

# New Problems in the Study of Disaster Prevention Based on Disaster Risk Governance

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## 1 Introduction

Recently in Japan, earthquakes causing heavy damage occur frequently in areas with low probabilities of occurrence. There is also an imminent danger of the occurrence of large-scale earthquakes in Tokai, Tonankai, Nankai, and Minamikanto regions, and those with an epicenter in metropolitan Tokyo. The Intergovernmental Panel on Climate Change (IPCC) predicts that flood and storm damage caused by global climate changes like earth warming will increase. It also forecasts that the risks of tsunamis, storm surges, volcanic eruptions, snows and ice, tornadoes, etc. will be unavoidable, indicating that some regions may need to take measures to control multi-hazard risks. Combined with increasing uncertainty about disaster risks as mentioned above, changes in social structures, such as a rapidly aging population, a declining birthrate, and weakening communities, are pressing us to revolutionize existing disaster prevention policies and strategies.

Learning a lesson from the repeated occurrence of unpredicted disasters, Japan has been changing the concept of its disaster prevention policy from preventing (avoiding) damage to mitigating (reducing) it by taking pre-/post-measures against disasters on the premise that disasters inevitably happen. Disaster measures are also shifting from conventional measures focusing on structures (hardware approaches) to the development of evacuation systems and emergency response measures (software approaches). Changes in social structures including a rapidly aging population, a declining birthrate, and urbanization have been forcing us to recognize the importance of

integrated pre-/post-disaster prevention policies with the objectives of recovering local economies and communities in damaged areas and increasing the possibility of restoring the normal lives of individuals and families.

A disaster resilient society is the one where society members understand, without assuming “zero risk,” disaster risks characterized by uncertainty and determine acceptable risk levels, based on which various major concerned bodies constituting the society take appropriate measures and cooperate with each other to perform disaster reduction activities.

The restructuring of disaster prevention policies thus requires to take full account of the uncertainty of disaster risks, individual and social vulnerability to them, mid- and long-term resilience to reconstruct communities and restore lives, social and individual diversity, and interdependence between society, economy, culture and tradition.

This paper hence analyzes the current problems of disaster prevention policies from the viewpoint of constructing a disaster-resilient society, premised on changes in social structures and various factors to be considered in disaster prevention policies. It also outlines the context and the basic concept of “disaster risk governance” we are proposing as a new framework for innovative disaster prevention policies. It then describes our proposed direction of research and development on the disaster reduction technology integrated with the social science, focusing on disaster risk information in particular. This paper proposes disaster risk governance as the “cooperative administration of disaster risks through social interactions between various major concerned bodies (risk communication based on disaster risk information) and the formation of

social networks.”

## 2 Current situation and problems of Japanese disaster prevention policies—seen from the viewpoint of disaster risk governance

### 2-1 *Systems for disaster prevention planning and their current situation*

Based on the “Basic Law on Disaster Management” and relevant laws, Japanese disaster measures are taken at each of the following stages: disaster prevention, emergency disaster response, and disaster recovery. The Central Disaster Prevention Council developed the highest-level plan, the “Basic Plan for Disaster Prevention,” according to the Basic Law (Figure 1). The Basic Plan indicates basic policies for priority issues in establishing disaster prevention systems, facilitating and optimizing disaster recovery, encouraging sciences and technologies as well as research on disaster prevention, disaster prevention services, and local disaster prevention plans.

As to imminent large-scale disasters in particular, the plan assumed damage, developed disaster prevention strategies, and set a disaster reduction target for each case (Figure 2). The disaster prevention strategy for Tokyo metropolitan epicentral earthquakes,<sup>[1]</sup> for example, assumes that the worst case (wind velocity 15 m/s) causes a human damage of about 11,000 persons and an economic loss of about 112 trillion yen, setting a disaster reduction target of 50% and 40% in 10 years, respectively. The strategy lists actual problems to be solved to achieve the targets. Those for reducing human damage are the seismic retrofitting of housing and buildings, fire measures, and the maintenance of dense urban. Those for reducing economic loss are the measures to reduce disaster recovery costs, the continuation of business operations, and the measures to quickly recover traffic networks.

At prefectural and municipal levels, disaster prevention councils consisting of the heads or their designated staff members of local public bodies, designated local administrative agencies, police and fire departments, and designated public institutions have been formed in prefectures and

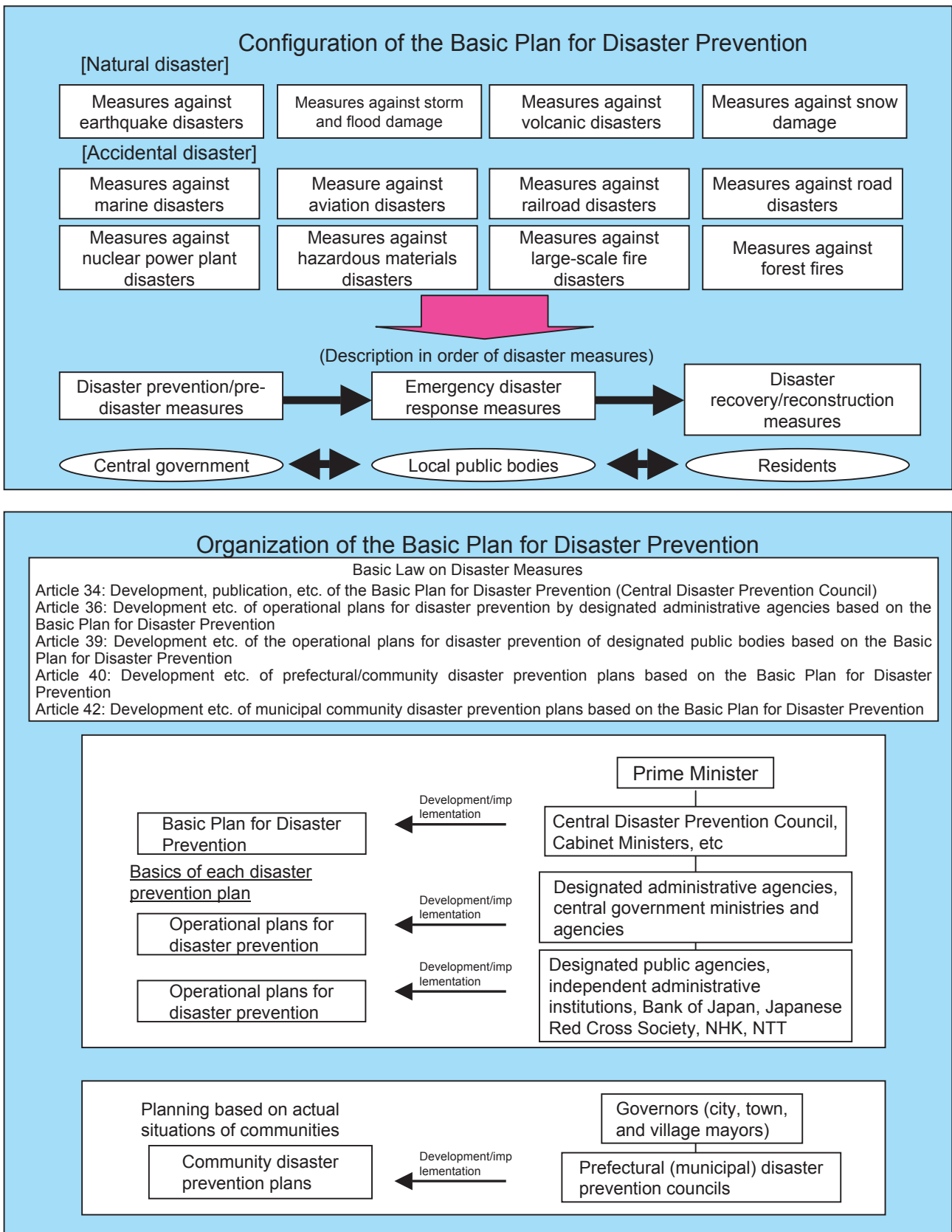
municipalities. Various disaster measures are taken based on the community disaster prevention plans developed by these councils.

Disaster prevention plans prepared by the Government and local public bodies include, however, no actual measures taking account of individual lifestyles, family relations, and the diversity of communities. Some of local public bodies have set up action programs for disaster prevention in addition to community disaster prevention plans based on the Basic Law on Disaster Management, expecting to add concreteness, flexibility, and effectiveness to the plans. The actual examples of these programs include pre-disaster measures such as making a list of human resources with skills in disaster prevention and making a system for collecting disaster damage information with the help of bike-riding residents. Community disaster prevention plans based on the Basic Law thus tend to give a formal description and lack concreteness and effectiveness. The development of new planning techniques including the creation of action programs for disaster prevention is needed to compensate the shortcomings of such plans.

### 2-2 *Necessity of multiple networks*

#### (1) **Encouragement of voluntary disaster prevention activities**

The Basic Law on Disaster Management encourages community members to voluntarily participate in disaster prevention activities. It also calls on the Government and local public bodies to foster voluntary disaster prevention organizations (voluntary organizations based on the spirit of mutual aid among neighbors), to improve the environment for the voluntary activities of disaster prevention, and to promote voluntary disaster prevention activities by community members. The Law defines Japanese disaster management on the premise of the comprehensive and integrated efforts of various major concerned bodies as well as administrative agencies. According to the White Paper on Disaster Management 2007, the disaster prevention agencies of central and local governments have been working in close cooperation with each other to establish systems for information collection, communication, and wide area response operations.



**Figure 1** : Configuration and organization of Japanese disaster prevention plan

Source: White Paper on Disaster Management 2007

In the current situation, however, individuals, communities, administrative agencies, NPOs, and other related organizations have fixed roles in society and are acting independently

with insufficient results. For example, local public bodies have started developing a system for confirming the safety and supporting the evacuation of people who need care at the time

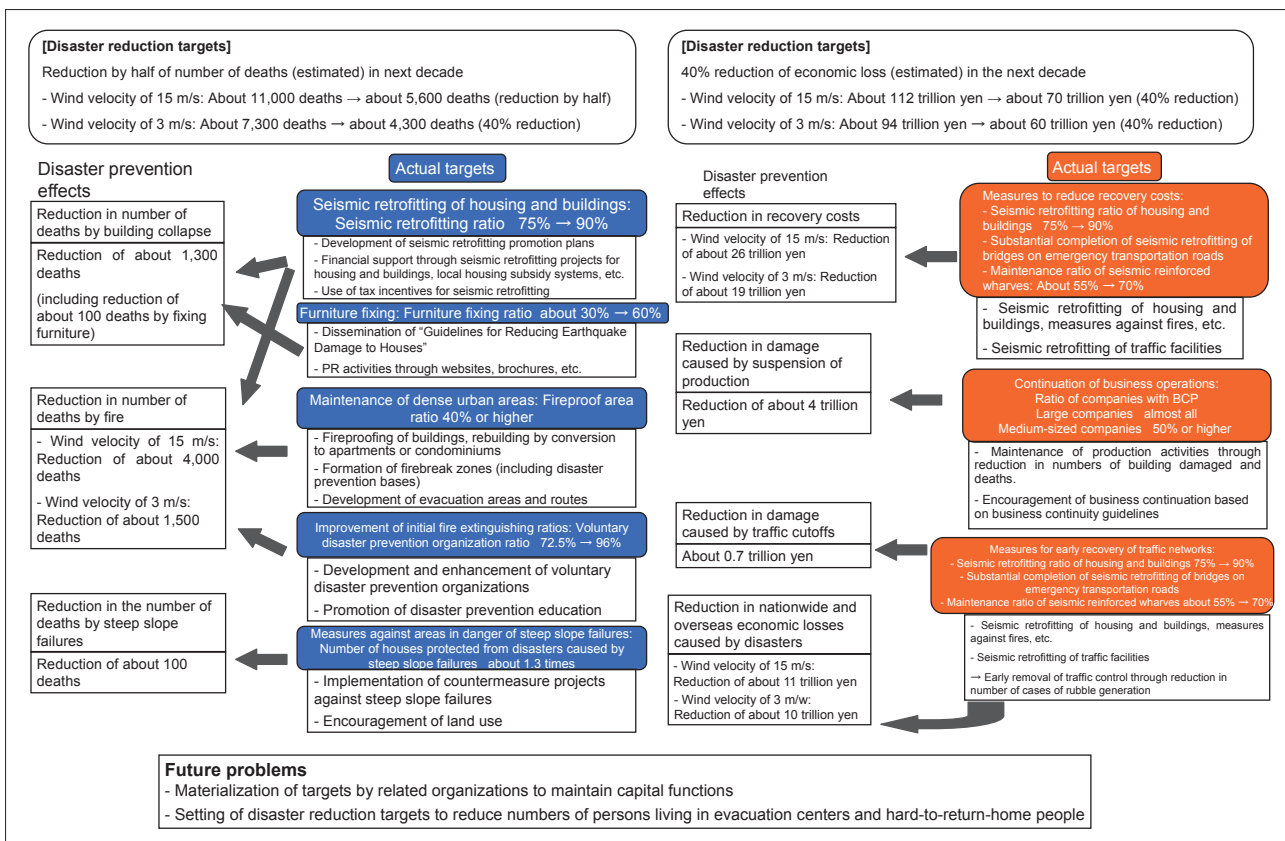


Figure 2 : Disaster prevention strategy for Tokyo metropolitan epicentral earthquakes

Source: White Paper on Disaster Management 2007

of disaster time, using a guideline<sup>[2]</sup> prepared by the Government. And nationwide municipalities have started making a list of them. Some of them, however, have not yet built a system for the safety confirmation and evacuation support. Even in the areas trying to establish their support systems, there is hardly any community that has set up a system consisting of multiple social networks including daytime working people in the communities concerned and conducted drills for emergencies. As described above, current disaster management systems are not designed well to cope with multiple social structures.

**(2) Current situation and problems of voluntary disaster prevention organizations**

According to the “Current Situation of Community Disaster Prevention Administration,”<sup>[3]</sup> the national average of the organization rates of voluntary disaster prevention organizations consisting of neighborhood associations or residents associations as a unit (as of April 1, 2005) was 64.5%. Even in Shizuoka Prefecture with the highest organization rate (98.5%), there are some districts where voluntary disaster prevention activities like

evacuation drills are uniform and routine. Voluntary disaster prevention activities based on relations within a community tend to become a mere name all over the country as the aging of society progresses. On the other hand, expectation for the roles of voluntary disaster prevention organizations is increasing. Such organizations are expected to confirm safety, perform rescue activities, and operate evacuation centers at the time of disaster. They are also expected to play various roles at ordinary times, such as to create disaster prevention maps, cooperate with public institutions to develop disaster prevention action programs based on assumed damage specific to the communities concerned, and pass on the experiences of disasters and the knowledge of disaster management (disaster cultures) to the next generation. Networking to support the various roles of voluntary disaster prevention organizations and the establishment of information sharing environment to enhance the knowledge management capabilities of communities will be essential in the future.

**(3) Establishment of the environment for disaster prevention activities through multiple networks**

In recent years, disaster relief volunteers aiding victims have been significantly contributing to disaster recovery. The Basic Law on Disaster Management (revised in December 1995) and the Basic Plan for Disaster Prevention (revised in July 1995) incorporated disaster relief activities by volunteers in disaster management policies. As a result, local public bodies have been positioning disaster relief volunteers in their community disaster prevention plans, cooperating with Councils of Social Welfare, NPOs, and other organizations to develop the contact points for volunteers (volunteer centers). The “Basic Policy on the Promotion of National Campaign to Reduce Disaster Damage”<sup>[4]</sup> indicates the importance of the establishment of local networks participated by various organizations such as Government agencies, local governments, schools, community centers, PTAs, enterprises, and volunteer organizations. Some communities set up an NPO participated by administrative agencies, medical institutions, a Council of Social Welfare, private businesses, voluntary disaster prevention organizations, residents associations, local media (community FM stations and CATVs) to establish disaster relief networks, operating volunteer centers at the time of disaster, as well as supporting the voluntary disaster prevention activities at ordinary times. At a disaster area (Hojo District) in Kashiwazaki City struck by the recently occurred Niigataken Chuetsu-oki Earthquake, a community organization for lifelong education took the initiative in forming a private-public joint disaster prevention network with voluntary disaster prevention organizations, community action groups, the local government, the Self-Defense Forces, and the fire department. Some districts are performing wide-area voluntary disaster prevention activities setting elementary or middle school district as a unit. While such pioneering activities have been gradually spreading nationwide, the establishment of the environment to support these social networks in performing disaster reduction activities has emerged as a new challenge for disaster prevention policies.

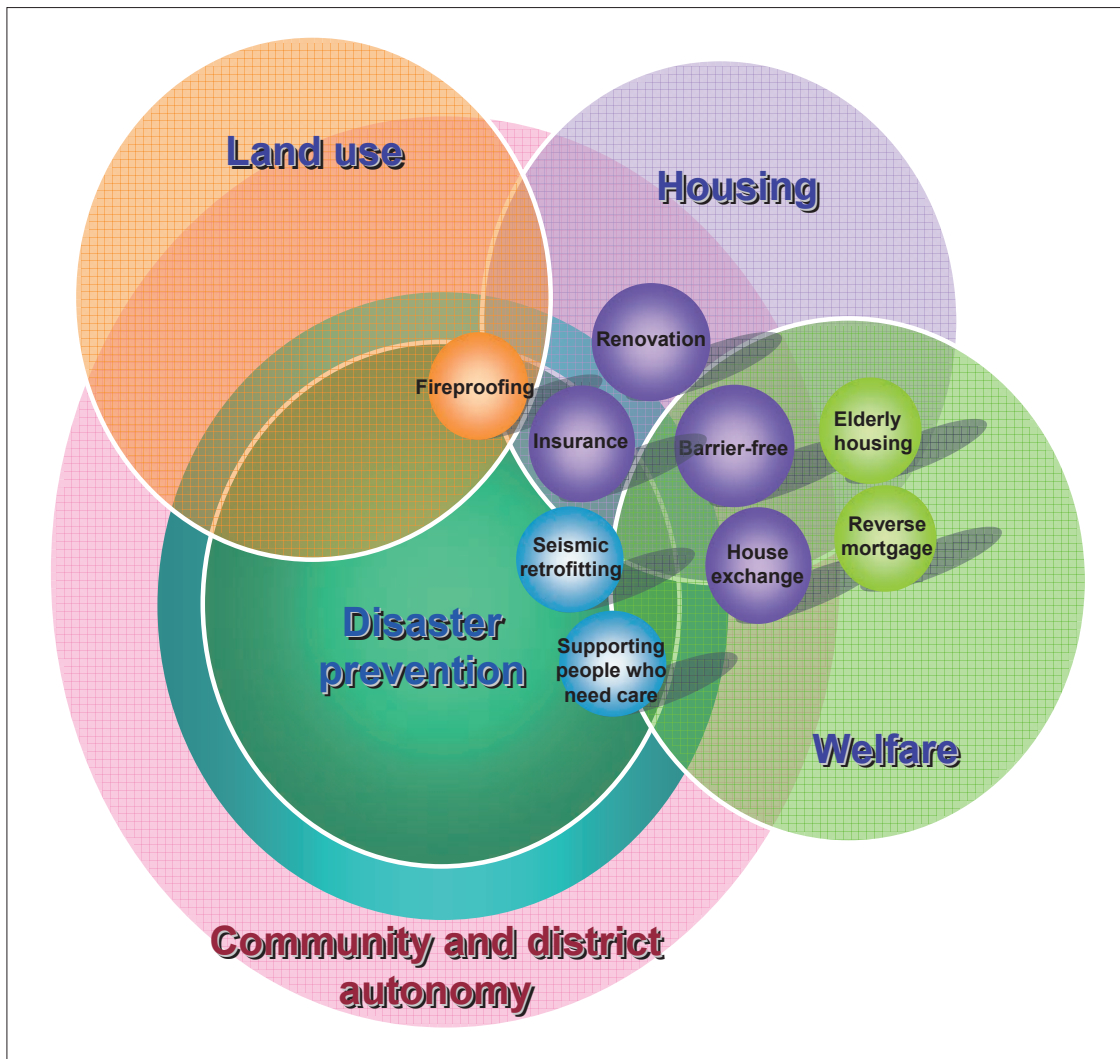
To reinforce emergency response and recovery activities at the time of large-scale disaster, local

governments have an emergency assistance agreement on medical care, food, materials, information, and recovery activities with private businesses and industrial associations. Some Contractors Associations, for example, have an agreement (onerous) to send heavy machines and operators for emergency recovery operations. Various agreements, such as to supply the distribution stock of fresh food to supermarkets and cooperative societies in place of emergency food stock, are concluded. An example of information-related agreement is to produce educational programs for increasing disaster awareness at ordinary times as well as to broadcast disaster information at the time of disaster. There are cases where local governments have mutual assistance agreements with each other to prepare for massive emergency response and recovery operations and continue administrative services. To ensure the effectiveness of these wide-ranging disaster prevention agreements, however, a common understanding of circumstances among related parties including voluntary disaster prevention organizations and disaster volunteers in general, as well as information sharing among the parties concerned with the agreements, is essential. Building cooperative mechanism between various major concerned bodies based on information sharing is hence important as part of disaster prevention policies.

**(4) Comprehensive restructuring of residents associations**

Comprehensive restructuring of residents associations beyond limited relations within a community will become important to increase the disaster prevention capabilities of communities through multiple social networks and administrative agencies for disaster prevention.

The “Basic Proposals on Disaster Prevention Strategies Taking Advantage of the Power of the Private Sector and the Market”<sup>[5]</sup> prepared by the “Expert Study Group on Improving Disaster Prevention Capabilities Taking Advantage of the Power of the Private Sector and the Market,” a subsidiary organization of the Central Disaster Prevention Council, suggested that, in addition to efforts aiming primarily at preventing disasters, activities like community renovation would



**Figure 3** : Linkages between disaster prevention policies and other related policies (case of seismic retrofitting of housing)

Source: National Research Institute for Earth Science and Disaster Prevention

increase the capabilities of individuals and communities, change communities, and improve their disaster prevention capabilities. The disaster prevention strategies should hence be modified to increase community disaster prevention capabilities, which are primarily of voluntary disaster prevention organizations, to encourage the comprehensive activities of regional organizations to find and solve community problems, and to use multiple social networks covering various life areas.

### *2-3 Comprehensiveness and integrity of disaster prevention policies*

#### **(1) Current situation on the comprehensiveness and integrity of disaster prevention policies**

Disaster prevention policies must cover not only a framework of so-called disaster prevention administration but also multiple policy areas

related to all life areas of residents (Figure 3). The current disaster prevention administration deals with pre-disaster measures such as to accelerate the seismic retrofitting of housing, expand voluntary disaster prevention organizations, establish activity environment for disaster prevention volunteers, and develop business continuation plans. To reduce social vulnerability and help disaster victims restore normal life, however, the future administration will need to link disaster prevention policies with wide policy areas for normal times including housing policies, urban planning, community policies, welfare policies, policies to promote civil activities, commercial policies, and industrial policies.

As for post-disaster measures, the Government and local governments have abandoned the idea of simply restoring things to their original state. They are instead taking various measures including legal, tax, and budgetary incentives to systematically

implement regional development programs, reconstruct disaster areas in a planned way, restore the lives of victims, secure housing, and recover regional economies. These measures are carried out in coordination with policies in areas other than disaster prevention.

Systematic and comprehensive assessment on Japanese disaster prevention policies should be performed separately. As far as the framework of the Basic Law, the planning system, and the trends of the policies are concerned, they are comprehensive and integrated to some extent. Looking at them from the viewpoints of disaster-affected people and response to uncertainty, however, each of disaster measures of administrative agencies, communities, and individuals is insufficient. In the case of individuals, for example, they do not always use distributed hazard maps for evacuation, sometimes throwing them away. Many local governments have neither publicized information on evacuation routes nor performed evacuation drills. Creating better hazard maps and indicating evacuation routes in an easy-to-understand way are the problems that administrative agencies and experts are facing. They are also related to personal risk literacy, disaster psychology, and the tradition of disaster experiences. People often want to find economic, traditional, or cultural reasons for moving house and choosing a site. The Government and local public bodies therefore should not one-sidedly offer hazard maps and information on their use, but should attach importance to risk communication (mutual learning process by various stakeholders through discussions and deliberations on risk information) and comprehensively take account of social and economic vulnerability and cultural value, before taking comprehensive and integrated measures to ensure the effectiveness of disaster prevention policies.

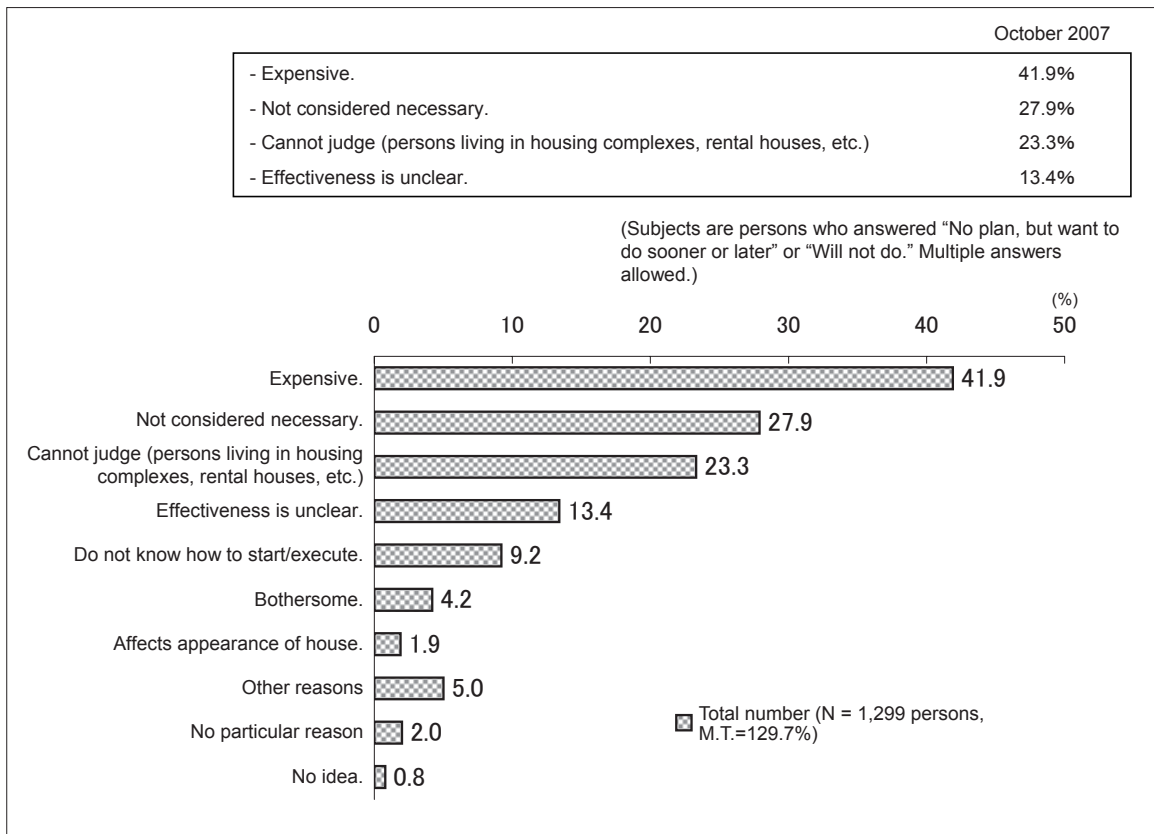
**(2) Examples of the seismic retrofitting of housing**

Using the policies for the seismic retrofitting of housing as case examples, the below describes actual problems on the comprehensiveness and integrity of the disaster prevention policies mentioned above. The Central Disaster Prevention Council estimates that about 11.5 million houses, 25% of a total number of about 47 million houses

in the country, have insufficient earthquake resistance. In September 2005, the Council decided the Government’s “Policy on Emergency Measures for the Seismic Retrofitting of Buildings.”<sup>[6]</sup> The Governments set the national target of achieving a seismic retrofitting ratio of 90% by the end of the next decade, expanded the subsidy systems for seismic assessment and seismic retrofitting, and introduced tax benefits including housing loan tax credits and the reduction of income taxes and fixed property taxes for households performing seismic retrofitting. Low-interest financing by Japan Housing Finance Agency and other financial institutions and the premium discounts (a maximum of 30%) of earthquake insurance based on the ratings specified by the “Housing Performance Indication System” (introduced in 2000) became available. The Revised Implementing Regulations of the Building Lots and Buildings Transaction Business Law (2006) obligate real estate dealers to disclose the results of seismic assessment and housing performance assessment as important information to the purchaser or the tenant of the building concerned when such assessments are made. The primary subjects of these policies are house owners and housing suppliers in general.

From the viewpoints of various residents, a policy to accelerate seismic retrofitting in conjunction with the rebuilding of old houses or barrier-free renovation may be effective to ensure the safety of housing and to improve the quality of life. To implement the policy, the construction of systems to provide information on financing methods for seismic retrofitting (e.g. reverse mortgage, financing systems for the reconstruction of old apartments, etc.) will be essential. According to the “Special Opinion Survey on Earthquake Disaster Measures” (2007) conducted by the Cabinet Office, many respondents gave reasons like financial difficulties, being a tenant, etc. for not performing seismic retrofitting. Although local governments subsidize for seismic retrofitting costs, they have no measures for tenants (Figure 4).

Policies to encourage the tenants who have been living in rental houses built on the old earthquake resistance standards to move house are also effective. In addition to seismic retrofitting policies premised on continuing to live in the same house, providing comprehensive housing information on



**Figure 4** : Reasons for resistance to seismic retrofitting work

Source: Summary of "Special Opinion Survey on Earthquake Disaster Prevention Measures" (Cabinet Office, November 2007)

various ways of living according to life styles and stages, such as moving house by using public rental housing systems and a move to an apartment with care or a group home for seniors, will be effective from the viewpoint of disaster prevention. The current websites operated by local public bodies, however, hardly provide such information. These comprehensive information services and consulting systems will become available only through the networking of local governments, central governments, and private-sector organizations.

Solving the problems requires taking advantage of various measures in policy areas other than disaster prevention from the viewpoints of various residents, in combination with the services of private businesses and those of the nonprofit sectors of NPOs. It is desirable, for example, that the Cabinet Office, the National Research Institute for Earth Science and Disaster Prevention, and local governments cooperate in developing guidelines for house builders, building contractors, and real estate agents to follow when providing to their customers the disaster risk information, such as hazard maps and historical disaster maps, created and provided by administrative agencies. It

is also desirable to develop an incentive system that the market assesses the provision of appropriate disaster risk information by private businesses as their contribution of society. The asymmetry of information between private businesses and consumers should be considered when providing the disaster risk information.

**(3) Examples of systems to help disaster victims restore normal life**

The comprehensiveness and integrity of disaster policies are also required for policies on systems to help disaster victims restore normal life following disasters. The current Japanese system is based on the Law to Help Disaster Victims Restore Normal Life enacted in 1998 as legislation introduced by Diet members. The law aims to help natural disaster victims start an independent life by providing them with aid money. The intended victims are those who have difficulty restoring normal life by themselves due to damaged infrastructures and economic reasons. In July 2007, the Cabinet Office published "An Interim Report of Review Meeting on Systems to Help Disaster Victims Restore Normal Life,"<sup>[7]</sup> a summary of



discussions toward the revision of the law. After going through these discussions, the Revised Law to Help Disaster Victims Restore Normal Life was enacted in the 168th extraordinary Diet session convened in 2007. The Revised Law enables the Government to provide disaster victims with cash as a token of sympathy on a fixed amount basis according to housing reconstruction methods (a maximum of 3 million yen), without limiting the use of money. The disaster victims are allowed to use aid money for the construction of a new house or the purchase of a house. Annual income and age limits to receive money were removed (before the revision, annual income limit was not more than 5 million yen in principle).

Before the interim report was published, the discussion point was whether to support housing construction (use of taxpayers' money to restore private property). Another discussion point was whether to fix the amount taking account of self-help efforts such as pre-disaster measures like seismic retrofitting and buying earthquake insurance, self-financing ability to restore normal life, and so on. The law is, however, only partly useful in helping disaster victims restore normal life. The Government should hence design a comprehensive support system that includes an incentive to encourage self-support efforts and acts as a safety network after assessing the social and economic vulnerability and the mid- and long-term difficulties in restoring normal life of disaster victims and affected areas.

### 3 | Aim of disaster risk governance

#### 3-1 *Necessity of disaster risk governance*

As described in Section 2-2, the current Basic Law on Disaster Management as a basis for forming a framework of disaster prevention policies stipulates the role and responsibility of the measures taken by disaster prevention agencies (public support, government support), of those based on the self-responsibility of individuals, households, and enterprises (self support), and of those taken by communities and volunteer networks (mutual support). Although the Basic Law assumes the diversity of major concerned bodies, actual disaster prevention policies are centered on public support. Concerns about excessive dependence

on public support are hence expressed. As for measures against infrequent large-scale disaster risks in particular, disaster prevention plans and measures centered on disaster prevention policies based on the hierarchy system are insufficient, and therefore, research and development on social technologies to integrate the measures with mutual support efforts in communities is essential.

An international mainstream approach in disaster prevention policies is to systematize disaster measures as an integrated risk management system.<sup>[8]</sup> The South Hyogo Prefecture Earthquake in 1995 was a good opportunity for Japanese people to recognize the necessity of a standard framework for continuous risk reduction based on the PDCA cycle. The framework was standardized as JISQ2001 "Guidelines for Building Risk Management Systems." The standard was at first developed as the one for crisis management focusing on emergency responses immediately after the outbreak of crisis, but was later expanded to include pre-disaster and recovery measures. It covers the risk reduction of not only concerned parties like enterprises and local governments but also others including consumers, residents, stakeholders, and business connections. The risk management systems are, however, extremely weak in creating multiple networks because they rely on top-down internal control.

The concept of "disaster risk governance" is hence needed as a new framework to complement the weakness of risk management systems and build horizontal social networks and disaster measures based on the networks.

#### 3-2 *Trends of governance arguments in various policy areas*

In Japan and other countries, major concerned bodies in the production and supply of public services have recently diversified. It is pointed out that administrative agencies have been changing their way of policy implementation to form and maintain networks with enterprises and NPOs.<sup>[9]</sup> Traditional governance performed by the Government and local public bodies are changing to cooperative governance and coordination involving various major concerned bodies. This trend is called "from governance to governance" in the field of public administration. In the USA

and UK, empirical discussions and analyses on the effectiveness of governance through the multiple networks led by administrative agencies are being made.<sup>[10,11]</sup>

With a growing trend toward decentralization in Japan, the subsidiarity principle (principle that policy decision and implementation should be made at levels closer to the residents and communities affected by it) on the sharing of roles of the Government and local governments has been extended to arguments about governance inside local governments. Subcontracting and designated management have become popular between local governments and various major concerned bodies in communities. Many parts of the country have started to adopt cooperation systems between residents associations and NPOs, as the intention of autonomous ordinances.<sup>[12]</sup>

### 3-3 General definition of risk governance

Expanding the concept of risk management, the field of general risk study uses a terminology of “risk governance” to address new technologies and environmental risks. Chapter 9 “Risk Governance as a New Trend of Addressing Risks” of “Handbook of Risk Research, Revised and Enlarged Edition” defines it as “the concept indicating the direction of new management to address social risk problems that, in place of regularly institutionalized governance, diversified and decentralized parties make coordination and decision called “joint governance or cooperative governance” through various networks and organizations (international, national, local governments, communities, NPOs, etc.) while keeping their autonomy and emergence.”<sup>[13]</sup>

International Risk Governance Council, a Switzerland-based private-sector network for international risk governance, proposed an integrated analysis framework for risk governance with the objective of providing a guideline for developing a comprehensive risk analysis and management strategy to deal with risks including natural disasters.<sup>[14]</sup> The framework emphasizes the importance of the way of effective involvement of stakeholders, risk-benefit relations, and trade-off between risks, as well as the scientific, social, and cultural aspects of risks. Such approaches are appreciated as the efforts to clarify the

elements contained in risk management and risk communication through the framework of risk governance, and to improve the quality of decision making on acceptable risk levels and measures in the social context.<sup>[15]</sup>

### 3-4 Concept of the National Research Institute for Earth Science and Disaster Prevention on “disaster risk governance”

The National Research Institute for Earth Science and Disaster Prevention launched the second phase of “Study on Disaster Risk Governance” project from the year 2006, aiming to change its research strategy from extending disaster risk management to innovating the governance structure itself constructing the framework of comprehensive risk governance.<sup>[16]</sup> The project defines disaster risk governance as the “cooperative governance of disaster risks through cooperation by forming social interactions (risk communication based on disaster risk information) and social networks between various major concerned bodies, presenting the following three requirements shown below in Items (1) - (3) for implementing the “disaster risk governance” in communities:

#### (1) Multiplicity (professional knowledge, experiential knowledge, and local knowledge) of disaster risk information and its community-wide sharing

The first requirement is that a community shares the scientific knowledge of local hazards and disasters, the knowledge of local disaster culture, as well as risk reduction technologies and methods. “Disaster risk information” can be classified as follows from the viewpoints of the producers and scopes of information:

- Professional knowledge

Knowledge, information (hazard maps, estimated damage maps, etc.), engineering measures, disaster prevention systems, social technologies, etc., held by professionals or administrative agencies.

- Experiential Knowledge

Experiences and lessons of disasters (disaster ethnography etc.)

- Local knowledge

Disaster characteristics of community, wisdom peculiar to a community, etc. (incidents, signs of disasters passed down for generations, disaster

culture, etc.)

Integrated disaster measures are taken based on the risk communication between these three information areas. In a broad sense, disaster risk information also includes the socially acceptable levels of disaster risks and personal and social preferences on disaster measures.

**(2) Social decision-making (risk preference) based on deliberate communication and discussions (risk communication) between various stakeholders**

The second requirement is that various stakeholders make comprehensive decisions based on deliberate communication and discussions (risk communication) about the selection of measures for reducing disaster risks, taking account of risk-benefit relations, trade-off between risks, and social acceptability.

Risk communication is carried out in various contexts based on the shared disaster risk information described in Item (1) according to changes in social situations. It is neither merely positioned in a system of institutional procedures for disaster prevention administration, nor directly related to decision making within an institutional framework. The effects of learning and training on disaster risks (literacy acquisition) and of knowledge management are expected during risk communication process for decision making. The rapid expansion of Internet enables web communication as a complementary tool for face-to-face risk communication. The development of the means and technologies to support risk communication in such information environment is required.

**(3) Establishment of horizontal and non-institutional cooperative frameworks consisting of various organizations and individuals in society through the use of social relations and personal incentives**

The third requirement is that various organizations and individuals in society cooperate to take measures to reduce disaster risks, using social relations such as mutual confidence and the norms, networks, and personal incentives cultivated on a daily basis, creating new mechanisms when needed, and taking advantage of individual abilities

and technologies.

Disaster risk governance should not be implemented on the premise that confidence between individuals and between stakeholders or social relations like the norms are built up. Disaster measures are likely to be taken by trial and error through the formation of social networks and communities. If the comprehensive autonomy of a community is vulnerable, disaster risk governance can be realized only when a novel community strategy of simultaneously forming and networking new public-supporting entities is implemented.

Disaster risk governance creates dynamism in communities in such a way that non-institutional and horizontal cooperation emerged from multiple networks is incorporated into institutional disaster measures.

**4 New directions of disaster prevention studies based on disaster risk governance**

**4-1 Positioning of research and development on the disaster reduction technology integrated with the social science**

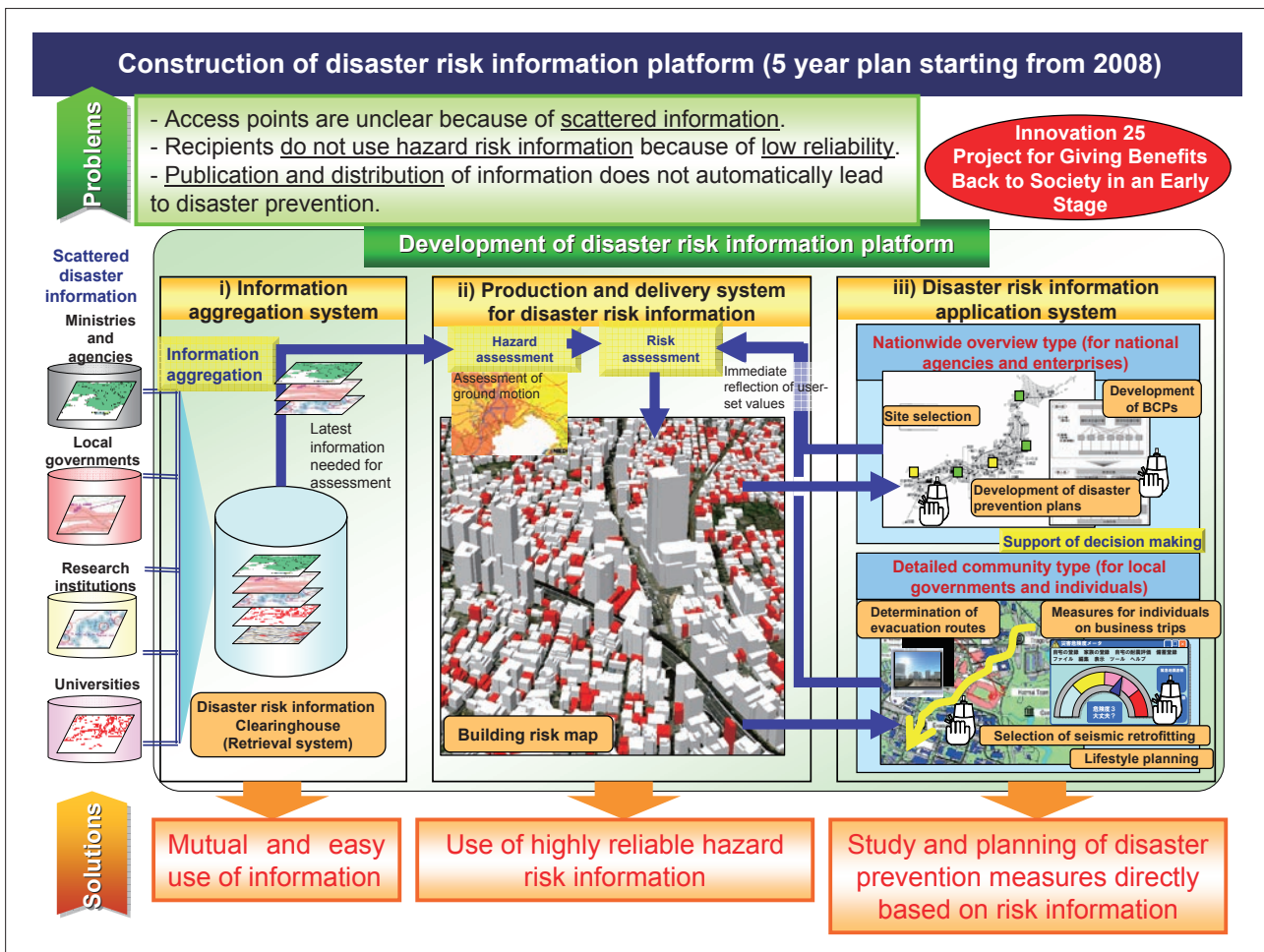
The research and development of the disaster reduction technology integrated with the social science corresponds to “the disaster reduction technology integrated with the social science,” one of the strategically important technologies mentioned in the “promotion strategies in the social infrastructure area” developed by the Council for Science and Technology Policy based on the Third Science and Technology Basic Plan<sup>[17]</sup> (Table 1). The Committee on Research and Development in the Disaster Prevention Area prepared “On the Policy for Promoting the Research and Development of Disaster Prevention”<sup>[18]</sup> in March 2003, positioning this technology as one of priority issues to be further promoted, requiring the promotion of “an understanding of social vulnerability and its causes, an assessment of the economic impacts of disasters, and the establishment of coordination with the social science area.” The above committee belongs to the Subdivision on R&D Planning and Evaluation attached to the Council for Science and Technology, Ministry of Education, Culture, Sports, Science and Technology. A long-term strategic guideline, “Innovation 25”<sup>[19]</sup> mentioned

**Table 1** : Key research and development issues on disasters and their objectives mentioned in the Third Science and Technology Basic Plan

(1) Survey study on observation, monitoring, and prediction of earthquakes	Subject	<u>Observation and survey research and disaster prevention technologies to reduce damage on massive earthquakes such as Tokyo metropolitan epicentral earthquakes, Tonankai/Nankai earthquakes, off-Miyagi Prefecture earthquakes; intensive development and extension of information infrastructures for disaster prevention and reduction; research on assessment and prediction of crust activity; survey research on earthquakes; construction of earthquake hazard stations; observation for earthquake prediction.</u>
	Objective	To improve earthquake prediction and disaster assessment immediately after occurrence of earthquakes and reduce damage by 2010 by carrying out intensive survey, observation, simulation on massive earthquakes such as Tokyo metropolitan epicentral earthquakes, Tonankai/Nankai earthquakes, off-Miyagi Prefecture earthquakes, and large-scale active fault earthquakes.
(2) Geological survey study	Subject	Systematic arrangement, database construction, and integration of geological information
	Objective	To reduce earthquake and volcanic disasters by 2010 by systematically arranging geological information essential for prediction of ground motion and volcanic eruption. To use information as a basis for industrial siting.
(3) Damage reduction technologies such as seismic retrofitting, improved disaster response, and advanced recovery and restoration planning	Subject	<u>Disaster reduction technologies such as seismic retrofitting of structures to prepare for large-scale earthquakes.* simulation of behaviors of structures and ground during earthquakes; prediction of effects of long-period ground motion and measures against it; development of earthquake-resistant construction methods; improvement of construction systems using robots and other means; safety verification of buildings; research on derailment during earthquakes.</u>
	Objective	To elucidate the overall earthquake-resistant performance of structures, develop simple and inexpensive technologies for seismic diagnosis, reinforcement, and retrofitting of existing structures, and significantly reduce damage caused by earthquakes and tsunamis by 2010 by conducting destructive vibration tests of full-scale models and analyzing the mechanism and strength of collapse of structures due to earthquakes.
(4) Technologies for predicting volcanic eruption	Subject	Prediction of volcanic eruption, prevention of volcanic disasters
	Objective	To reduce eruption disasters by 2010 by establishing a method for quickly and reliably determining strength of volcanic activity and developing physicochemical models of eruption.
(5) Technologies for observation, prediction, and disaster reduction of storm and flood damage, sediment disasters, and snow damage	Subject	<u>Water management technologies using rainfall prediction and other means; prediction technologies of sediment disasters and storm and flood damage through radar and lidar observation; elucidation of mechanism of phenomena in natural disasters such as storm and flood damage and snow damage, and establishment of simulation technologies.* improvement of rainfall prediction technologies; prediction of typhoons and locally intense phenomena through simulation; processing and analytical technologies of observed offshore wave information; hazard prediction of sediment disasters and related disaster reduction technologies.* qualitative reinforcement of river banks for flood control safety.</u>
	Objective	To improve simulation technologies for storm and flood damage and snow damage caused by heavy rains and strong winds and reduce damage by 2015. To elucidate the mechanism of locally intense phenomena such as urban heavy rains, establish technologies for predicting occurrence of locally intense phenomena, and significantly reduce damage associated with such phenomena by 2012. To increase the ratio of flood protected areas to about 62% (about 58% in 2000) and increase number of sediment protected houses to about 1.4 million (about 1.2 million in 2002) in 2007.
(6) Technologies for observation and monitoring of natural disasters using satellites and other means	Subject	Satellite technologies for disaster monitoring; unmanned aircraft systems for disaster monitoring.
	Objective	To contribute to ensuring public safety and security by 2015 by developing a satellite observation and monitoring system and continuously providing observation data useful for disaster prevention and reduction. To begin operation of an unmanned aircraft system and enable collection and provision of timely and detailed on-site information at the time of disasters by 2012.
(7) Technologies for monitoring, warning, information transmission, and disaster prediction at the time of disaster	Subject	Immediate transmission of earthquake information; disaster information sharing systems; methods for collecting and transmitting disaster information; real-time observation of submarine earthquakes; <u>ensuring fire safety in various buildings and facilities; technologies for assessing and publicizing the hazard and spread of damage in various disasters using interdependence analysis and other means.* damage reduction for dangerous facilities in large-scale earthquakes; technologies for early assessment of damage situations.</u>
	Objective	To enable protection of human life by 2010 by using digital bidirectional communication technologies and providing the public with information clearly indicating dangerous areas by a maximum of about one hour earlier than in the past in order to ensure time for evacuation. To establish social science-based analytical methods for identifying social vulnerabilities to disaster and predicting damage, including secondary and tertiary damage, by 2015. To improve disaster information transmission during disasters, speed up proper judgment of initial response, and establish technologies for evacuation behavior through independent, quick, appropriate self-help and mutual-help evacuation behavior by 2010. To strengthen overall disaster prevention capabilities by communities and establish methods for planning optimum measures and recovery strategies.
(8) Technologies for initial response and emergency response such as rescue activities	Subject	<u>Significant improvement of on-site fire-extinguishing and rescue activities and modernization of fire equipment; information systems to support firefighting and disaster prevention activities during large-scale disasters; firefighting methods and ensuring safety against specific disasters; fire and explosion prevention and control of chemicals; technologies to support quick transport of emergency assistance materials and victims; technologies to support early economic recovery.</u>
	Objective	To materialize the following in response to the type of disasters by 2015 by surveying and reviewing strategies for improving firefighting and disaster prevention science and technology through use of advanced sciences and technologies in response to current social conditions and public needs: (1) ensuring safety in overcrowded urban spaces in fires, (2) firefighting and disaster prevention activities during large-scale natural disaster, (3) ensuring safety against specific disasters, (4) fire and explosion prevention and control of chemicals, (5) improvement of safety of dangerous facilities (earthquake resistance and measures against aging degradation). To develop support systems for emergency and alternative transport, draw up pre-disaster emergency and alternative transport plans, and contribute to implementation of quick emergency and alternative transport during disasters by 2008. To develop risk management methods for international transport infrastructures enabling maintenance and early recovery of international transport and economic activities after disasters and improve reliability of Japanese international transport functions by 2010.
(9) Research useful for forming a disaster-resilient society	Subject	<u>Research on improving business continuity management capabilities at the time of disaster.* research on disaster risk management to improve community disaster prevention capabilities; safety measures for man-machine systems at the time of earthquake; use of deep subterranean spaces.</u>
	Objective	To predict in an integrated way damage caused by various disasters by 2011 by developing methods for assessing overall risk in communities and constructing standard emergency response systems for organizational operation at the time of disasters. To run a model business and apply results of research on disaster prevention to disaster prevention activities in communities.
(10) Technologies for ensuring safety and reducing accidents in facilities	Subject	Research on safety of dangerous facilities; technologies for planning of equipment safety
	Objective	To standardize technological criteria for dangerous facilities, promote quick and smooth introduction of new technologies and materials, diversify safety measures for dangerous facilities, and reduce accidents frequently occurring in dangerous facilities by 2010. To develop basic technologies for safety measurement and assessment of facilities in steel works and ensure safety by 2010.

\* Partly included in strategically important sciences and technologies

Source: Promotion Strategy for Priority Areas (March 28, 2006, Council for Science and Technology Policy)



**Figure 5 :** Research and development on a disaster risk information platform at National Research Institute for Earth Science and Disaster Prevention

Source: National Research Institute for Earth Science and Disaster Prevention

the construction of “disaster information communication systems” as one of the subjects of “Project for Giving Benefits Back to Society in an Early Stage” to materialize the roadmap for the technological innovation strategy. In response, the National Research Institute for Earth Science and Disaster Prevention will launch the research and development of “a disaster risk information platform (tentatively called)” (Figure 5) to support disaster risk governance as one of the subjects of the “Project for Giving Benefits Back to Society in an Early Stage.” This research and development should be carried out in close coordination with that of the disaster reduction technology integrated with the social science made by other research institutions, universities, etc.

**4-2 Research areas and potential subjects on the disaster reduction technology integrated with the social science**

The Promotion Strategy for Priority Areas

mentioned in the Third Science and Technology Basic Plan (social infrastructure area) defines the disaster reduction technology integrated with the social science as “the technology to assess social vulnerability to disasters and their effects on society and economy, taking account of interdependence, to make the degree of risk known to the public for improving overall disaster prevention capabilities including the self-help and mutual help efforts in communities, and to ensure the continuity of administration, business, and transportation at the time of disaster.” The National Research Institute for Earth Science and Disaster Prevention interprets it as the social technology integrated with knowledge and technologies in the science and technology areas as well as a variety of knowledge in the social science area.

The disciplines required for the disaster reduction technology integrated with the social science are risk management, risk analysis, disaster psychology, disaster information, urban

**Table 2** : Examples of particularly important integrated research areas and potential research subjects

<p>(1) Integrated risk assessment methods</p> <ul style="list-style-type: none"> <li>• Integrated community risk assessment methods considering multiple hazards and risks</li> <li>• assessment methods for social and economic vulnerabilities of individuals, communities, and enterprises to natural disasters considering interdependence</li> <li>• Mid- and long-term disaster risk simulation methods for individuals considering lifestyles and life stages</li> </ul>
<p>(2) Participatory disaster risk communication methods</p> <ul style="list-style-type: none"> <li>• methods in which individuals and communities share disaster risk information (professional knowledge, experiential knowledge, local knowledge) and increase risk awareness</li> <li>• Consensus building methods to study disaster prevention methods considering risk acceptability, risk trade-off, and costs and benefits of individuals and communities</li> <li>• methods in which multiple networks make decisions on disaster measures through communication</li> </ul>
<p>(3) Comprehensive and integrated disaster measures and disaster response measures</p> <ul style="list-style-type: none"> <li>• disaster prevention plans to increase comprehensiveness and integration of disaster prevention policies, and participatory and cooperative development methods for action plans</li> <li>• Autonomous and decentralized disaster response measures in which multiple networks aggregate information, unify situation awareness, and cooperate at the time of disaster</li> <li>• Comprehensive risk life planning methods considering disaster risks</li> </ul>
<p>(4) Technologies and methods of social operation for decentralized and interoperable disaster risk information platforms</p> <ul style="list-style-type: none"> <li>• Shared application technologies for disaster risk information, and cooperative models in which multiple networks provide Comprehensive and Integrated disaster information based on those technologies</li> <li>• participatory Integrated risk assessment and simulation technologies using decentralized interoperable environment</li> <li>• knowledge management methods that store information such as residents disaster experiences, potential incidents, and risk awareness and transform such information into local knowledge on local information platforms in order to support Comprehensive community autonomy and community formation in ordinary times</li> </ul>

Source: National Research Institute for Earth Science and Disaster Prevention

planning, land use planning, insurance system, fund system, voluntary disaster prevention, disaster volunteering, and restoration. In addition to the above, research areas such as local administration, district administration, resident activities, resident participation and cooperation, community, housing policy, welfare, finance, local development, local economy, industry, community information, communication, and consensus building will become important from the view points of the three requirements of disaster risk governance.

Of these research areas to be integrated with the disaster reduction technology, the following four areas are particularly important. Potential research subjects in these areas are exemplified as follows (Table 2):

#### **(1) Integrated risk assessment methods**

Research on risk assessment methods to comprehensively assess the interdependence and social and economic vulnerability of individuals and communities by integrating a variety of hazard information and disaster risk information (professional knowledge, experiential knowledge, local knowledge) on earthquakes, tsunamis, volcanic eruptions, sediment disasters, storm and flood damage, etc.

#### **(2) Participatory disaster risk communication methods**

Research on risk communication methods, based on the results of the risk assessment described in the above Item (1), to help local governments, individuals, communities, and businesses mutually understand social and economic vulnerability to disasters in the process of participatory risk assessment, and to create various disaster measures and disaster response measures comprehensively integrated with various policy areas.

#### **(3) Comprehensive and integrated disaster measures and disaster response measures**

Research on social measures to use social relations (multiple networks) formed in communities at ordinary times and a variety of local resources stored in communities, and to implement various disaster measures and disaster response measures created by the methods described in the above Item (2).

#### **(4) Technologies and methods of social operation for decentralized and interoperable disaster risk information platforms**

Research on the construction of decentralized and interoperable disaster risk information platforms to facilitate the materialization of disaster risk

governance and on their social operation.

## 5 Conclusion

Taking account of the uncertainty of disaster risks and changes in social structures, this paper has described the necessity of changing the subjects of present disaster prevention policies and the methods of disaster risk management from the viewpoints of multiple networks and the comprehensiveness and integrity of disaster prevention policies. The concept of disaster risk governance should be established as a new framework to create innovative disaster prevention policies. “The disaster reduction technology integrated with the social science” is important as a new research subject based on the concept. What are required are research on comprehensive risk assessment methods taking account of the interdependence and social and economic vulnerability of the multiple networks of individuals, communities, local governments, and enterprises, and that on disaster risk information based on these methods.

Individual research and development on the materialization of the concept of “disaster risk governance” should not be performed independently, but should be promoted in an integrated way under unified research and development management. Research and development should also be conducted in close cooperation with related administrative agencies, local public bodies, enterprise, NPOs, resident organizations, etc. To consistently and effectively carry out a series of research and development, researchers and businessmen in various disciplines need to work in close cooperation with each other. Setting social missions, integrating a variety of knowledge in various areas, and coordinating problem-solving research and development require to build a research environment including the training of qualified project managers and the formation of networks. These efforts should be carried out under the cooperation of research and development oriented independent administrative institutions and universities.

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