction of research and development.

(4) Promotion of International Collaborative Research Programs

For promotion of international collaborative research programs, the SCJ is requested to take the initiative to determine research areas and to create an environment in which research results can be put into practice. The SCJ's initiation of the international collaborative research programs will promote international contributions of Japan. Similarly, in order to create a basis for international collaborative research programs, it is vital to build cooperation with international agencies of each country working with the member countries of the Science Council of Asia in the framework of international academic cooperation under the SCJ.

The SCJ has held the annual "International Conference on Science and Technology for Sustainability", where the overpopulation insufficient infrstructuresand the povertyin urban in the developing countries have been main issues for the discussion. The conference is recommended to examine those issues focusing on disaster mitigation as the main theme in the future. By doing so, international collaboration will be successfully promoted in research programs.

Members of the Special Task Committee on Disaster Mitigation under Global Changes of Natural and Social Environments

Chairperson: Masanori HAMADA (Section III Member): Department of Civil and Environmental Engineering, Waseda University

Vice Chairperson: Kojiro IRIKURA (Section III Member): Disaster Prevention Resarch Institute, Kyoto University

Secretary: Shunsuke IKEDA (Section III Member): Department of Civil Engineering, Tokyo Institute of Technology

Secretary: Kenji SATAKE (Affiliate Member): National Institute of Advanced Industrial Science and Technology

Teruko USUI (Section I Member): Department of Geography, Nara University

Taichi MAKI (Section II Member): Department of Environmental Sciences and Technology, University of Ryukyus

Atsuyuki OKABE (Section III Member): Department of Urban Engineering, the University of Tokyo

Fumihiko IMAMURA (Affiliate Member): Disaster Control Research Center, Tohoku University

Shigeru KAKUMOTO (Special Affiliate Member): National Research Institute for Earth Science and Disaster Prevention

Osamu KUSAKABE (Affiliate Member): Department of Civil Engineering, Tokyo Institute of Technology

Tomoko KUSAMA (Affiliate Member): President of Oita University of Nursing and Health Sciences

Junichi KOSEKI (Special Affiliate Member): Institute of Industrial Science, The University of Tokyo

Hidenobu JINNAI (Affiliate Member): Department of Civil and Environmental Engineering Faculty of Engineering, Hosei University

Yasuhiro SUZUKI (Special Affiliate Member): Graduate School of Environmental Studies, Nagoya University

Akimasa SUMI (Affiliate Member): Transdisciplinary Initiative for Global Sustainability, The University of Tokyo

Kuniyoshi TAKEUCHI (Affiliate Member): The International Centre for Hazard and Risk Management, University of Yamanashi

Hidehiko TAMASHIRO (Special Affiliate Member): Department of Global Health and Epidemiology, Graduate School of Medicine, Hokkaido University

Tetsuro TSUJIMOTO (Affiliate Member): Department of Civil Engineering, Nagoya University Graduate School of Engineering

Isao HAYASHI (Special Affiliate Member): National Museum of Ethnology, National Institutes for the Humanities, Inter-University Research Institute Corporation

Yoshitsugu HAYASHI (Affiliate Member): International Research Center for Sustainable Transport and Cities, Nagoya University Graduate School of Environmental Studies

Toshio YAMAGATA (Affiliate Member): Department of Earth and Planetaly Science, Graduate School of Science, The University of Tokyo

Tsuyoshi ICHIMURA (Special Affiliate Member): Department of Civil Engineering, Tokyo Institute of Technology

Cooperative Members of the Committee:

Shinichi IWASAKI	Department of Storm, Flood, and Landslide Research, National Research Institute for Earth Science and Disaster Prevention
Itsushi UNO	Department of Ocean-Atmosphere Dynamics Research Institute for Applied Mechanics, Kyushu University
Minoru KURIKI	Foundation of River & Basin Integrated Communications
Kazuo KONAGAI	Institute of Industrial Science, University of Tokyo
Hiroshi SATO	Department of Computer Science, National Defense Academy
Makoto TAKAHASHI	Department of Geography, Graduate School of Environmental Studies Nagoya University
Toshitsugu FUJII	Volcano Research Center, Earthquake Research Institute, University of Tokyo
Muneo HORI	Division of Earth Mechanics, Earthquake Research Institute, University of Tokyo