JICA Handbook for Mainstreaming Disaster Risk Reduction (DRR)

(Forethought to DRR for Development Projects)

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Japan International Cooperation Agency（JICA）

SUNCOH CONSULTANTS Co., Ltd.
EARTH SYSTEM SCIENCE Co., Ltd.

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1. The Development of the Handbook

1.1. Background of the Development of the Handbook

The term “Mainstreaming Disaster Risk Reduction” has been used since around 2000, when the present United Nations Office for Disaster Risk Reduction (UNISDR)[1] was established. In the United Nations, it has been used in the UN Secretary-General’s reports on the progress of International Strategy for Disaster Reduction (ISDR) since 2001, mentioned frequently since the 2nd UN World Conference on Disaster Reduction in 2005, and featured in the UN General Assembly’s resolutions on ISDR since 2012.

As a background, it has been pointed out that investment in disaster risk reduction in the context of sustainable development has not been sufficient despite the fact, that recent increase in damage and loss due to the escalating frequency and severity of major natural disasters has been impeding sustainable development and aggravating poverty in developing countries. In the context of sustainable socioeconomic development and the solution of poverty and other social problems, it is indispensable to reduce the damage from disasters. The facilitation of post-disaster response also calls for “mainstreaming disaster risk reduction,” which promotes comprehensive measures proactively incorporating disaster risk reduction in all phases of development.

“Mainstreaming” means “incorporating and promoting disaster risk reduction as an important element of the subject matters (such as developmental strategies as shown below)” and “**Mainstreaming disaster risk reduction”** is defined as the approach to “protect lives from disasters and aim at sustainable development and poverty reduction through comprehensive, multidisciplinary and continuous implementation and expansion of risk reduction measures envisioned against various scales of disasters at every phase in every sector of development and building disaster-resilient society.”

Disasters endanger human lives and deprive us of properties and assets accumulated in society, as well as the time and opportunities for development. Furthermore, they force the governments to allocate a large budget to response/relief and recovery. Because developing countries have limited budgetary resources allocated for disaster risk reduction, they are vulnerable to disasters and experience difficulty in sustainable development. Recent climate changes have been working to accelerate natural disasters, and the population at risk of storms, earthquakes, etc. is expected to be doubled to about 1.5 billion by 2050[2]. The improvement of response capabilities against natural disaster risks and the construction of a resilient society at all levels are crucial goals of development.

JICA expects that disaster risk reduction budgeting is broadly recognized as investment to protect human lives and ensure sustainable socio-economic development, rather than "recovery costs" covering post-disaster financial needs for response and reconstruction, and making up for time and opportunities lost among individuals and society. This consensus is expected to further accelerate the efforts to build disaster-resilient countries and communities, and DRR efforts to be pursued not

[1] UNISDR：The United Nations Office for Disaster Reduction
[2] World Bank(2011) "*Natural Hazards, UnNatural Disasters-The Economics of Disaster Prevention*"

only in sector-specific projects, but also as a multidisciplinary theme integral to development in general.

From this perspective, this Handbook has been developed to promote “Mainstreaming Disaster Risk Reduction,” emphasizing that (i) governments should position disaster risk reduction as a national priority, (ii) a perspective of disaster risk reduction should be adopted by every development sector, and (iii) proactive investment in disaster risk reduction should be increased.

1.2. Purpose of the Development of the Handbook

This Handbook describes the directions and practical methods to be used by JICA in executing the ODA projects of Japan, ”a leading country in disaster risk reduction”[3], for the implementation of forethought to DRR in its projects toward the goal of mainstreaming disaster risk reduction needed for sustainable development.

Future projects implemented and developed by JICA are expected to reflect the basic principles described here in concrete cooperation, support, and assistance programs and projects.

The intended main users of this Handbook are JICA personnel and the specialists implementing specific JICA projects. The Handbook has also been written to be informative to government personnel and counterparts in counterpart countries, as well as United Nations agencies, the World Bank, Asian Development Bank, and other donors. To help the readers understand the effectiveness and necessity of investment in disaster risk reduction towards the sustainable development, it also provides the methods for quantitative assessment of the effect of disaster control measures on GDP growth.

It is hoped that the use of this Handbook may facilitate mainstreaming disaster risk reduction in JICA projects and awareness building among various stakeholders concerning mainstreaming disaster risk reduction, help increase in investment in disaster risk reduction in the context of sustainable development, and eventually contribute to the reduction of poverty in developing countries.

1.3. Structure of the Handbook

The Handbook for Mainstreaming Disaster Risk Reduction (Forethought to DRR) consists of six chapters: 1. Development of the Handbook, 2. Mainstreaming Disaster Risk Reduction, 3. Methods for Forethought to DRR in JICA Projects, 4. Explanation of Implementation Methods in JICA Forethought to DRR, 5. Mainstreaming Disaster Risk Reduction in Japan, and 6. Case studies of Mainstreaming Disaster Risk Reduction. Chapters 1 and 2 describe the practice of mainstreaming disaster risk reduction and the meaning of the development of the Handbook. Chapter 3 reviews the past actions of JICA in disaster risk reduction to ensure common understanding within JICA. Chapter 4 explains the concrete methods for forethought to DRR promoted in the Global

[3] Director-general for policy planning (disaster prevention), Cabinet office of Japan (supervising editor 2002) "International cooperation for disaster risk reduction by Japan" in "DISASTER MANAGEMENT NEWS No.12 November 2002" The Institute of Disaster Policy & Information Society, Tokyo.

Environment Department. Chapters 5 and 6 present the cases of forethought to DRR in Japan and by JICA to help JICA personnel get a concrete picture of mainstreaming disaster risk reduction.

2. About "Mainstreaming Disaster Risk Reduction"

2.1. Global Trend of "*Mainstreaming DRR*"

When disaster occurs, it causes serious damages to humans, materials, economics and environments. Especially, it is a critical problem especially for developing countries, severely affecting their population in poverty and inhibiting economic growth. It prevents the eradication of poverty.

In 1989, UN designated the 1990s as the "*International Decade for Natural Disaster Reduction (IDNDR)* (A/RES/44/236)". In 1994, "World Conference on Natural Disaster Reduction" was held in Yokohama, Japan, and "*Yokohama Strategy and Plan of Action for a Safer World*" was adopted in this conference. In this strategy, basic recognition is written as; "Sustainable economic growth and sustainable development cannot be achieved in many countries without adequate measures to reduce disaster losses, and that there are close linkages between disaster losses and environmental degradation" and ten principles were identified such as risk assessment, disaster prevention and environmental protection. In 1999, "*International Decade for Natural Disaster Reduction*" is completed. During "International Decade for Natural Disaster Reduction" up to 1999, country-level DRR initiatives were developed and regional DRR cooperation mechanisms were enhanced, including establishment of "Asian Disaster Reduction Center".

Under this international trend, the UN General Assembly adopted the "International Strategy for Disaster Reduction" in December 1999 and established "United Nations International Strategy for Disaster Reduction (UNISDR)". The term "*Mainstreaming Disaster Risk Reduction (DRR)*" has been used since around 2000 when UNISDR was launched. This term was used by the "*Implementation of the International Strategy for Disaster Reduction Report of the Secretary-General*"(A/56/68-E/2001/63) in the context of sustainable development.

In August 2002, "*Living with risk: a global review of disaster reduction initiatives,*" the first UN white paper on DRR, was issued in cooperation with Japan, US, European countries and the Philippines.

"*2nd UN World Conference on Disaster Reduction*" was held on January 2005 in Kobe City, Hyogo, Japan. "The Hyogo Framework for Action 2005-2015 (HFA)" was adopted in this conference. UNISDR explains HFA[4] as; "The Hyogo Framework for Action (HFA) is the first plan to explain, describe and detail the work that is required from all different sectors and actors to reduce disaster losses. It was developed and agreed on with the many partners needed to reduce disaster risk - governments, international agencies, disaster experts and many others - bringing them into a common system of coordination. The HFA outlines five priorities for action, and offers guiding principles and practical means for achieving disaster resilience. Its goal is to substantially reduce disaster losses by 2015 by building the resilience of nations and communities to disasters. This means reducing loss of lives and social, economic, and environmental assets when hazards strike.

[4] UNISDR(2005) "*Hyogo Framework for Action (HFA)*" http://www.unisdr.org/we/coordinate/hfa

In 2006, the World Bank founded the Global Facility for Disaster Reduction and Recovery (GFDRR), a specialized facility to perform financial support and technical assistance in DRR. GFDRR explains themself as; "*GFDRR provides grant financing and technical assistance to help mainstream disaster and climate risk management policies into country-level strategies*" on their website[5].

This term "*Mainstreaming DRR*" had been frequently used after 2005, the year when HFA was adopted. Also, this term is used on UN General Assembly resolution about UNISDR since 2012.

Since 2009, UN started to publish "*Global Assessment Report on Disaster Risk Reduction (GAR)*" biannually, and UNISDR developed the terminology book[6] for basic definitions on DRR in 2009, although the term "*Mainstreaming DRR*" is not clearly defined in this book.

The word "*Mainstreaming DRR*" is featured in a number of documents as an essential concept in international development. The UN, in recent years, emphasizes promotion of "Mainstreaming DRR", calling for incorporating the viewpoint of DRR in every development strategy. The components of "Mainstreaming DRR" are as below;

1) Positioning DRR as a national priority issue.
2) Incorporating DRR in every development sector.
3) Increasing investment in DRR.

"*Great East Japan Earthquake and Tsunami*" occurred in March 2011. A huge number of victims and enormous damage on economy were caused by the subduction-zone earthquake of magnitude 9.0 and tsunami in the Pacific Ocean coast of the Tohoku and Kanto regions. This large-scale multiple disaster was difficult to handle even by Japan, a leading country in DRR with a long history of implementing a series of countermeasures (See Chapter "Basic Act on Disaster Control Measures of Japan" and "Building Standards Act of Japan").

Meanwhile, this disaster brought valuable scientific expertise in natural disaster and new lessons in DRR. In 2012, the Government of Japan hosted the conference "*World Ministerial Conference on Disaster Reduction in Tohoku*" in July and "*Sendai Dialogue: 2012 IMF-World Bank Group Annual Meetings*" (co-hosted by the World Bank) in October. The theme "*Mainstream DRR*" was discussed in this two conferences. In December 2012, the UN General Assembly Resolution (A/RES/67/209) decided to hold the "3rd World Conference on Disaster Risk Reduction" in March 2015 at Sendai city, Miyagi Prefecture, Japan, which suffered extensive damage from the "*Great East Japan Earthquake and Tsunami*."

On 2013, UN published the report "*Global Assessment Report on Disaster Risk Reduction 2013 (GAR 2013).*" This report focused on business and disaster risk management, reviewing major disasters such as Japan's earthquake and tsunami, Thailand's flood in 2011 and the USA's

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5 http://www.gfdrr.org/who-we-are
6 UNISDR(2009) "*2009 UNISDR terminology on Disaster Risk Reduction*" http://www.unisdr.org/we/inform/terminology/

"Hurricane Sandy" in 2012. Under global economy system, business may be affected by natural disasters such as earthquakes, floods and storms, easily suffering from severe damage to vulnerable factories, office and other facilities and resources as well as interruption and halt of corporate activities. On this book, an economic model that measures the social and economic impacts of disaster is simulated by JICA's "DR²AD Model" which shows risk reduction investments and allows policy-makers to evaluate multi-index effects of these investments[7] (refer sections 3.3 and 6.10 for detail).

On February 2014, the government of Japan and World Bank established "Tokyo Disaster Risk Management Hub" in the Tokyo office of the World Bank to make use of Japan's expertise in DRR for development programs worldwide.

The year 2014 was a milestone year, with termination of Hyogo Framework of Action 2005-2015 (HFA) and Millennium Development Goals (MDGs). While new frameworks and goals are issued for the next 10 to 15 years, the zero draft of the post HFA[8] was published by the UNISDR in a study meeting in October, 2014. It is an early draft of the final document which will be adopted by the Third UN World conference on Disaster Risk Reduction in Sendai, Japan, in March, 2015.

2.2. Significance and Effects of "*Mainstreaming DRR*"

Disasters take away not only human lives but also properties, assets of individuals and private companies and time and chance for new developments as well. It is a serious problem that frequent natural disaster such as storm, flood or surge, repeatedly brings damage to the residents of high risk areas and deprive them of lives and opportunities for economic development, hindering their poverty alleviation.

Generally, national and local governments allocate their social and economic development budgets in accordance with their various priorities. However, DRR is regarded as incidental cost of the whole society and the adequate proportion for DRR projects is not clearly indicated in the national or local budget. Especially in developing countries, only "Economic growth" is prioritized and budget for DRR is often small. Additionally, in the developing countries, there is a tendency to secure a large part of their budget for post-disaster emergency response (such as rescue and emergency distribution) rather than investment for natural disaster prevention and mitigation.

The World Bank, in "*Building Safer Cities: The Future of Disaster Risk*"[9], reports on the findings of the joint research with U.S. Geological Survey; "*Economic losses worldwide from natural disasters in the 1990s could have been reduced by **$280 billion** if **$40 billion** had been invested in preventive measures.*" UNDP[10] paraphrases the estimation as "*Every dollar invested into*

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[7] UN (2013) "*Global Assessment Report on Disaster Risk Reduction (GAR 2013)"*
[8] Post HFA: Post-2015 Framework for Disaster Risk Reduction.
[9] The World Bank (2003) "*Building Safer Cities: The Future of Disaster Risk*" P.50
[10] UNDP "*Act Now - Save Later*" http://www.undp.org/content/undp/en/home/ourwork/get_involved/ActNow/

disaster preparedness saves seven dollars in disaster aftermath," which has since been featured in various reports by UNDP and other agencies.

Also, JICA takes actions not only to support recovery but also to build disaster resilient society ("*Build Back Better*") at each step of recovery and reconstruction activities after a disaster. Furthermore, JICA provides supports to developing countries by claiming and setting forth in its strategy that countries and local society can sustainably develop with learning and sharing lessons from past disasters, investing for DRR and preparing for future disasters.

Interests have been growing in the concept of "*DRR*" and the importance of DRR investment has been recognized as many disasters occur all over the world in recent years. While DRR investment is expected to increase in the world, JICA think it is difficult to build a resilient society for disaster, simply by implementing development project aiming only at DRR. In order to protect human lives and properties from natural disasters, JICA seeks to reduce disaster risks by incorporating "perspective of DRR" in all development projects, based on the results of "proper risk assessment." In addition, JICA thinks that cooperation and bidirectional communication with all sectors by "the perspective of DRR" is required for sustainable development (see Fig. 2-1).

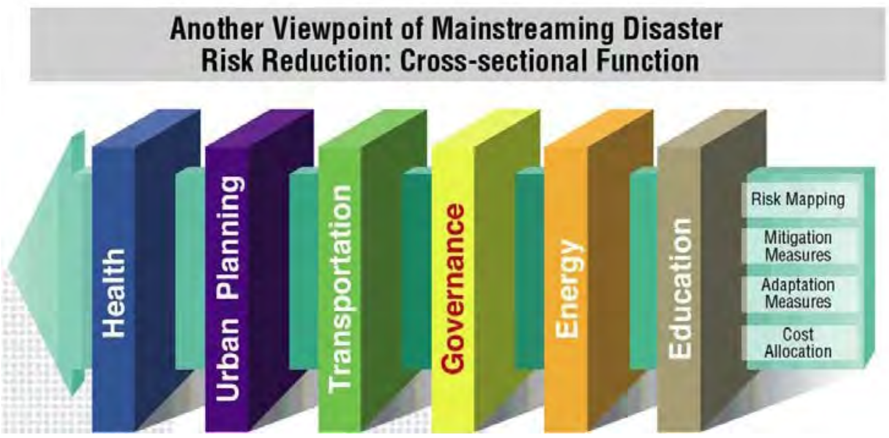

Fig. 2-1: Schematic Diagram of Mainstreaming Disaster Risk Reduction as Cross-sectional Function

(Source: JICA(2014) *"JICA's Cooperation on Disaster Management, Towards Mainstream of Disaster Risk Reduction -Building Disaster Resilient Society-"*)

In the zero-draft of post-HFA, which was published in October 2014, the investment disaster risk reduction to enhance economic, social, cultural and environment resilience is described as "Priority 3", in which effectivity of investment to DRR is specified, and in "Priority 4" of the draft, enhancing disaster preparedness for effective response and to "Build Back Better" in recovery are described. Moreover, In SDGs(Sustainable Development Goals) draft(A/68/970), which will be post UN MDGs, several articles related to DRR were added as new goals by

2030[11]. While Post-HFA and SDGs has not been finalized at the time of writing (February 2015), it is evident that the importance of DRR in the world would grow and Japan, a prominent disaster-prone country, is expected to make use of its abundant knowledge and experience in international cooperation.

[11] In the draft of SDGs, "Goal 9: Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation" were added and an importance of infrastructure improvement with resilient set an goal. Furthermore, "Goal 11:Make cities and human settlements inclusive, safe, resilient and sustainable", "Goal 13:Take urgent action to combat climate change and its impacts" (for climate change), "Goal 14: Conserve and sustainably use the oceans, seas and marine resources for sustainable development" (for natural conservation) and "Goal 15: Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss" (also for natural conservation) is related to disaster risk reduction.
Also see "Chapter 5 Mainstreaming Disaster Risk Reduction in Japan".

3. Method of Disaster Risk Screening and Scoping for JICA's Projects

3.1. Actions by JICA in Disaster Risk Reduction

For geological and geographical reasons, Japan is a country affected by many natural disasters. As such, it has a wealth of experience and technologies concerning disaster management. Against this background, JICA has been conducting various international cooperation projects concerning disaster management in developing countries. Through successful performance of these projects, JICA has accumulated much experience and know-how concerning disaster management in the field mostly in developing countries.

Since the areas prone to disasters and their impacts are often the areas inhabited by socially vulnerable people, such as the needy, disaster management cooperation surely becomes more and more important for JICA from the perspective of the realization of “human security.”[12]

Disaster is defined as result of combination of 3 elements which are hazards (natural phenomena which can cause natural disasters), vulnerability (vulnerability to hazards) and exposure (exposure to hazards)[13]. Looking back the past performance of JICA in disaster management cooperation, Japan has been using its experience in disaster management in providing cooperation covering various disasters, such as floods, landslides, volcanic disasters, earthquakes, tsunamis and storm surges, tropical cyclone, and coastal erosion. Since the 1990s designated as the International Decade for Natural Disaster Reduction, JICA has been conducting a lot of projects in the forms of technical assistance, developmental study, specialist dispatch, grant aid cooperation, etc.

The recent trends of disaster management cooperation are characterized by the introduction of the perspective of social science; the emphasis on mutual help and self help among the four sources of support in disaster management[12]: public help, mutual help, self help, and external help; and the shift of focus to mitigation and preparedness among the stages of the disaster management cycle (Figure 3-1): prevention/mitigation → preparedness→ response/relief → reconstruction/recovery.

Examples of recent cases include earthquake response plans based on risk assessment represented by earthquake micro-zoning, preparation of hazard maps and evacuation drills involving community and resident participation, and cooperation concerning the spread of anti-seismic design standards and anti-seismic reinforcement technologies. In addition, we aim to develop a sustainable society that is resilient to disasters through the repeated practice of disaster management cycles.

The following lists the activities of JICA in disaster risk reduction cooperation.

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[12] NAGAISHI Masafumi, NAKAYAMA Atsushi and YAMAZAKI Ai (2005) “The report of WCDRR – JICA’s approach to disaster management cooperation for developing countries-“ (*KOKUSAIKYOURYOKUKENKYUU* (International Cooperation Research) Vol.21No.1) in Japanese.

[13] KAKIMOTO Ryuji, FUJIMI Toshio (2008) “*Time Series Variation of Flood Exposure Induced by Flood Prevention Projects*” 38th workshop proceedings of the Committee of Infrastructure Planning and Management

From 1960 to present: Training in seismology and disaster management policies was conducted in and outside of Japan, accepting trainees from developing countries in cooperation with Building Research Institute Incorporated Administrative Agency (Ministry of Construction Building Research Institute before reorganization)

1980s: Beginning of assistance in disaster management in the Philippines, Peru, Mexico, etc.

March 2003: Publication of report "Disaster Management and Development" by JICA Research Institute

March 2008: Publication of report "Community Disaster Management from the Perspective of Capacity Development" by JICA Research Institute

February 2009: Publication of "Guidelines: Disaster Management"

March 2011: Great East Japan Earthquake

2011: Execution of project study "Effective Approaches to Earthquakes and Tsunamis"

2012: Execution of project study "Study on Mainstreaming Disaster Risk Reduction"

2014: Execution of project study "Methods for Forethought to DRR in Development Projects"

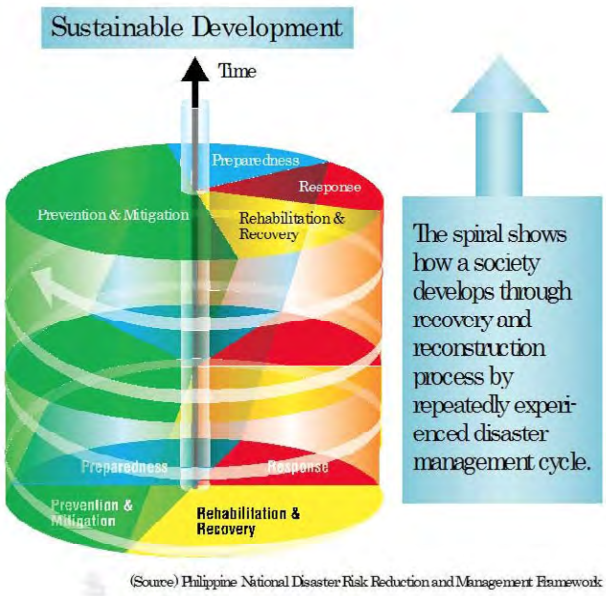

Fig. 3-1: Management Cycle of Disaster

(Source: JICA(2014) *"JICA's Cooperation on Disaster Management, Towards Mainstream of Disaster Risk Reduction -Building Disaster Resilient Society-"*)

3.2. Value of Forethought for Disaster Risk Reduction

Traditionally, disaster risk reduction has generally been regarded as an "incidental cost to society as a whole," and no clear guideline has been drawn as to the appropriate proportion of investment in disaster risk reduction relative to the total budget. However, disasters endanger human lives and cause a loss of properties and assets we have built, as well as the time and opportunities for various development activities. Once a disaster happens, much cost is needed for response/relief and recovery. In such cases as frequent storms and floods, people living in the same areas are repeatedly hit by disasters and repeatedly deprived of the opportunities for economic growth, suffering great difficulty in escaping poverty.

Japan, a country hit by frequent natural disasters, has long been making proactive investment in disaster management since the times when it was a developing country. It has been trying to reduce human loss and economic loss through promotion of actions for disaster mitigation and forethought to DRR (Fig. 3-2 and Fig. 3-3).

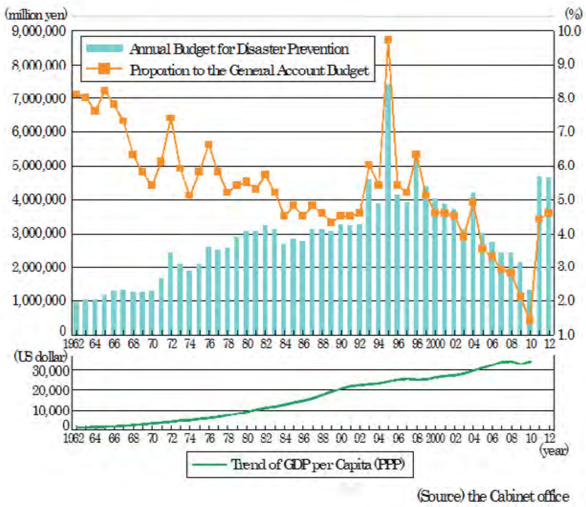

Fig. 3-2: Trend of annual budget for disaster risk reduction in Japan

(Source: *"JICA's Cooperation on Disaster Management, Towards Mainstream of Disaster Risk Reduction-Building Disaster Resilient Society-"*)

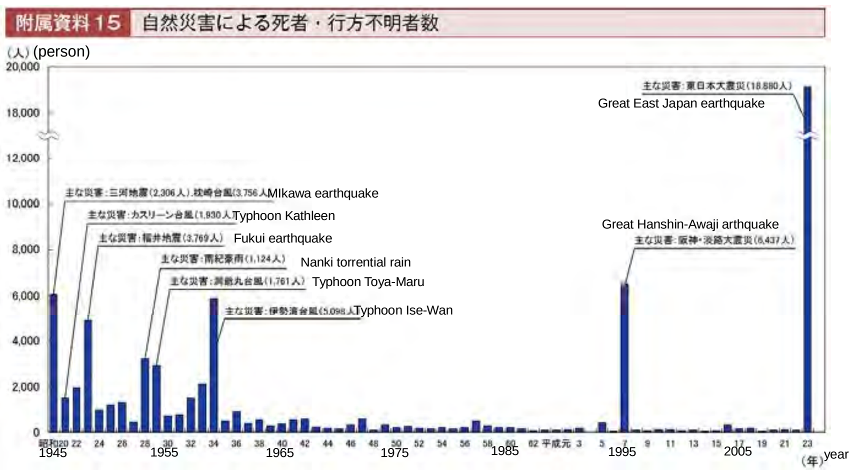

Fig. 3-3: No. of dead and missing persons in major natural disasters

(Source: Cabinet Office, Government of Japan (2012)*"White Paper on Disaster Management 2012"* Appendix-58)

However, in developing countries where priority is placed on economic development, constant budget for disaster management is often limited and tends to be allocated to preparation for emergency response after a disaster rather than mitigation or preparedness. Table 3-1 and Figure 3-4 compare the disaster risk reduction budget for pre-disaster measures in four disaster-prone countries: Colombia, Mexico, Nepal, and Japan. While the figure is over 2.5% in Japan, it is about 1% in Colombia and Nepal and less than 0.2% in Mexico. In addition, Table 3-2 compares the expenditure for pre-disaster measures and that for post-disaster responses in the three countries other than Japan. The expenditure for post-disaster responses surpasses that for pre-disaster measures in Mexico and Nepal.

Table 3-1 Comparison of pre disaster expenditure of 4 disaster prone countries (in million US dollar)

FY		2001	2002	2003	2004	2005	2006	2007	2008
Mexico	a.Expenditure	–	–	142,610	147,217	168,760	196,984	215,298	273,543
	b.Pre Dsaster Expenditure	–	–	289.7	252.3	287.9	262.6	215.9	387.1
	b/a	–	–	0.20%	0.17%	0.17%	0.13%	0.10%	0.14%
Colombia	a.Expenditure	–	–	–	19,335	25,499	28,612	36,927	–
	b.Pre Dsaster Expenditure	–	–	–	182.6	222.2	326.1	319	–
	b/a	–	–	–	0.94%	0.87%	1.14%	0.86%	–
Nepal	a.Expenditure	1,068	1,079	1,175	1,392	1,554	1,836	2,429	3,149
	b.Pre Dsaster Expenditure	14.2	11.1	11.9	13.7	15.7	16.1	19.6	24.2
	b/a	1.33%	1.03%	1.01%	0.98%	1.01%	0.88%	0.81%	0.77%
Japan	a.Expenditure	697,776	667,528	710,755	784,709	775,735	699,920	694,669	819,474
	b.Pre Dsaster Expenditure	27,554	25,783	21,348	24,021	20,905	18,403	17,399	20,351
	b/a	3.9%	3.9%	3.0%	3.1%	2.7%	2.6%	2.5%	2.5%

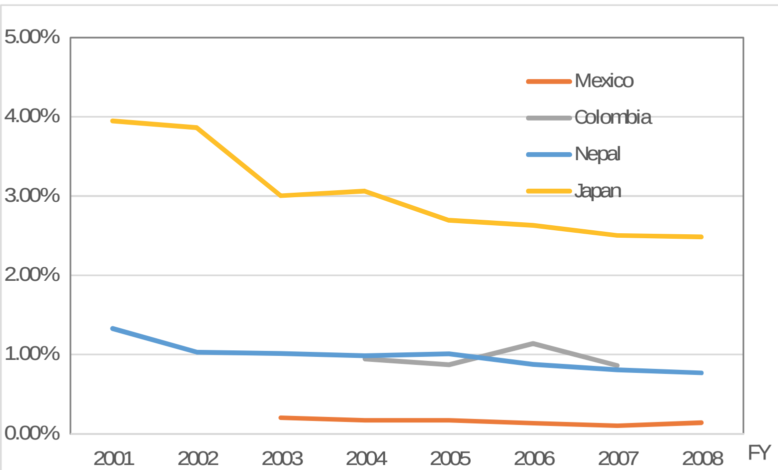

Fig. 3-4: Rate of expenditure in disaster management to government budget in 4 disaster prone countries.

Sources of Table 3-1 and Figure 3-2 :

a. Expenditure for pre disaster risk reduction

Alejandro de la Fuente (2010) *"Government Expenditures in Pre and Post Disaster Risk Management."* Background Note for *"World Bank-U.N. Assessment on the Economics of Disaster Risk Reduction. Natural Hazards, Unnatural Disasters: The Economics of Effective Prevention. November 2010"*

Cabinet office, government of Japan (2008) *"White Paper on Disaster Management 2007(html)"*

(note) The pre disaster risk risk reduction of Japan is including science and technology on disaster management, preparedness and national conservation.

b. Total expenditure

Website of OECD

https://stats.oecd.org/Index.aspx?DataSetCode=SNA_TABLE12

Website of the Ministry of Finance, Government of Colombia

http://www.minhacienda.gov.co/HomeMinhacienda

Website of the Ministry of Finance, Government of Nepal

http://www.mof.gov.np/en/archive-documents/budget-details--red-book-28.html

Website of the Ministry of Finance, Government of Japan

http://www.bb.mof.go.jp/server/2005/dlpdf/DL200572001.pdf

(note) The exchange rates are referred to the statistics of UNCTAD.

http://unctadstat.unctad.org/wds/TableViewer/tableView.aspx?ReportId=117

Table 3-2: Pre and post disaster expenditure in 3 disaster prone countries during 1998-2008 (in million US dollar)

Country	Total	Average	St. Dev.	Average (as share of total)	Average growth rate per year
Colombia					
Pre	1,050.01	262.50	61.73	60.75	22.08
Post	757.51	189.38	95.42	39.25	65.26
Mexico					
Pre	2,614.51	237.68	78.93	32.20	16.13
Post	7,788.94	708.09	568.40	67.80	118.41
Nepal					
Pre	164.35	14.94	3.93	43.06	7.44
Post	237.21	21.56	8.78	56.94	18.42

(note) Colombia data covers 2003-2007.

（Source: Alejandro de la Fuente (2010) "*Government Expenditures in Pre and Post Disaster Risk Management.*" Background Note for "*World Bank-U.N. Assessment on the Economics of Disaster Risk Reduction. Natural Hazards, Unnatural Disasters: The Economics of Effective Prevention. November 2010*"）

3.3. Development of Economic Simulation Model for Investment for DRR

The reasons for the lack of sufficient proactive investment in disaster risk reduction, in addition to the issues of priorities in developmental investment and social and cultural backgrounds, include the difficulty in measuring the effects of investment in disaster risk reduction in socioeconomic development and defining the indicators for the achievement of objectives, as well as the difficulty in making quantitative assessment of the effect of proactive investment in disaster risk reduction on sustainable development.

In response, JICA developed the DR^{2}AD[14] model (Disaster Risk Reduction Investment Accounts for Development Model), which is a method for visualizing the effects of proactive investment in disaster risk reduction by quantitatively demonstrating the effects of disaster risk reduction on GDP growth. The DR^{2}AD model quantitatively shows the impact of disasters occurring with various levels of frequency and scale on long-term economic growth, aiming to clarify how investment in disaster risk reduction may reduce the impact of disaster risks (Figure 3-4). The model is improved continuously.

To break the negative spiral of poverty and disasters, to reduce damage before a disaster occurs, and to minimize the damage from disasters, it is essential that appropriate methods such as the one described here are used, the effectiveness of proactive investment in disaster risk reduction is understood, and disaster forethoughts are practiced continuously aiming at the reduction of human loss and economic loss and the promotion of economic development.

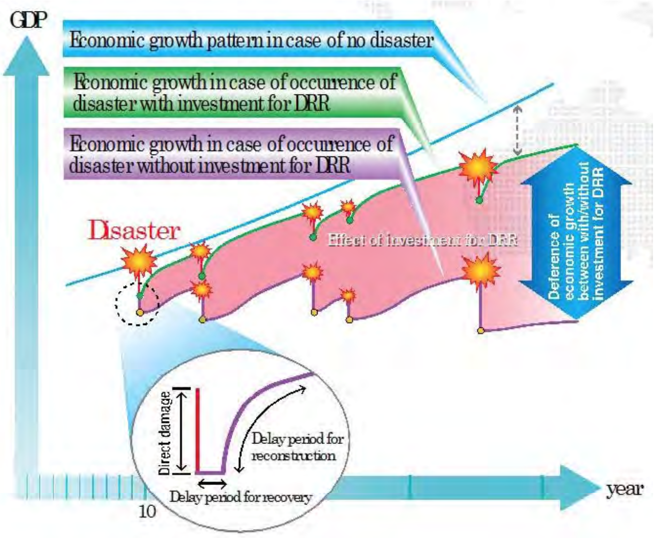

Fig. 3-4: Pattern diagram of investment for disaster risk reduction and economic development

(Source: "JICA's Cooperation on Disaster Management, Towards Mainstream of Disaster Risk Reduction -Building Disaster Resilient Society-")

[14] http://www.jica.go.jp/topics/news/2013/20130612_01.html
http://www.jica.go.jp/topics/news/2013/ku57pq00001ecfq5-att/20130612_01_01.pdf

3.4. Method for Disaster Risk Reduction Forethought

When JICA plans or implements a development project[15], prediction of possible natural hazards and natural disaster risk assessment are necessary. The results from these predictions and assessment will be the basic intelligence for the study of countermeasures. Not only taking measures but also risk assessment is costly. To utilize the limited budget and time, risk assessment must be done efficiently. It is important to assess disaster risk accurately and appropriately in each step of planning of the project.

The level of risk depends on three elements: hazards (natural phenomena which can cause natural disasters), vulnerability (vulnerability to hazards) and exposure (exposure to hazards). When these three elements exist at same time, disaster risk is boiled up. (Figure 3-3)

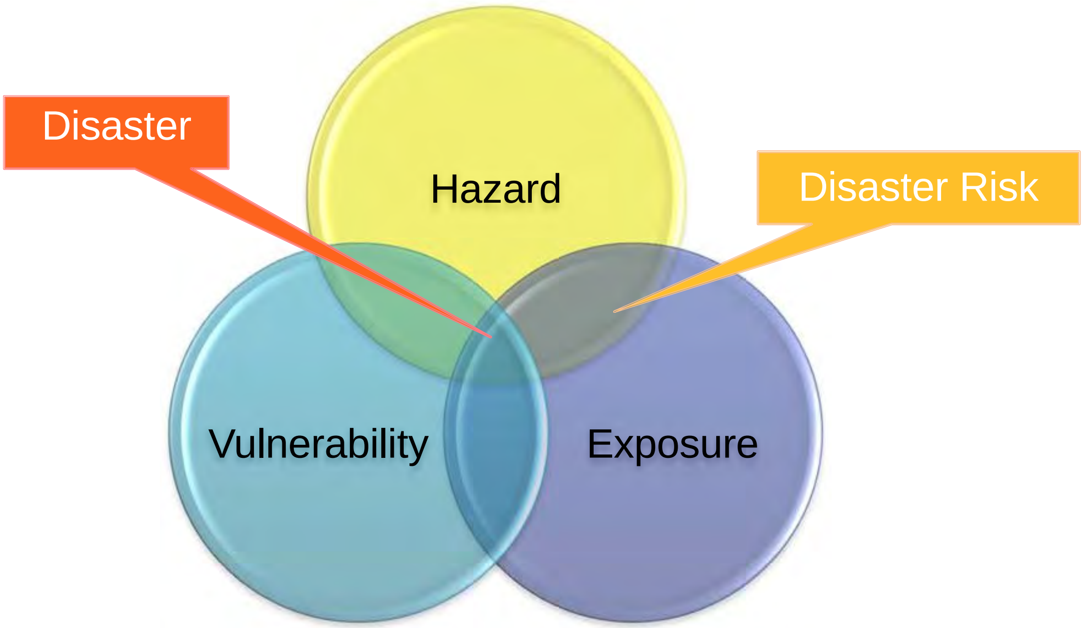

Fig. 3-1: Concept of disaster

For instance, when building new school is planned at a settlement which has flood risk, there are three options to be taken to reduce disaster risk: mitigation of hazards, reduction of vulnerabilities and Reduction of exposures. However, hazards are natural phenomena which human being cannot control easily, though the scale of disaster could be assessed to plan countermeasures. Usually, amount of rainfall will not be able to be reduced directly. Thus, the remained options to be taken are reduction of vulnerabilities and exposures. Vulnerabilities to flood are weakness of buildings and people against flood. To reduce those vulnerabilities, some improvements such as buildings

[15] In this handbook, the target projects are Grant Aid and Technical Cooperation Projects only since JICA proactively manage from planning to implementation in these two types of projects. In Official Development Assistance Loans, the main actors are aid receiving countries and JICA cannot control the implementation of the projects. Thus, Official Development Assistance Loans are not the direct target of this handbook. However, the same approach of the Grant Aid should be applied to the Official Development Assistance Loans including design work. The forethought to Official Development Assistance Loans will be a next challenge.

elevated not to be affected by flood and people educated to take appropriate actions are necessary. On the other hand, to reduce exposures, it is necessary to construct the school where there is less flood risk. These three elements must be analyzed to assess disaster risk,

In forethought to DRR for the JICA project, risk assessment is conducted in two stages in broad terms. At the beginning of planning of projects, risk assessment is conducted by deskwork as the first stage to classify the projects which need to adapt forethought to DRR and the projects which do not need it. In the detailed planning survey and preparatory survey, some experts who have specific knowledge on DRR conduct detailed disaster risk assessment and study the necessary measures as the second stage. Existing natural disaster risk at the candidate site of the project and necessity of risk assessment and study of countermeasures must be clearly mentioned in the terms of reference of those surveys.

The countermeasures studied here are able to be implemented only in JICA projects and limited because of the limitation of the budget and time period and the original project goals are generally to be prioritized.

In light of the conditions mentioned above, three approaches which can be adopted in the JICA project are determined. The three approaches are:

a. Avoidance of disaster risk: To change the location of the site to avoid the existing natural disaster risk (Reduction of exposures)
b. Natural disaster adaptation: To add structural measures and non-structural measures on projects to control natural hazards and adapt to natural disasters (Reduction of vulnerabilities)
c. Enhancement of capacity of local DRR: To append some DRR function such as evacuation shelter on the facilities constructed in the project (reduction of vulnerabilities)

Here “b.” and “c.” are individuated because the necessary input for “c.” is much less than “b.” and “c.” would be easier to be adopted.

Considering countermeasures for DRR, “a. Avoidance of disaster risk” to reduce exposures should be considered firstly among those three elements. Though this is the most effective elements to reduce disaster risk, sometimes it is not easy to change the location of project activities due to various reasons. When it is difficult to adopt “a. Avoidance of disaster risk”, “b. Natural disaster adaptation” should be considered next. Moreover, when “b. Natural disaster adaptation” is difficult to be adopted due to the limitation of budget and time, “c. Enhancement of capacity of local DRR” should be considered since the necessary cost to implement “c.” is relatively low.

For example, when a project constructs a school or a hospital at a village with flood risk, the best solution to avoid the disaster risk is relocation to a safer hill without flood risk such (a. Avoidance of disaster risk). If there is no suitable place for relocation, structural measures such as elevation of the ground floor of the school or hospital will be applied to mitigate the flood risk. Even though structural measures are applied, the function of the school or hospital will be damaged by the flood when the flood water level is higher than predicted. Thus, non-structural measures such as improvement of the disaster response system are necessary as well (b. Reduction of disaster risk).

Furthermore, schools and hospitals can be used as centers of DRR at community level such as evacuation shelters and storage of emergency supplies. The approach for enhancement of local DRR with the constructed facility should be considered (c. Enhancement of capacity of local DRR)

These three approaches will be described below.

3.4.1. Reduction of Disaster Risk

In the detailed planning survey and preparatory survey, after natural disaster risk at candidate sites is assessed, the relocation of candidate sites to safer places should be considered to avoid the risk if necessary. For instance, the relocation of a candidate site for construction of a school at lowlands beside a river with a flood risk to a higher place without flood risk is an example. However, sometimes there is no suitable place for relocation. Moreover, considering accessibility of public facilities such as schools and hospitals, the location of the facilities cannot be far away from residential areas and it is difficult to relocate the site. In addition, sometimes counterpart governments of the cooperation have to prioritize economic growth rather than disaster risk reduction due to political reasons. In this case, the governments have to choose sites where the economic benefit is maximized even if there are risks of natural hazard there. When it is impossible to relocate the site to avoid disaster risk, structural measures and non-structural measures should be considered to reduce the disaster risk.

3.4.2. Improvement of adaptation abilities for natural hazard and disaster

Although it is difficult to control meteorological phenomena and terrestrial phenomena, it is possible to mitigate damages by structural measures. At the same time, structural measures can prevent the natural hazard partially but cannot prevent disaster completely. When the scale of natural hazard surpasses the capacity of structural measures, natural disaster occurs. To mitigate the damage of disaster as much as possible, non-structural measures such as improvement of the disaster management system is necessary. Furthermore, to keep the function of the structural measures, it must be maintained appropriately. For appropriate maintenance, establishment of a maintenance system, training of a maintenance staff and budget are necessary. These activities are parts of non-structural measures. To improve the prevention system, structural measures and non-structural measures adapted to the local characteristics should be adopted.

(1) Structural Measures

Structural measures should be adopted in accordance with the predicted types of natural hazard, as classified in the table 3-3.

Table 3-3: List of structural measures (by type of disaster)

Type of disaster	Structural measures
Flood	Improvement of drainage system, River improvement, River embankment, Ring levee, Set back levee, Bank protection, Retarding basin, Regulating reservoir, Construction of new dam or expansion of existing dams, Dredging of dams and rivers, Improvement of water resistance of public facilities and lifelines, water stop boards.
Tropical Cyclone	Enhancement of wind resistance of buildings Other countermeasures are equivalent to flood and storm tides
Storm Surge	Tide embankments, seawalls, revetment, Offshore breakwater, Wave dissipating works
Landslide	Planting works at mountainous areas and slope land, Check dams, Slope works, Training dikes, Channel works, Sediment-retarding basins, Terracing at slope land, Slope protection, Retaining walls, Landslide prevention works
Earthquake	Enhancement of earthquake resistance of buildings (public facilities and ordinary houses), Enhancement of earthquake resistance of infrastructures (bridges, port facilities, lifelines)
Tsunami	Tide embankments, Breakwaters, Water gates, River embankments
Volcano	Check dams, Training dikes, Sediment-retarding basins, Energy dissipaters, Channel works

(2) Non-structural measures

Non-structural measures are supplements of structural measures. The purview of non-structural measures covers from national level measures such as improvement of legal schemes and early warning systems to local level measures such as improvement of evacuation and emergency response systems. The measures which append some DRR-related function to the constructed facilities and contribute to improvement of local DRR for the overall community will be described in the next section “Enhancement of capacity of local DRR”.

Regarding the operation of the facilities with disaster risk, establishment of emergency response system and maintenance system in terms of DRR should be considered. Non-structural measures to be considered in each sector are shown in the table below (Table 3-2). The classification of sectors listed in the table is based on “*Issues*” listed in “JICA KNOWLEDGE SITE”[16]. Further, it is adopted in the classification of Scoping List C (refer to Chapter 4.3)

[16] JICA KNOWLEDGE SITE: http://gwweb.jica.go.jp/KM/KM_Frame.nsf/NaviSubjMain?OpenNavigator

Table 3-4: List of non-structural measures (by sector)

Sectors		Non-structural measures
Urban / Regional development Private sector development	Industrial complexes	- Fire spread prevention - Promotion of tree planting in the catchment area - Arrangement of forest zone to deaden force of water - Regulation of land-use - Restriction of inhabitable area - Development of local DRR plan - Early warning and emergency communication systems - Preparation of evacuation route and shelter - Awareness raising of DRR and strengthening of local voluntary disaster management organization - DRR education - Conducting evacuation drill and response drills
Transportation	Airport	- Preparation of DRR response manual - Preparation of evacuation route - DRR education for staff - Conducting response drills
	Port	- Preparation of DRR response manual - Preparation of evacuation route - DRR education for staff - Conducting response drills
	Road	- Development of operation and maintenance in terms of DRR - Preparation of DRR response manual - DRR education for staff - Conducting response drills
	Railway	- Development of operation and maintenance in terms of DRR - Preparation of DRR response manual - Preparation of evacuation route - DRR education for staff - Conducting response drills
	Bridge	- Development of operation and maintenance in terms of DRR - Preparation of DRR response manual - DRR education for staff - Conducting response drills

Natural resource and energy	Electric line and power distribution	- Development of operation and maintenance in terms of DRR - Preparation of DRR response manual - DRR education for staff - Conducting response drills
	Power plant	- Development of operation and maintenance in terms of DRR - Preparation of DRR response manual - DRR education for staff - Conducting response drills
Education	School	- Appending evacuation shelter function to educational facilities - DRR education for school staff and students - Conducting evacuation drills
Health	Hospital	- Preparation of DRR response manual - Preparation of evacuation routes - DRR education for staff - Conducting response drills
Environment management	Sewage-treatment plant	- Preparation of DRR response manual - Preparation of evacuation routes - DRR education for staff - Conducting response drills
	Sewer pipe network	- Preparation of DRR response manual - DRR education for staff - Conducting DRR drills
	Waste repository	- Preparation of DRR response manual - Preparation of evacuation routes - DRR education for staff - Conducting response drills
Water resources /Disaster management	Water treatment plant	- Preparation of DRR response manual - Preparation of evacuation routes - DRR education for staff - Conducting response drills
	Water pipe network	- Preparation of DRR response manual - DRR education for staff - Conducting response drills

Agricultural / rural development	Irrigation	- Development of operation and maintenance in terms of DRR - Preparation of DRR response manual - Preparation of evacuation routes - DRR education for staff - Conducting DRR drills
Fisheries	Fisheries facilities	- Development of operation and maintenance in terms of DRR - Preparation of DRR response manual - Preparation of evacuation routes - Disaster education for staff - Conducting DRR drills
Natural resource and energy Water resources / Disaster management Agricultural / rural development	Dam, reservoir	- Development of operation and maintenance in terms of DRR - Preparation of DRR response manual - Preparation of evacuation routes - DRR education for staff - Conducting DRR drills

3.4.3. Improvement of capabilities about local disaster risk reduction

When facilities constructed in the project have some DRR-related function such as an evacuation shelter or storage of emergency supplies, it contributes to strengthening DRR at community level. Moreover, when officials in charge of disaster risk reduction in local governments and communities are involved in the emergency response system and maintenance system of the facility itself mentioned in chapter 3.1.2, DRR activities and systems in the community will be activated through the project activity. These additional options which should be considered for improvement of local DRR are shown in the table below.

Table 3-5: List of countermeasures for improvement of capabilities about local disaster risk reduction

Item	Objective, contents and points to keep in mind
To append evacuation shelter function to the constructed facility	To append evacuation shelter function for neighboring residents to the facility constructed in the project. Preparation of operation manual of evacuation shelter and evacuation route to the shelter and publication for the residents would be necessary to utilize the facility as an evacuation shelter in emergencies
To append emergency supplies storage function to the constructed facility	To append emergency supplies storage function to the facility constructed in the project. Medical supplies and foods must be stocked in facilities which can be bases of disaster response such as hospitals.
To incorporate emergency response system of the constructed facility into local emergency response system	When the disaster response manual of the facility constructed in the project is prepared, the manual should be linked to the local disaster management system. The disaster response of the facility will be more effective when it harmonizes with the local disaster response.
To involve officials in charge of disaster management in local government and communities in operation and maintenance system of the constructed facility	To utilize the facility constructed in the project as an evacuation shelter in emergency, sharing information with officials in charge of disaster management in local government and local voluntary disaster management organizations is necessary in ordinary times. Furthermore, to keep the functions as disaster response facilities and utilized appropriately, cooperation with communities should be established.

3.5. Forethought to DRR in Development Projects

Developing countries are often vulnerable to natural disasters and can suffer severe damage from natural disasters that are similar in magnitude to those occurring in Japan. These disasters not only destroy the livelihood of affected people but also greatly cut down national strength and impede development. Considering the conditions of the countries supported by JICA, it is essential to the development of counterpart countries that assistance projects include disaster forethoughts as much as possible so that people can continue their daily living. The knowledge of disaster risk reduction learned from the experience in many disasters is a field in which Japan can show its strength. The importance of mainstreaming disaster risk reduction is considered to increase also as a means for Japan to prove its ability to provide information and offer technical solutions.

Disaster forethoughts in the past projects of JICA demonstrated the followings.

Disaster forethoughts have already been incorporated in the projects concerning social infrastructure development, such as roads, ports, airports, industrial parks, water supply facilities, and irrigation facilities. Disaster risk reduction projects have been conducted in the areas prone to disasters such as typhoons, floods, earthquakes, and landslides. In the cases of restoration projects after disasters, buildings and infrastructures were reconstructed to be more resistant to disasters than the ones destroyed by disasters. In addition, disaster-resistant buildings were constructed as a contribution to community disaster risk reduction, such as schools that can be used as refuge facilities and hospitals that can withstand disasters.

In addition to the structural ("hardware") measures described above, many non-structural ("software") measures have been taken, such as the education in community disaster risk reduction and the improvement of facility maintenance capabilities. There have been a number of cases in which structural measures are combined with non-structural measures, such as the preparation of hazard maps and the revision of land use. Development projects can cause a risk for disasters, and countermeasures for such risk were implemented in some cases (for example, road embankment can work as a levee and retain water to cause flooding).

On the other hand, as buildings such as schools are designed and constructed according to building standards and anti-seismic standards, they are naturally built to withstand disasters without special attention to disaster risk reduction.[17] In the projects other than the construction of infrastructures and buildings, virtually no attention has been paid to disaster forethoughts.

However, to promote mainstreaming disaster risk reduction, it is necessary that all personnel involved in development have an awareness of disaster forethoughts. This should enable them to implement the disaster forethoughts that have been overlooked and recognize the possibility of disaster forethoughts as a value added. If countermeasures for DRR are not taken into account, structures installed could be damaged and the cooperation project may be in vain, but simple countermeasures might help to avoid suffering from damage. In developing countries which have a small budget for development, development projects would enhance the investment effect by considering disaster risk reduction.

After the Great East Japan Earthquake, it has been widely known that capability of reducing natural hazards by building strong structures is limited. Adding non-structural countermeasure such as residential evacuation to conventional structural countermeasure, disaster management including "mitigation" (minimizing, if not eliminating, damages by natural disaster) has been gaining recognition.

As the methodology for the introduction of disaster forethoughts, we use a two-phase approach consisting of "screening," in which the disasters to be examined and identified, and "scoping," in which concrete measures are studied, based on the schemes already used in environmental and

[17] Typhoon Yolanda in 2013 in the Philippines did not destroy the school built under a Japanese grant aid. This was because the Japanese building standards were used and not because special attention was paid to disaster risk reduction.

social considerations and climate change considerations. The next chapter explains the concrete methods for disaster forethoughts.

4. JICA's Disaster Risk Screening and Scoping for Development Projects: Implementation Methods in Projects

4.1. Flow of Disaster Forethought in Projects and Positioning of the Handbook

4.1.1. Overview

In every project conducted by JICA, it is important that all JICA personnel involved in a project understand the meaning of disaster forethoughts and perform study paying attention to the need for disaster forethoughts.

The disasters covered by this document are natural disasters including floods, typhoons, storm surges, landslides, earthquakes, tsunamis, volcanoes, and droughts. Sea level rises and other impact of climate changes are not covered. This document is applied to the sectors in all subjects. The process of disaster forethoughts begins in the stages before project implementation, including the preliminary evaluation of disaster risks and the study and countermeasures concerning any risks identified.

(1) Targeted Disasters

Targeted disasters in this book are natural disasters, therefore it doesn't include man-made hazard. An example for natural hazard's classification is shown in Table 4-1. Among natural disasters, 8 disasters which are flood, tropical cyclone, storm surge, land slide, tsunami, earthquake, volcano and drought, and which may occur anywhere on earth and give tremendous impacts, are targeted in this paper. And it excludes biohazard which is difficult to forecast and to take countermeasure against.

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Table 4-1: Natural hazard's classification and targeted hazards

Coverage of this study	Hazard*	Remarks	Classification*
○	Flood		Hydro-meteorological hazard
○	Tropical cyclone	This refers to tropical cyclones, which are called differently in different regions as typhoon, cyclone, and hurricane. Treated as synonymous to storm.	Hydro-meteorological hazard
○	Landslide	This includes sediment disasters in general. Not only landslides but also collapse of cliffs and steep slopes and debris flow (flush floods) are included. Debris flow includes volcanic mud flow.	Geological hazard
○	Storm surge	While this is often caused by a typhoon, low pressure systems other than typhoons can also be a cause.	Hydro-meteorological hazard
○	Earthquake		Geological hazard
○	Tsunami	Note that the cause is not limited to an earthquake. Submarine eruption and massive landslide can also be a cause.	Difficult to classify *Related to both geology and hydrometeorology
○	Volcano	The target is the disaster associated with eruption.	Geological hazard
○	Drought	This is treated as a hazard affecting agriculture. Impact on water supply and other aspects are not considered.	Hydro-meteorological hazard
	Heavy snow		Hydro-meteorological hazard
	Avalanche		Hydro-meteorological hazard
	Extreme temperature	Extreme high temperature, Extreme low temperature, Heat wave, Cold wave	Hydro-meteorological hazard
	Wild fire		Hydro-meteorological hazard
	Disease epidemics		Biohazard
	Animal / Insect palgues		Biohazard

Note) The types of hazards have been defined referring to the IFRC website https://www.ifrc.org/en/. Hazard classification is based on "UNISDR Terminology on Disaster Risk Reduction (2009)" (UNISDR, 2009).

(2) Targeted sectors

There are 19 sectors targeted here, covered by all thematic departments of JICA. Of 23 sector issues identified by JICA on its website 'JICA KNOWLEDGE SITE", JICA allocates a thematic department in charge of each of 18 sectors (excluding South-south Triangular Cooperation and Citizen Participation) (Table 4-2).

Table 4-2: Targeted Sectors and Thematic Departments in Charge

Sectors	Related projects	Thematic Issue Departments
Urban / Regional Development	Urban planning, Regional development, Industrial Park(complexes)	Infrastructure and Peacebuilding Department
Transportation	Road, Airport, Port and Harbor, Urban transportation	
ICT	Communication facilities, Broadcast system	
Gender and Development		
Peace-building		
Poverty Reduction		
Private Sector Development	Industrial infrastructure, Tourism development	Industrial Development and Public Policy Department
Natural Resources and Energy	Electric power plants, Electric power transmission and distribution, Mining development	
Governance	Legal and judicial systems, Public administration	
Economic Policy	Fiscal management and financial systems	
Education	Schools, Education systems, Training	Human Development Department
Social Security	Support for person with disability, Pensions, Social insurance	
Health	Hospitals	
Natural Environment Conservation	Forests, Natural environment conservation	Global Environment Department
Environment Management	Waste management Sewage	
Water Resources and Disaster Management	Urban water supply, Rural water supply	
Climate Change		
Agricultural/Rural Development	Rural development, Irrigation	Rural Development Department
Fisheries	Local fishing community, Fishing port	

4.1.2. Flow of Disaster Risk Screening and Scoping

Generally speaking, not all personnel are aware of DRR unless they are in charge of DRR plans and social infrastructure development projects. As a result, a project that requires forethought to DRR may not be provided with such considerations, or forethought to DRR that could be implemented as a value added may end up without them. On the other hand, as mentioned in 3.4, there may be cases such as the school constructed according to the Japanese building standards, which is provided with sufficient forethought to DRR without recognition.

Development projects such as Grant Aid and Technical Cooperation conducted by JICA are usually implemented by commissioning studies by consultants having specialist knowledge. JICA needs to ensure that the assignment to consultants include the studies needed for the implementation of forethought to DRR so that adequate forethought to DRR are implemented. As some projects do not need forethought to DRR, it is also necessary to judge whether or not they are needed in each project.

In each development project conducted by JICA, it is necessary to (i) judge whether or not forethought to DRR are needed and, if they are considered necessary, to (ii) describe the studies and other tasks required concerning forethought to DRR in the Terms of Reference (ToR) to the consultant.

The task concerning (i) above is “screening” and that concerning (ii) is “scoping.” This chapter describes the processes and methods concerning screening and scoping. The flow in the development project of JICA is shown for technical cooperation and grant aid cooperation, and the timing of these processes is illustrated in Figure 4-1 and Figure 4-2.

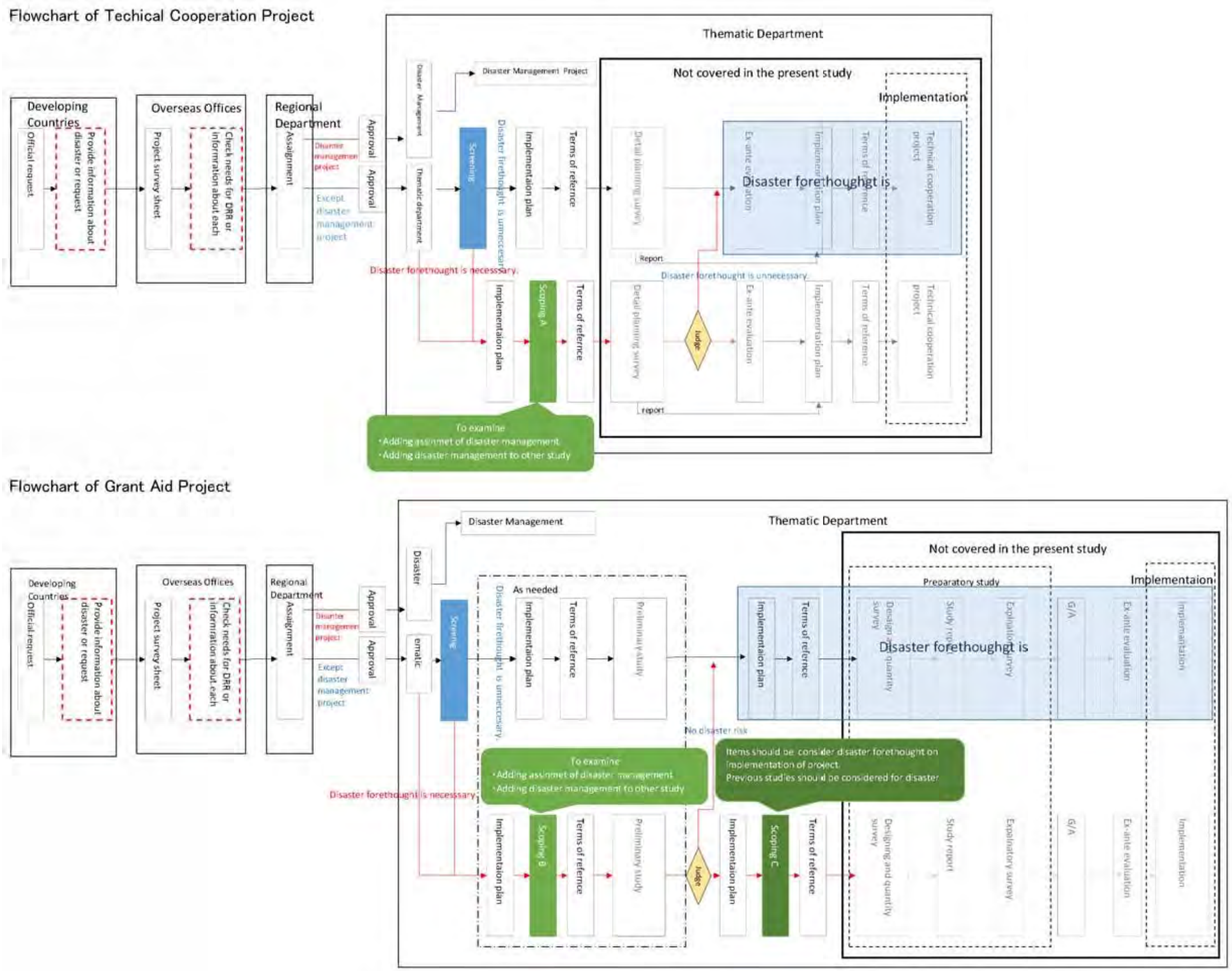


Fig. 4-1: Flowchart of procedure of forethought to DRR in JICA's development project

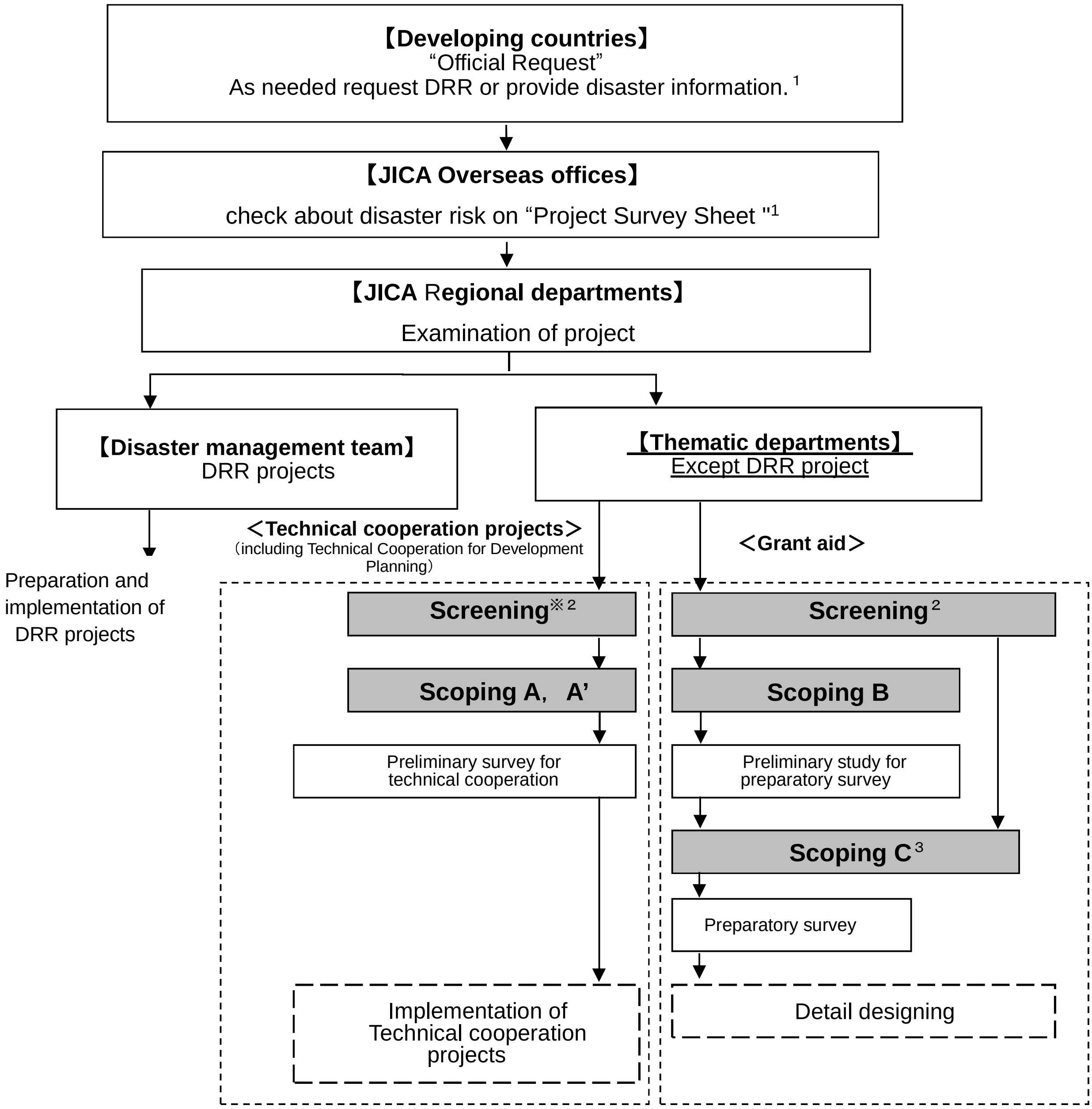


Fig. 4-2: The timing when should be conduct "Screening" and "Scoping" in preparation to development projects

*1 If a counterpart government or the overseas office considers forethought to DRR are necessary, check “Forethought to DRR needed” and perform scoping concerning the relevant disasters.

*2 If screening shows forethought to DRR are not necessary, scoping is not performed.

*3 The need for forethought to DRR is judged based on the result of preliminary study, and scoping is performed if considered necessary. If forethought to DRR are deemed unnecessary before preliminary study, scoping C for the relevant disasters is not performed.

4.2. Screening Methods

4.2.1. Screening Methods

After confirming the requests of the counterpart government concerning forethought to DRR and the disaster information from the JICA overseas office, screening is performed using the natural disaster databases on the Internet covering the characteristics of disasters all over the world. This is performed by checking the required items on the screening sheet. Screening is performed for each hazard which are floods, tropical cyclones, storm surges, landslides, earthquake, tsunami and drought. The flowchart of screening is illustrated in Figure 4-3.

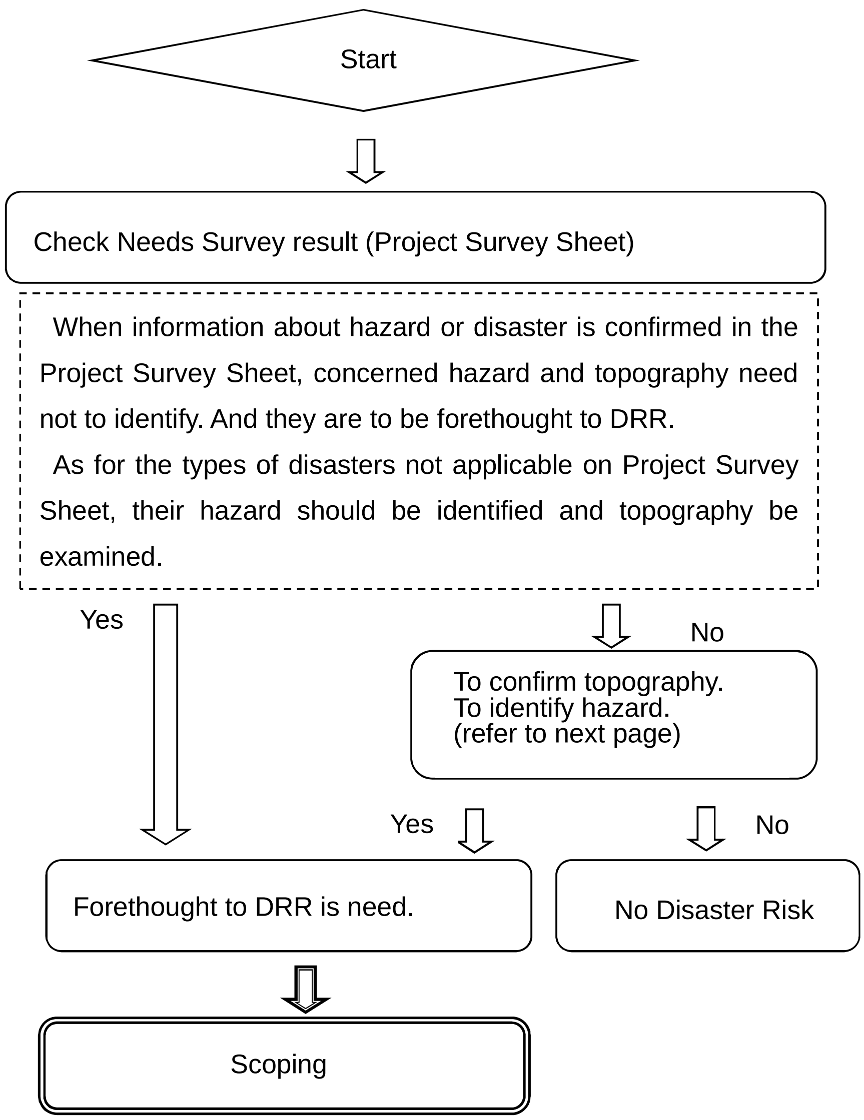


Fig. 4-3: Flowchart of Implementation of Screening

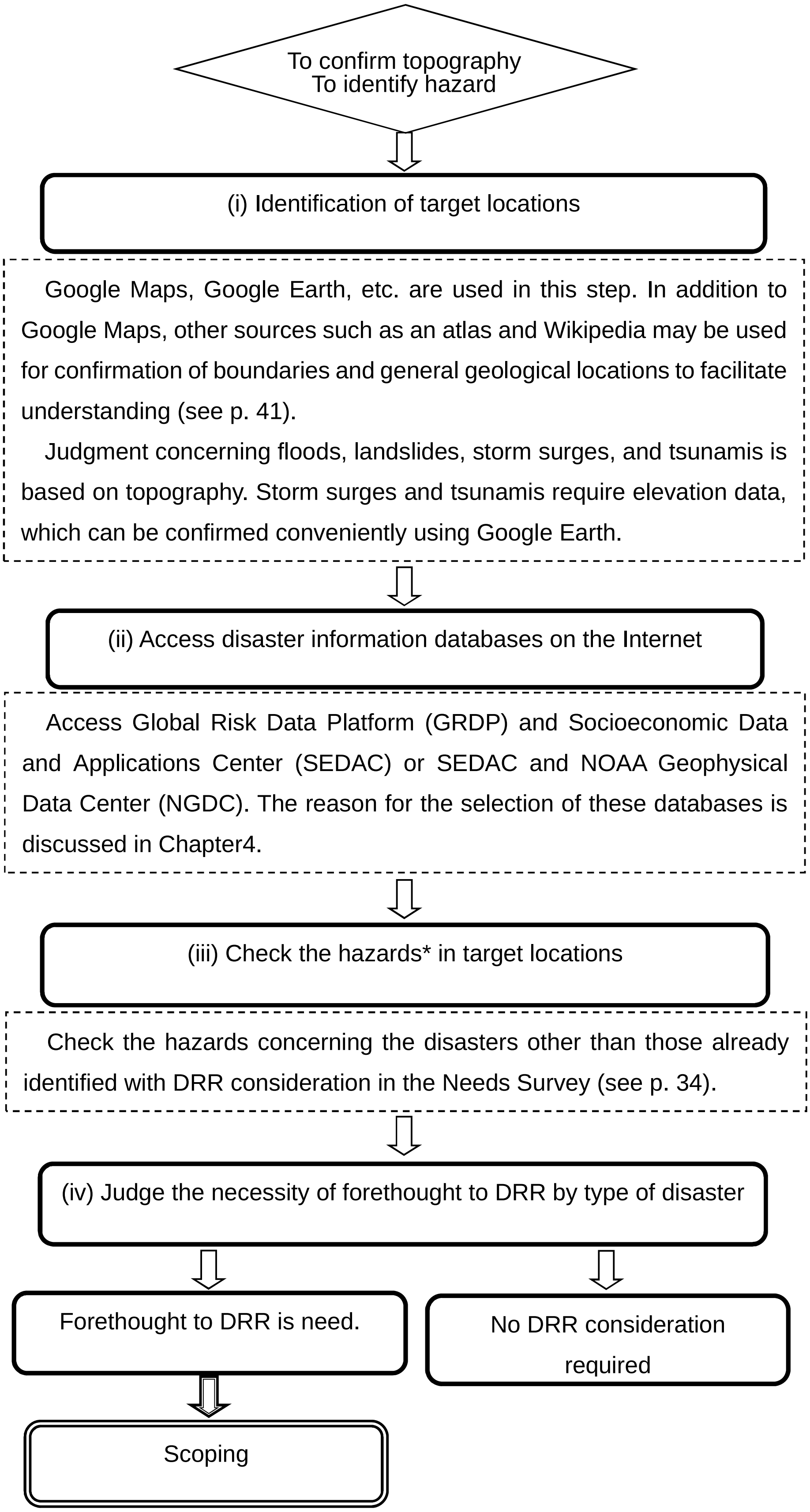


Fig. 4-4: Flowchart of Implementation of Screening (To identify topography and hazard)

The entries on the screening sheet (see the following page) comprise of the following items.

(i) Needs Survey: Description of the result of confirmation of information on forethought to DRR indicated on the Questionnaire on Requested Project

(ii) Confirmation of hazards: Description of the result of confirmation of the hazards in the target area using databases

a. Use GRDP + SEDAC for confirmation.

b. If GRDP is inaccessible, try again after a while.

c. If it is still inaccessible, use SEDAC + NGDC.

If more than one level is found for a type of hazard, check all applicable levels.

(iii) Confirmation of topography: Description of the result of confirmation of the topography of the target area using Google Maps and other sources

Check for the presence of rivers (floods), mountainous and hilly areas (landslides), coastal areas with 10 m or less elevation (storm surges), those with 35 m or less elevation (tsunamis).

Elevation can be confirmed conveniently using Google Earth, which shows the elevation of the point at which the cursor is placed. However, caution must be used because the data can be clearly inaccurate.

(iv) Description of the result of evaluation concerning forethought to DRR based on the above items

(Note) * Hazard

A hazard is an event or an external action causing a disaster. Japanese people often do not distinguish a hazard from a disaster, which is a result of the hazard. A hazard can also mean a potential situation that can be a real hazard in the future. In other words, it is an indicator of the danger of a disaster based on the topography, geology, climate characteristics, etc. in the relevant area. It is the hazard in this sense that is examined in screening, because it is considered the most appropriate for the judgment of the necessity of forethought to DRR.

Apart from hazards, there are other indicators concerning disasters. One is exposure on the part of the affected by hazards, and another is risk, which is the combination of the negative effect and the probability of a disaster.

Although the past occurrence of disasters can also be an indicator, it is not always appropriate for the confirmation of disasters in screening, because disasters can occur in the places with no past history. However, the history of past disasters is used for screening concerning droughts in GRDP and tsunamis in NGDC, as the databases do not provide the data for hazards.

①Needs Survey

Identification of
②hazards
③topography

④Screening results

(Note !) In case "Global Risk Data Platform" is inaccessible, use "screening sheet2".

Project Title	

Disaster Risk Screening Sheet

Object	Needs Survey	Hazard Identification		Topography Identification	Result of screening[2]
Data Level	Basic Information	Main Data Source	Source for Volcano	Main Data Source	
Data sources / Hazards	Project Survey Sheet[1]	UNEP / UNISDR Global Risk Data Platform	NASA U.S.A Socioeconomic Data and Applications Center	Google Map / Google Earth	
Flood	Description of disaster risk ☐Yes→Fore-thought to DRR ☐No	Hazards/Flood Frequency(100)(1km Grid) ☐1~5(events/100y.) ☐5~50(events/100y.) ☐50<(events/100y.) ☐No Data		・Located in large river delta ・Located near river ☐Yes ☐No	Forethought to DRR ☐ Yes ☐ No
Tropical cyclone	Description of disaster risk ☐Yes→Fore-thought to DRR ☐No	Hazards/Frequency ☐0.25>(events/y.) ☐0.25~0.50(events/y.) ☐0.50~0.75(events/y.) ☐0.75~1.00(events/y.) ☐1.00~1.24(events/y.) ☐No Data			Forethought to DRR ☐ Yes ☐ No
Storm surge	Description of disaster risk ☐Yes→Fore-thought to DRR ☐No			・Located in coastal area ・Located in E.L.10m or below ☐Yes ☐No	Forethought to DRR ☐ Yes ☐ No
Land-slide	Description of disaster risk ☐Yes→Fore-thought to DRR ☐No	Hazards/Landsilides PR(1km Grid) ☐Low ☐Medium ☐High ☐Very High ☐No Data(上記以外)		・Located mountain or hill slope or its adjacent area ☐Yes ☐No	Forethought to DRR ☐ Yes ☐ No
Earth-quake	Description of disaster risk ☐Yes→Fore-thought to DRR ☐No	Hazards/Earthquakes MMI (10km Grid) ☐5~7(MMI for 10% in 50y.) ☐7~8(MMI for 10% in 50y.) ☐8~9(MMI for 10% in 50y.) ☐More than 9(MMI for 10% in 50y.) ☐No Data			Forethought to DRR ☐ Yes ☐ No
Tsunami	Description of disaster risk ☐Yes→Forethought to DRR ☐No	Hazards/Tsunami (1km Grid) ☐0.2> ☐0.2~0.4 ☐0.4~0.6 ☐0.6~0.8 ☐0.8~1.0 ☐No Data		・Located in coastal area ・Located in E.L.35m or below ☐Yes ☐No	Forethought to DRR ☐ Yes ☐ No
Volcano	describing about disaster risk ☐Yes→Fore-thought to DRR ☐No		Global Volcano Hazard Frequency and Distribution, v1 (50km Grid) ☐1~10 ☐11~30 ☐31~60 ☐61~130 ☐No Data		Forethought to DRR ☐ Yes ☐ No
Drought Agricultural project	Description of disaster risk ☐Yes→Fore-thought to DRR ☐No	Past events/Drought events(50km Grid) ☐Yes ☐No Data			Forethought to DRR ☐ Yes ☐ No

(20150128版)

1) When disaster risk reductiuon will be considered.

2) For each disaster, when all items are checked "No" or "No Data", the disaster risk reduction will not be considered.

Screening Sheet

(1) **Confirmation of Needs Survey Result**

The staff of oversea offices are to check the information about disaster history which offered from counterpart countries. And these staff should provide a comment about necessity of disaster risk reduction, because they have a lot of information of each partner countries. It is important to confirm latest disaster information so that the external database used for hazard check latest information. Below is a draft of the survey form. When starting screening, confirm whether or not the need for disaster considerations is indicated on the Questionnaire on Requested Project.

Project survey sheet (ex.)

《Disaster Risk Reduction》

1. Information on disaster is included in Project Survey Sheet.

☐Flood ☐Tropical cyclone ☐Storm surge ☐Landslide ☐Earthquake
☐Tsunami ☐Volcano ☐Drought (Agriculture Project only)

Comments

2. Forethought to following hazards are needed.

☐Flood ☐Tropical cyclone ☐Storm surge ☐Landslide ☐Earthquake
☐Tsunami ☐Volcano ☐Drought (Agriculture Project only)

Why need? / History of Disaster

(2) **Confirmation of Hazards and Topography**

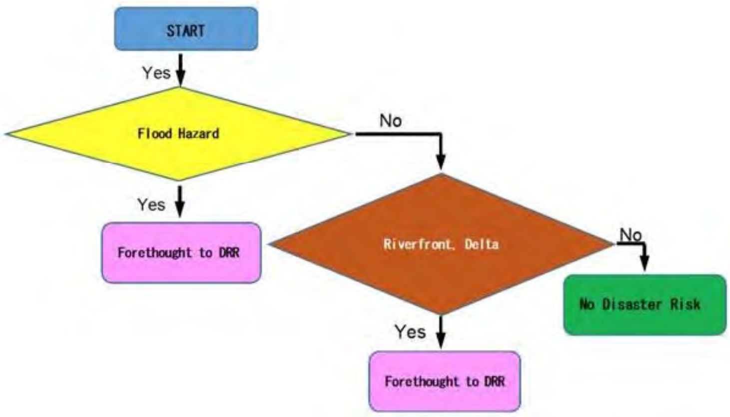
Judge the necessity of forethought to DRR mainly based on hazards and topography, as describe below. Only for droughts, priority is given to the judgment based on the nature of project (agriculture or other than agriculture).

(i) Judge the necessity of forethought to DRR using **hazards** as the primary input and **topography** as the secondary input.

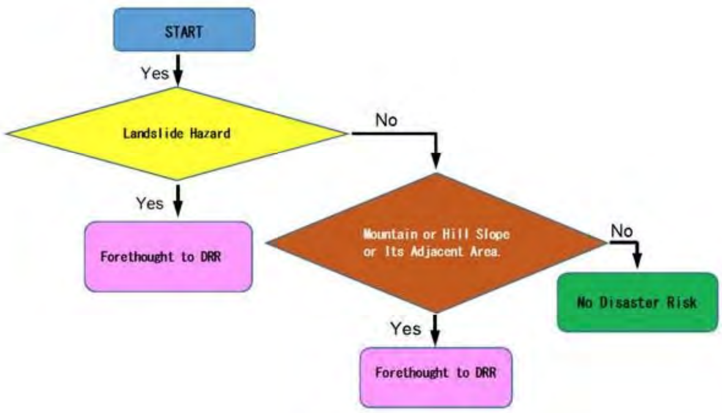
: Although the possibility of a disaster can be estimated from topography, accurate judgment is difficult.

⇒ Floods, landslides, tsunami

Flood



Landslide



Tsunami

Fig. 4-5(1): Procedure of screening with hazard and topography data.

(Note) Hazards and topography must be examined in the evaluation of floods using SEDAC

(ii) Judge the necessity of forethought to DRR using **hazards** as the primary input.

: It is difficult to estimate the possibility of a disaster from topography.

⇒ Tropical cyclones, earthquakes, volcanoes

Tropical Cyclone

Earthquake

Volcano

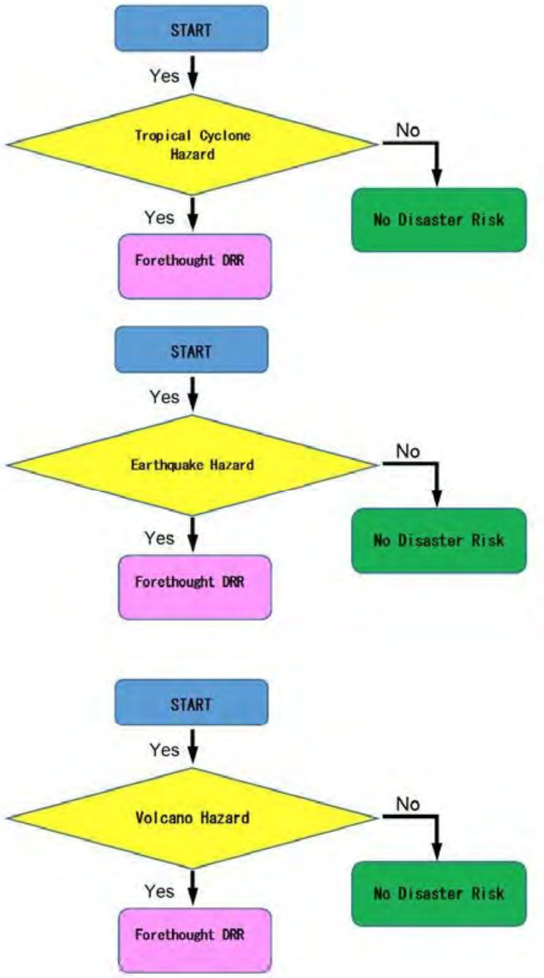


Fig. 4-5(2): Procedure of screening with hazard and topography data.

(iii) Judge the necessity of forethought to DRR using **topography** as the primary input.

: The possibility of a disaster can be estimated from topography.

⇒ Storm surges

Storm Surge

Fig. 4-5(3): Procedure of screening with hazard and topography data.

(iv) Judge the necessity of forethought to DRR using **the nature of project** as the primary input and **hazards** as the secondary input.

: Necessity can be judged from the nature of project. It is difficult to estimate the possibility of a disaster from topography.

⇒ Droughts

Drought

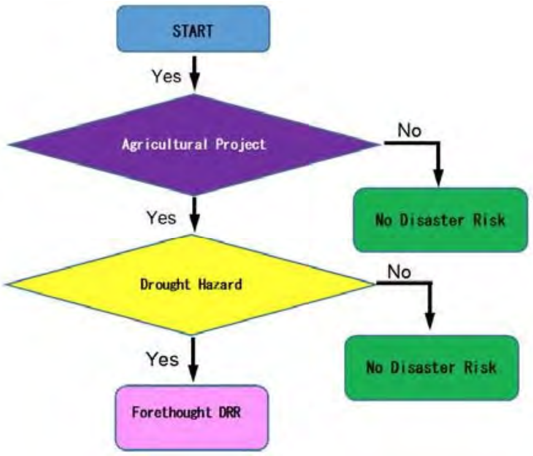


Fig. 4-5(4): Procedure of screening with hazard and topography data.

(3) When Global Risk Data Platform is Inaccessible

The Global Risk Data Platform (GRDP) used as the main source of disaster information is an excellent database that provides hazard classification data with 1 km grid resolution in some types of disasters. However, it becomes inaccessible at times. As it usually becomes accessible again after some time, it is desirable to retry and use this database. If this would impede the screening process due to the limitation of time, screening may be performed using another database on a secondary screening sheet (Screening Sheet 2) prepared for this purpose.

The database that can be used in place of GRDP is hosted in the website of Socioeconomic Data and Applications Center (SEDAC) operated by NASA. This database is also used in the standard screening sheet as the database for volcanic hazards.

As compared with GRDP, the data in SEDAC are coarser (Table 4-1), particularly in the case of the data for floods and earthquakes. This difference may cause unevenness in the results of screening. For this reason, we have made it mandatory to confirm topography when flood hazards are examined using SEDAC. In the case of earthquake hazards, special treatment as used for floods is not required, and the data retrieved are used as they are, even if the results may be different from those obtained using GRDP.

Since SEDAC does not display place names on the map or administrative borders other than national borders, special attention is needed in identifying places.

In addition, because SEDAC does not contain information on tsunamis, NOAA's website of National Geophysical Data Center (NGDC) is used for the screening concerning tsunamis.

Table 4-1 Difference in display resolution between GRDP and SEDAC

Hazard	Global Risk Data Platform	Socioeconomic Data and Applications Center
flood	Approx. 1km	Approx. 100km
tropical cyclone	Approx. 2km	Approx. 5km
storm surge	—	—
land slide	Approx. 1km	Approx. 5km
earthquake	Approx. 1km	Approx. 50km
tsunami	Approx. 1km	—
volcano	—	Approx. 50km
drought	Approx. 50km	Approx. 200km

source : both websites of "Global Risk Data Platform" and "NASA Socioeconomic Data and Applications Center"

The items from (i) to (v) above are summarized in Table 4-2.

(4) Evaluation

Based on the entries in the screening sheet, the necessity of forethought to DRR is evaluated for each type of **disaster** as follows.

(i) If the necessity of forethought to DRR on the Questionnaire on Requested Project is "Yes,", confirmation of hazards and topography is not performed and the judgment is "forethought to DRR needed."

(ii) If the necessity of disaster consideration on the Questionnaire on Requested Project is "No" and the screening shows a match of hazard and topography conditions with the project conditions, the judgment is "forethought to DRR needed."

(iii) Only if the entry in the Questionnaire on Requested Project and the result of confirmation of hazards and topography are all "No" or "No Data," the judgment is "forethought to DRR not needed."

Table 4-2 Hazard data base and data source of topography using for screening

Type	hazard	GRDP	SEDAC	NGDC	topographical data e.g. Google Maps	remarks
standard	flood	◎			○	primarily: hazard secondarily : topography
	tropical cyclone	◎				hazard
	storm surge				◎	topography only for coastal area
	land slide	◎			○	primarily: hazard secondarily : topography
	earthquake	◎				hazard
	tsunami	◎			○	primarily: hazard secondarily : topography only for coastal area
	volcano		◎			hazard
	drought	◎				agriculture project
for backup	flood	GRDP is inaccessible	◎		◎	hazard and topography
	tropical cyclone		◎			hazard
	storm surge				◎	topography only for coastal area
	land slide		◎		○	primarily: hazard secondary : topography
	earthquake		◎			hazard
	tsunami			◎	○	primarily: hazard secondarily : topography coastal area
	volcano		◎			hazard
	drought		◎			only for agriculture project

notes 1)◎ : data base or data source use for screening primarily
○ : data base or data source use for screening secondarily
2)Data set in each database should be shown are below.
GRDP　Global Risk Data Platform
flood　Hazards/Flood Frequency(100)
tropical cyclone　Hazards/Frequency(100)
land slide　Hazards/Land Slide PR
earthquake　Hazards/Earthquakes MMI
tsunami　Hazards/Tsunami hazard
drought　Past events/Drought events

SEDAC　NASA Socioeconomic Data and Applications Center
flood　Global Flood Hazard Frequency and Distribution, v1 (1985–2003)
tropical cyclone　Global Cyclone Hazard Frequency and Distribution, v1 (1980–2000)
land slide　Global Landslide Hazard Distribution, v1 (2000)
earthquake　Global Earthquake Hazard Frequency and Distribution, v1 (1976–2002)
volcano　Global Volcano Hazard Frequency and Distribution, v1 (79–2000)
drought　Global Drought Hazard Frequency and Distribution, v1 (1980–2000)

NGDC　NOAA National Geophysical Data Center
tsunami　Tsunami Events & Tsunami Observations

(5) Hazards in Databases

The types of hazards shown in different databases have somewhat different meanings. The following summarizes the feature of each hazard type.

(i) Flood

Features of flood hazard shown on GRDP and SEDAC are illustrated in Table 4-3.

Table 4-3: Features of flood hazard shown on GRDP and SEDAC

Data Base	GRDP	SEDAC
DATA SET	Hazards/Flood Frequency（100）	Global Flood Hazard Frequency and Distribution, v1 (1985−2003)
Display resolution	Approx. 1 km grid	Approx. 100km grid
Classification	3 levels: 1-5 events/100 years, 5-50/100 years, and 50 or more/100 years	4 levels: 1-2, 3-5, 6-11, and 12-25. A larger number in a grid cell indicates higher frequency of the occurrence of floods.
Features	Distribution of the frequency of floods per 100 years estimated from the flood distribution model based on global runoff analysis (Herold & Mouton, 2011) and flood history.	Based on the list of major floods in 1985-2003 compiled by Dartmouth Flood Observatory in Canada. Calculated for the units of 2.5' (approx. 5-km) grid cells.

source : both websites of "Global Risk Data Platform" and "NASA Socioeconomic Data and Applications Center"

(ii) Tropical cyclone

Features of tropical cyclone hazard shown on GRDP and SEDAC are illustrated in Table 4-4.

Table 4-4: Features of tropical cyclone hazard shown on GRDP and SEDAC

Data Base	GRDP	SEDAC
DATA SET	Hazards/Frequency(Tropical Cyclone)	Global Cyclone Hazard Frequency and Distribution, v1 (1980−2000)
Display resolution	Approx. 2 km grid	Approx. 5 km grid
Classification	5 levels: less than 0.25 occurrences/year, 0.25-0.50, 0.50-0.75, 0.75-1.00, and 1.00-1.24	4 levels: 1-5, 6-15, 16-30, and 31-65. A larger number in a grid cell indicates higher frequency of the occurrence of rainstorms.
Features	Distribution of tropical cyclones with Saffir-Simpson Hurricane Wind Scale of 5 estimated from modified Holland's model (1980) taking into consideration the migration of tropical cyclones based on the data for tropical cyclones generated in 1969-2009.	Compiled from the data used for GDRP's Past events/Tropic cyclone tracks. Prepared in a 2.5' (approx. 5-km) grid based on the tracks of more than 1,600 rainstorms generated in the Pacific, Atlantic, and Indian Oceans in 1980-2000.

source : Both websites of "Global Risk Data Platform" and "NASA Socioeconomic Data and Applications Center"

The Saffir-Simpson Hurricane Wind Scale according to NOAA (2014) is shown in Table 4-5.

While tropical cyclones corresponding to the Saffir-Simpson Hurricane Wind Scale of 5 cause devastating damage (such as destruction of houses), those with smaller scales can cause major damage depending on local conditions.

Table 4-5: Saffir-Simpson Hurricane Wind Scale（NOAA(2014))

Category	Sustained Winds	Types of Damage Due to Hurricane Winds
1	119-153 km/h	Very dangerous winds will produce some damage: Well-constructed frame homes could have damage to roof, shingles, vinyl siding and gutters. Large branches of trees will snap and shallowly rooted trees may be toppled. Extensive damage to power lines and poles likely will result in power outages that could last a few to several days.
2	154-177 km/h	Extremely dangerous winds will cause extensive damage: Well-constructed frame homes could sustain major roof and siding damage. Many shallowly rooted trees will be snapped or uprooted and block numerous roads. Near-total power loss is expected with outages that could last from several days to weeks.
3(major)	178-208 km/h	Devastating damage will occur: Well-built framed homes may incur major damage or removal of roof decking and gable ends. Many trees will be snapped or uprooted, blocking numerous roads. Electricity and water will be unavailable for several days to weeks after the storm passes.
4(major)	209-251 km/h	Catastrophic damage will occur: Well-built framed homes can sustain severe damage with loss of most of the roof structure and/or some exterior walls. Most trees will be snapped or uprooted and power poles downed. Fallen trees and power poles will isolate residential areas. Power outages will last weeks to possibly months. Most of the area will be uninhabitable for weeks or months.
5(major)	252 km/h or higher	Catastrophic damage will occur: A high percentage of framed homes will be destroyed, with total roof failure and wall collapse. Fallen trees and power poles will isolate residential areas. Power outages will last for weeks to possibly months. Most of the area will be uninhabitable for weeks or months.

(iii) Landslide

Features of landslide hazard shown on GRDP and SEDAC are illustrated in Table 4-6.

Table 4-6: Features of landslide hazard shown on GRDP and SEDAC

Data Base	GRDP	SEDAC
Data Set	Hazards/ Landslide PR	Global Landslide Hazard Distribution, v1 (2000)
Display resolution	Approx. 1 km grid	Approx. 5 km grid
Classes	4 levels: Low, Medium, High, and Very High	6 levels: Low, Low to Moderate, Moderate Medium, Medium to High, High, and Very High
Feature	The distribution of annual frequency estimated from multivariate analysis using the response variable of landslide occurring mainly in Europe and the 6 predictor variables of slope, geology, soil moisture, vegetation, precipitation and earthquakes.	Based on the landslide and avalanche hazard distribution map prepared by Norwegian Geotechnical Institute predicting the frequency of landslides from slope, soil, soil moisture, precipitation, seismic activity, and temperature data in the units of 2.5’ (approx. 5-km) grid cells.

Landslide terrain and its development according to Watari and Kobashi (1987) are shown in Fig. 4-3. Landslides characteristically show recurrence and reactivation, and occur in a peculiar terrain (landslide terrain) consisting of a scarp and a sliding mass.

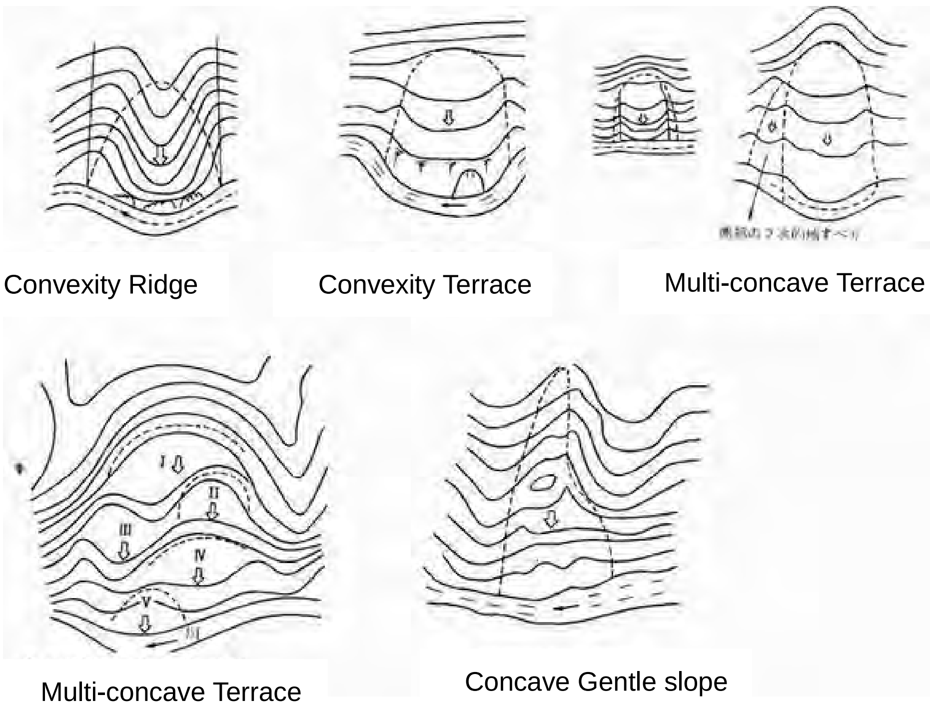


Fig. 4-3: Landslide types depend on Topography and its developing process (Watari and Kobashi(1987))

(iv) Earthquake

Features of earthquake hazard shown on GRDP and SEDAC are illustrated in Table 4-7.

Table 4-7: Features of earthquake hazard shown on GRDP and SEDAC

Data Base	GRDP	SEDAC
DATA SET	Hazards/ Earthquakes MMI	Global Earthquake Hazard Frequency and Distribution, v1 (1976–2002)
Display resolution	Approx. 10 km grid	Approx. 50 km grid
Classification	Seismic intensity that occurs at the probability of 10% in 50 years 4 levels: 5-7, 7-8, 8-9, and 9 or more	4 levels: 1-10, 11-50, 50-100, and >100 A larger number in a grid cell indicates higher frequency of the occurrence of earthquake.
Features	The distribution of earthquakes classified by the Modified Mercalli Intensity (Wood & Neuman, 1931; Richter, 1958) expected to occur at the probability of 10% in 50 years, estimated from the simulation of maximal acceleration and velocity amplitude using the parameters of the distance from epicenter, crustal structure, and rock/soil geology.	Prepared based on the Earthquake Catalog data of Advanced National Seismic System (ANSS) operated by USGS. The distribution of earthquakes with the Richter Scale of more than 4.5 occurring in 1976-2002. Calculated for the units of 2.5' (approx. 5-km) grid cells.

Modified Mercalli Intensity (MMI) according to USGS (2014a) is shown in Table 4-8. MMI is a measure for strong ground motion (the severity of shaking in a place) used in the United States and many other countries, which is designed to facilitate the comparison in the severity of damage based on the damage caused by past earthquakes. Although it cannot be compared directly with the seismic intensity used by Japan Meteorological Agency, as it is based on seismic intensity meters and building styles differ between countries, V corresponds generally to 4 in Japan, VI to 5 lower, VII to 5 upper, VIII to 6 lower, IX to 6 upper to 7, and X to 7.

Table 4-8: Modified Mercalli Intensity

Intensity	Shaking	Description/Damage
I	Not felt	Not felt except by a very few under especially favorable conditions.
II	Weak	Felt only by a few persons at rest, especially on upper floors of buildings.
III	Weak	Felt quite noticeably by persons indoors, especially on upper floors of buildings. Many people do not recognize it as an earthquake. Standing motor cars may rock slightly. Vibrations similar to the passing of a truck. Duration estimated.
IV	Light	Felt indoors by many, outdoors by few during the day. At night, some awakened. Dishes, windows, doors disturbed; walls make cracking sound. Sensation like heavy truck striking building. Standing motor cars rocked noticeably.
V	Moderate	Felt by nearly everyone; many awakened. Some dishes, windows broken. Unstable objects overturned. Pendulum clocks may stop.
VI	Strong	Felt by all, many frightened. Some heavy furniture moved; a few instances of fallen plaster. Damage slight.
VII	Very strong	Damage negligible in buildings of good design and construction; slight to moderate in well-built ordinary structures; considerable damage in poorly built or badly designed structures; some chimneys broken.
VIII	Severe	Damage slight in specially designed structures; considerable damage in ordinary substantial buildings with partial collapse. Damage great in poorly built structures. Fall of chimneys, factory stacks, columns, monuments, walls. Heavy furniture overturned.
IX	Violent	Damage considerable in specially designed structures; well-designed frame structures thrown out of plumb. Damage great in substantial buildings, with partial collapse. Buildings shifted off foundations.
X	Extreme	Some well-built wooden structures destroyed; most masonry and frame structures destroyed with foundations. Rails bent.
XI	Extreme	Few, if any (masonry) structures remain standing. Bridges destroyed. Rails bent greatly
XII	Extreme	Damage total. Lines of sight and level are distorted. Objects thrown into the air.

(v) Tsunami

Features of tsunami hazard shown on GRDP and NGDC are illustrated in Table 4-9.

Table 4-9: Features of Tsunami hazard shown on GRDP and NGDC

Data Base	GRDP	NGDC
DATA SET	Hazards/ Tsunami hazards	Tsunami Event Database Tsunami Run-up Database
Display resolution	Approx. 1 km grid	Dot display
Classification	Probability of occurrence in 500 years 5 levels: less than 0.2, 0.2-0.4, 0.4-0.6, 0.6-0.8, and 0.8-1.0	Tsunami Event Database Causative factor (earthquake, volcano, landslide), scale of earthquake, deaths (1-50, 51-100, 101-1,000, and >1,000) Tsunami Run-up Database Run-up height: 1-2 m, 2-5 m, 5-10 m, and 10 m<
Features	The distribution of the 500-year probability of tsunami caused by an earthquake estimated from the hazard maps based on existing literature data on tsunami and the numerical model analysis in several areas. The hazards of tsunamis caused by landslides, rock falls, and volcanic eruption are not included.	Global Historical Tsunami Database has been constructed covering the tsunamis that have occurred in Pacific, Indian, and Atlantic Oceans since 2000 B.C. The database summarizes the time of occurrence, cause, the scale of earthquake associated with tsunami, the location of epicenter, maximum wave height, human damage, and run-up height in coastal areas.

The tsunamis covered by GRDP are those expected in association with earthquakes that may occur at a 500-year probability. The hazards of past tsunamis caused by landslides, rock falls, and volcanic eruption in Italy and Portugal are not taken into consideration

(vi) Volcano

Features of volcano hazard shown on SEDAC are illustrated in Table 4-10.

Table 4-10: Features of Volcano hazard shown on SEDAC

データベース	SEDAC
DATA SET	Global Volcanic Hazard Frequency and Distribution
Display resolution	Approx. 50 km grid
Classification	4 levels: 1-10, 11-30, 31-60, and 61-130
Features	The source is the volcano database of NOAA NGDC. Of the volcanic eruptions that occurred in 1979-2000, the number of those with the Volcanic Explosivity Index (Newhall & Self, 1982) of 2 to 8 as calculated for each 2.5' (approx. 5 km) grid cell is compiled in a 50-km grid and classified into 4 levels.

The schematic diagram of the Volcanic Explosivity Index according to USGS (2014b) is shown in Figure 4-4. An eruption with the Volcanic Explosivity Index of less than 2 is “small scale” or “with no recognizable volcanic ejecta.” The level of hazard used in screening is considered to provide a relative indicator of the distribution of volcanic hazards that are large enough to cause damage. However, because volcanoes with no past records of eruption can still cause eruption, attention must always be paid to volcanic hazards on and around a volcano.

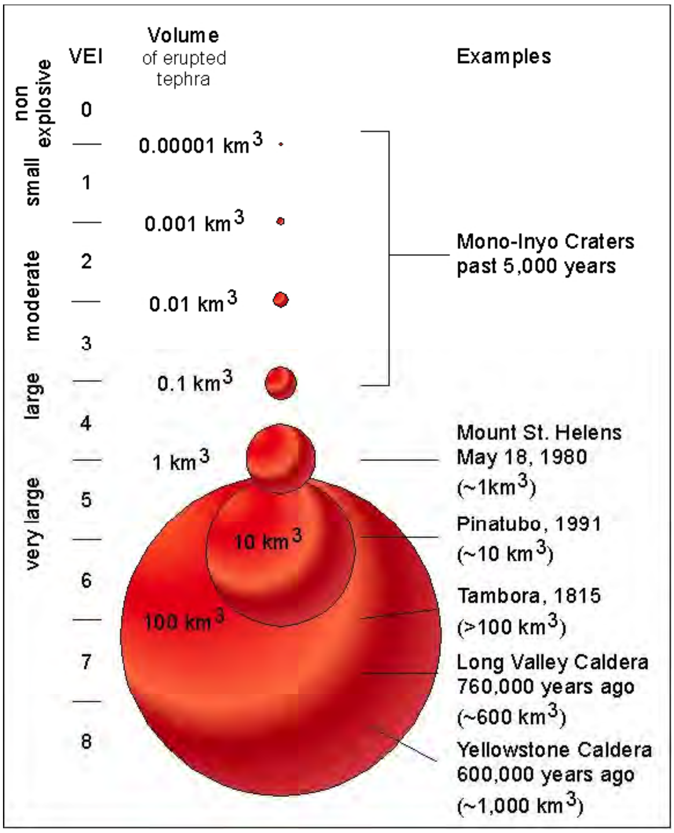


Fig. 4-4: Schematic model of Volcanic Explosivity Index（USGS, 2014b）

(vii) Drought

Features of drought hazard shown on GRDP and SEDAC are illustrated in Table 4-11.

Table 4-11: Features of draught hazard shown on GRDP and SEDAC

データベース	GRDP	SEDAC
DATA SET	Past events/ Drought events	Global Drought Hazard Distribution, v1 (2000)
Display resolution	Approx. 50-km grid	Approx. 200-km grid
Classification	Present or absent, no levels	5 levels: 0, 1-3, 4-6, 7-10, 11-19 A larger number in a grid cell indicates higher frequency of occurrence of drought.
Features	Presence or absence of drought estimated for each approx. 50-km grid cell estimated from the Standardized Precipitation Index (McKee et al., 1993) based on the grid data set for monthly precipitation in the world.	The Weighted Anomaly of Standardized Precipitation (WASP) index developed by International Research Institute for Climate and Society (IRI) of Columbia University in the U.S. has been applied. Drought is defined as a spell of 3 months or more with the rainfall of 50% or less of the median of the monthly rainfall for the 21 years from 1980 to 2000. The data are calculated for each 2.5’ grid cell.

4.2.2. Methods for Identification of Hazards and confirmation of Topography

(1) Identification of Hazards Using Global Risk Data Platform

(i) Open the following website in an Internet browser.[18]

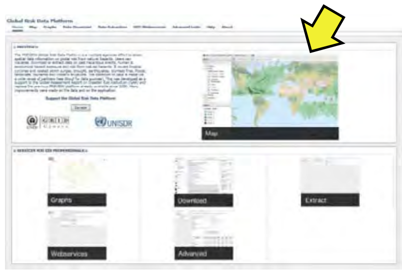
Home: http://preview.grid.unep.ch

Data view page: http://preview.grid.unep.ch/index.php?preview=map&lang=eng

(ii) Move to Map page.

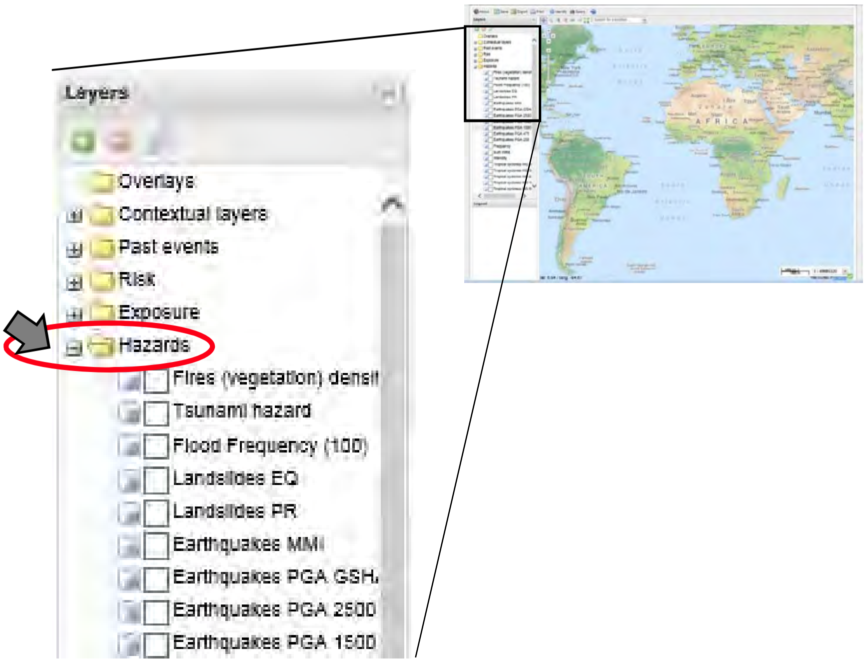
First, the top page is shown.

Click on the part marked with the arrow in the figure below to move to the Map page.



(iii) Expand the Hazards folder.

Expand the Hazards folder in the sub-window of the Map page to display the list.



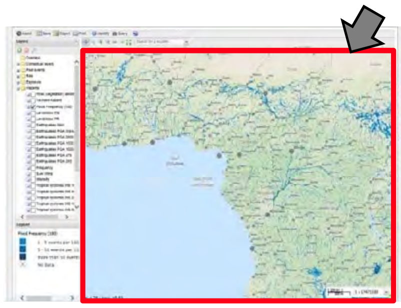
To see the data for droughts, expand the Past Events folder as they are contained in Past Events.

(Note) It takes time to display hazards in GRDP. Do not end the confirmation of hazards until all data are displayed to avoid incorrect judgment. The display of data can also slow down when the settings for hazard display are changed.

[18] While several Internet browsers are available, Internet Explorer (IE) that comes with Windows is said to be slow in starting up and display. Although IE 9.0 and later versions are considerably improved, some other browsers such as Firefox, Google Chrome, and Opera are generally considered better in display speed.

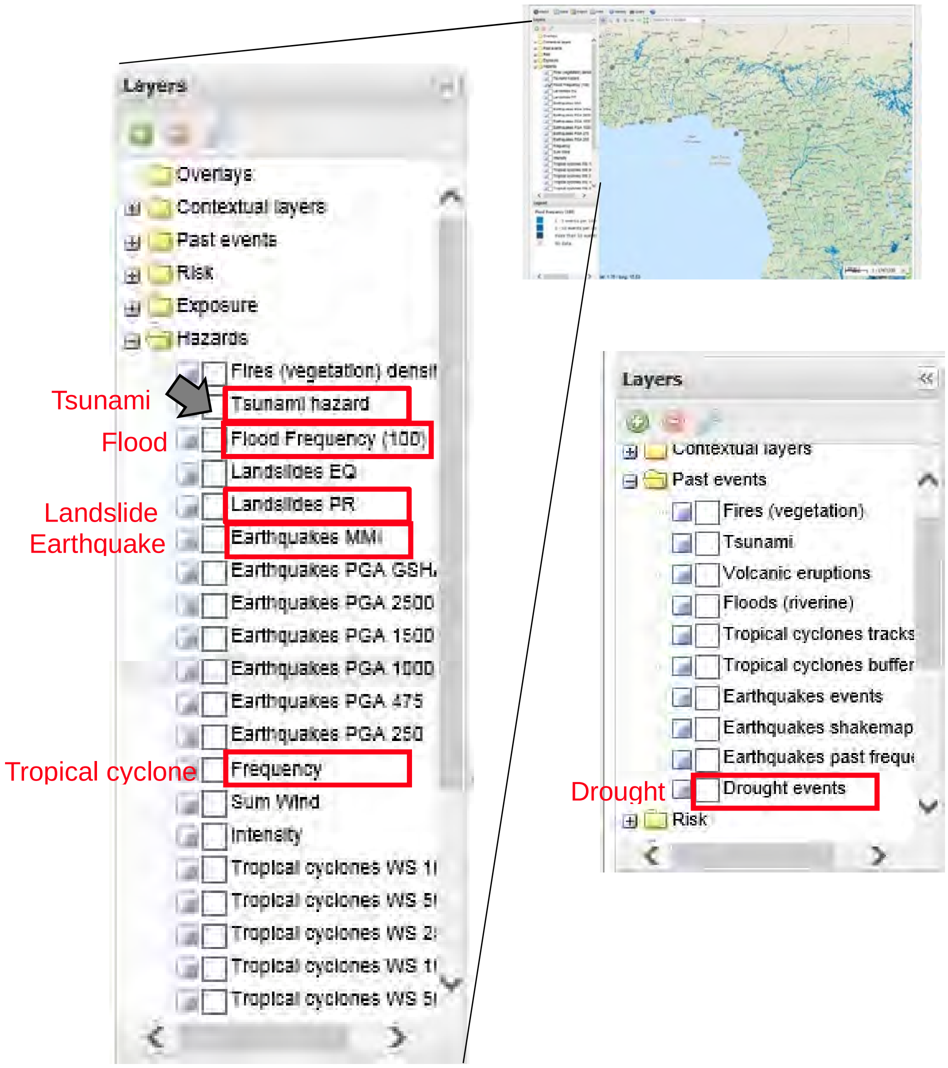
(iv) Display the target area.

Using the mouse or other interface, display the target area in the map.



(v) Identify hazards.

By selecting hazards one after another in the sub-window, identify the hazards in the target area



(2) Identification of Hazards Using Socioeconomic Data and Applications Center

(i) Open the following website in an Internet browser.

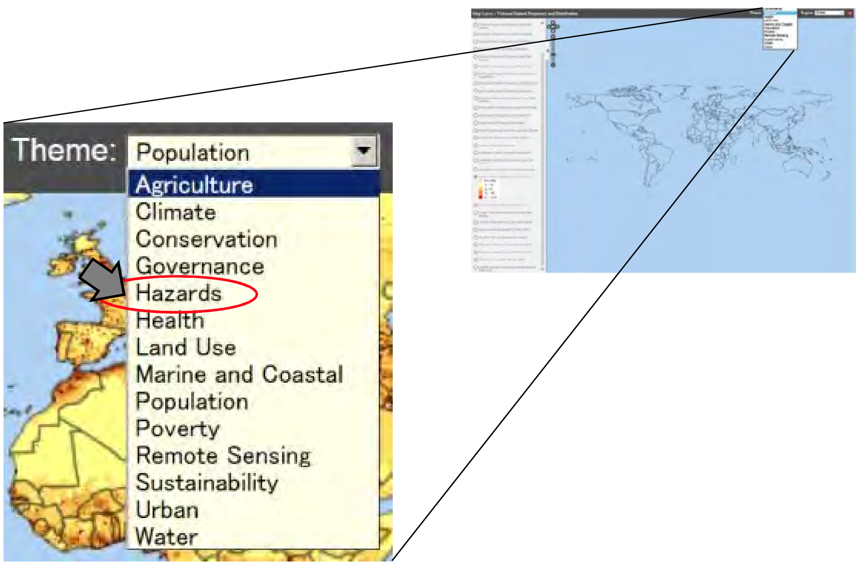
Home: http://sedac.ciesin.columbia.edu/

Data view page: http://sedac.ciesin.columbia.edu/maps/client

(ii) Move to Map Viewer page

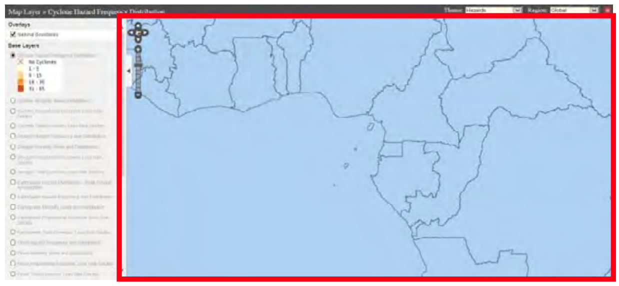
Select "Map Viewer" from the map icons on the top page.

(iii) Select Hazards in Theme



(iv) Display the target area

Using the mouth or other interface, display the target area

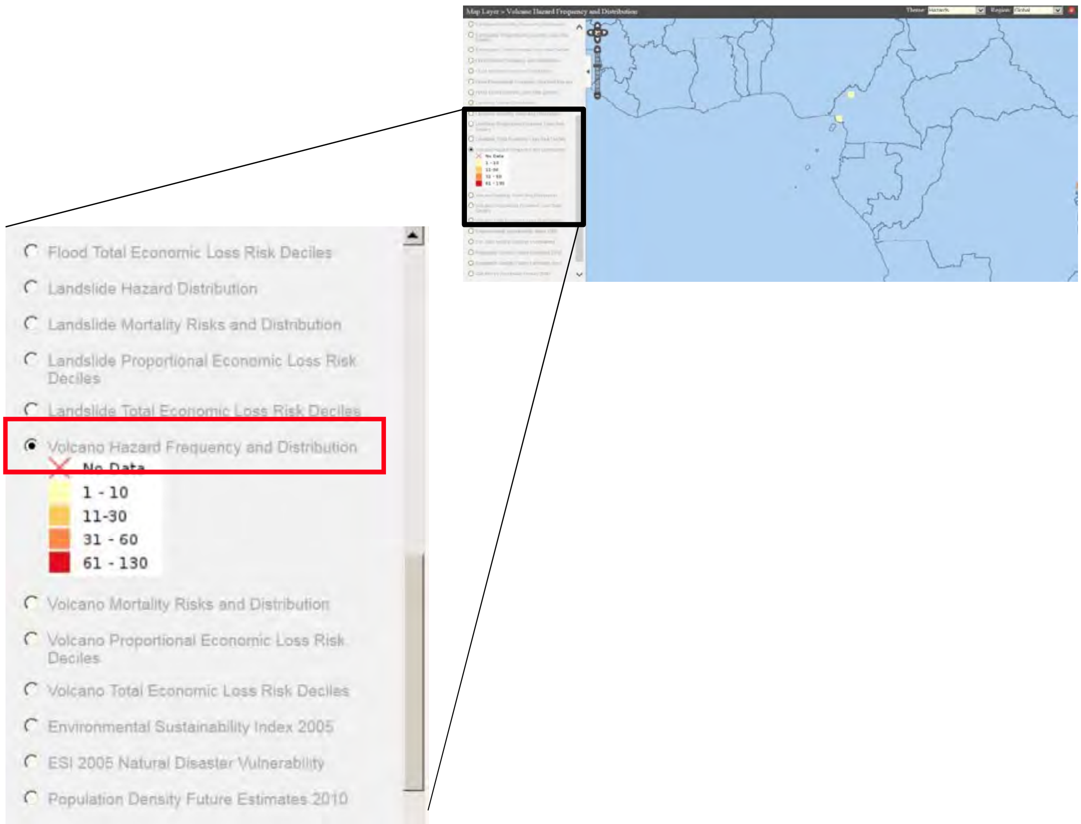


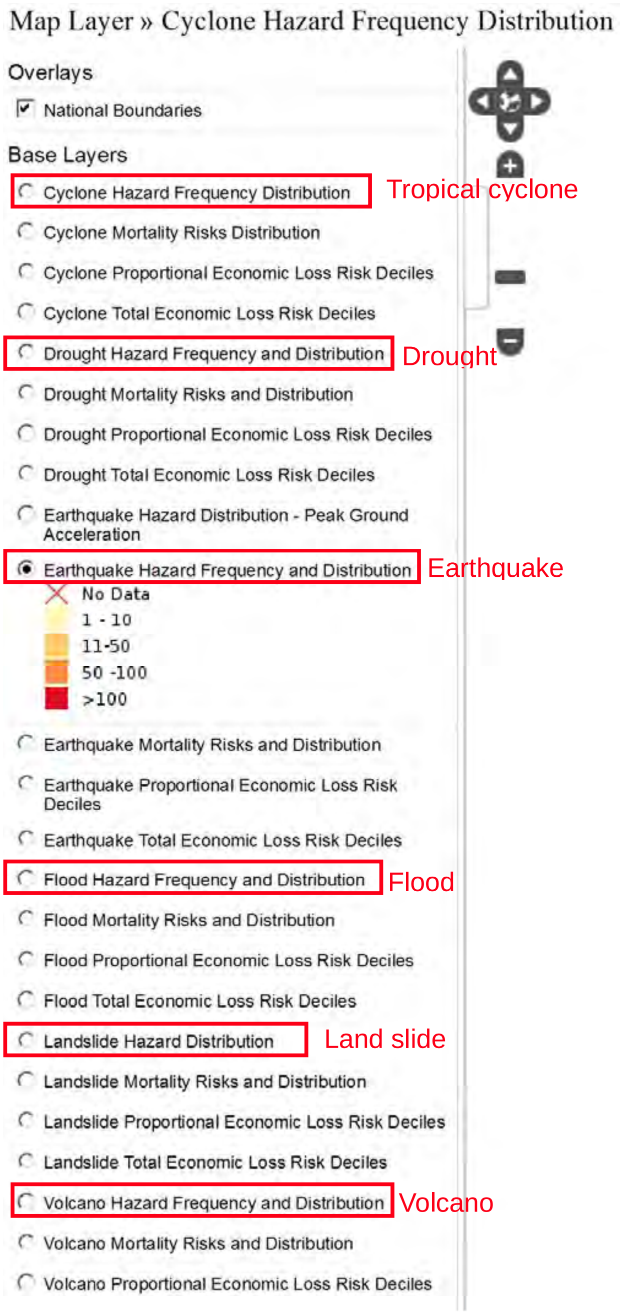
(v) Identification hazards

By selecting hazards one after another in the sub-window, confirm the hazards in the target area.

The example here shows a volcano. To view the data for a volcano, select Volcanic Hazard Frequency and Distribution.

For other disasters, see the sub-window layout shown on the next page.





(3) **Identification of Hazards Using NOAA National Geophysical Data Center**

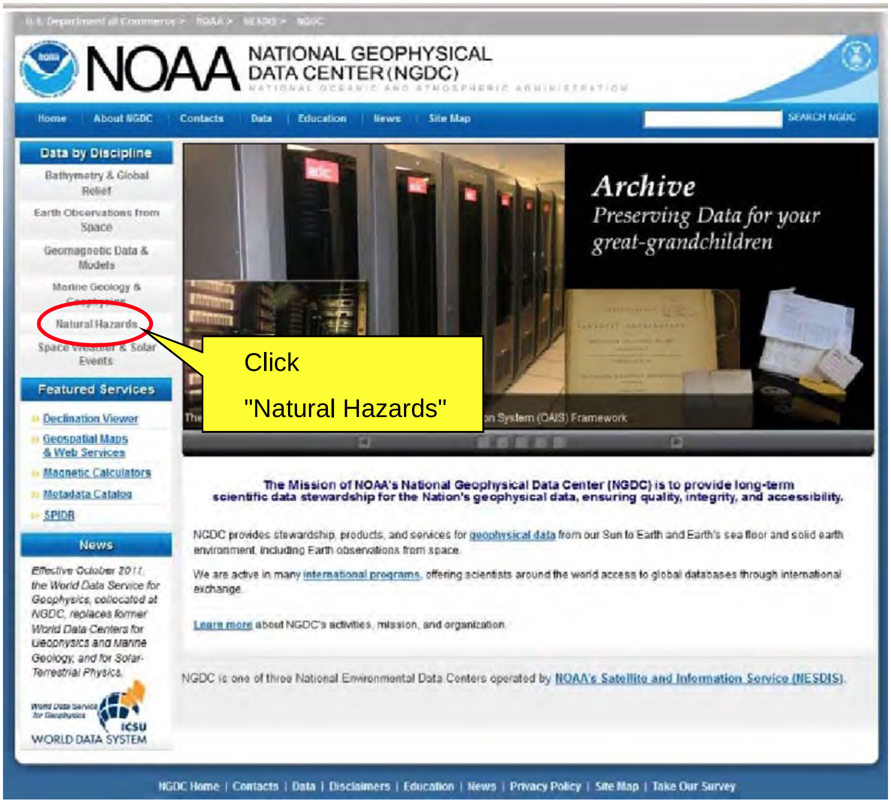
When SEDAC is used as the primary database for disaster information, the data for tsunamis should be obtained from NOAA National Geophysical Data Center (NGDC) in the U.S., because SEDAC does not contain the data for tsunamis.

The following shows how to view hazard data in NGDC.

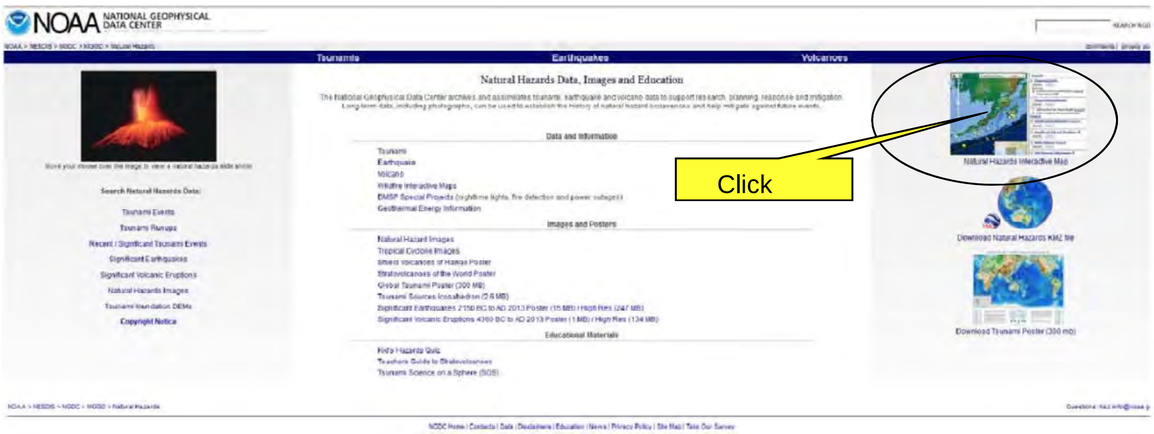
(i) Open the following website in an Internet browser.

Home: http://www.ngdc.noaa.gov/

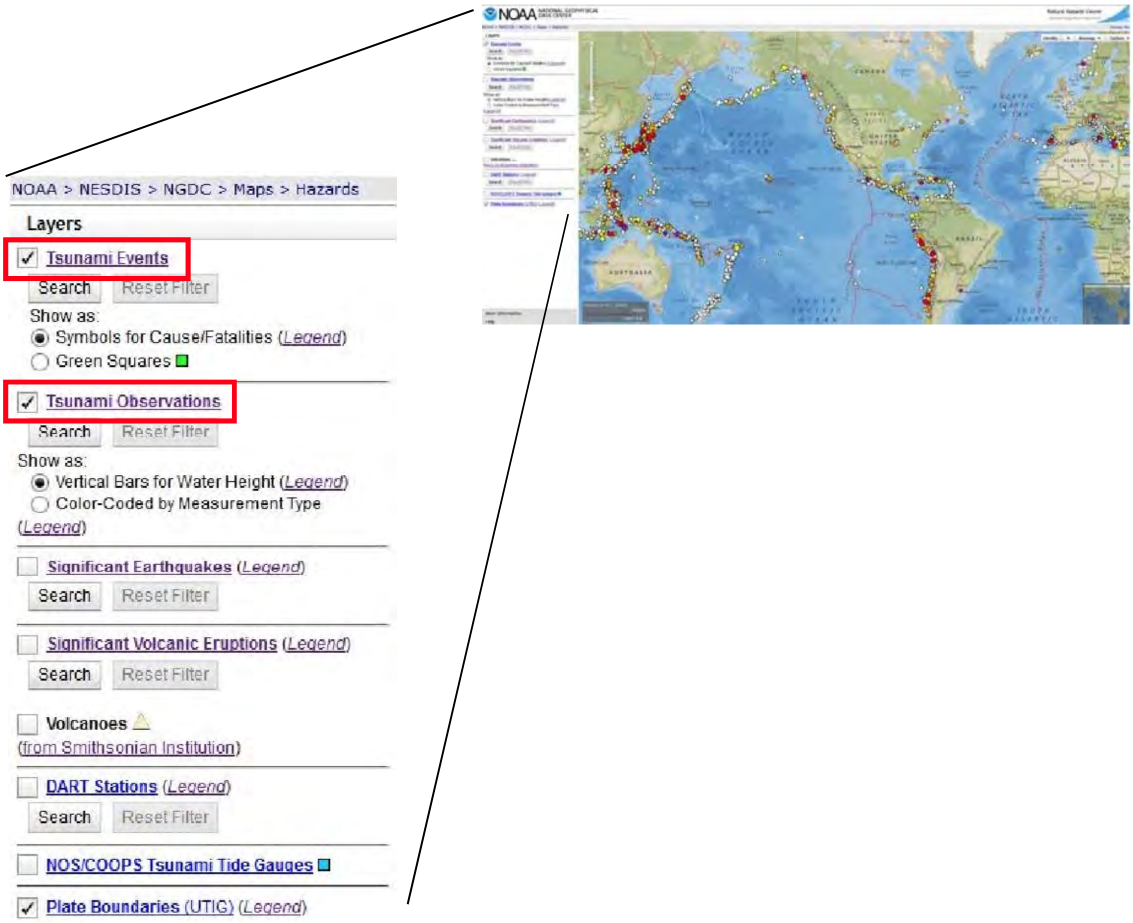
Tsunami: http://maps.ngdc.noaa.gov/viewers/hazards/?layers=0

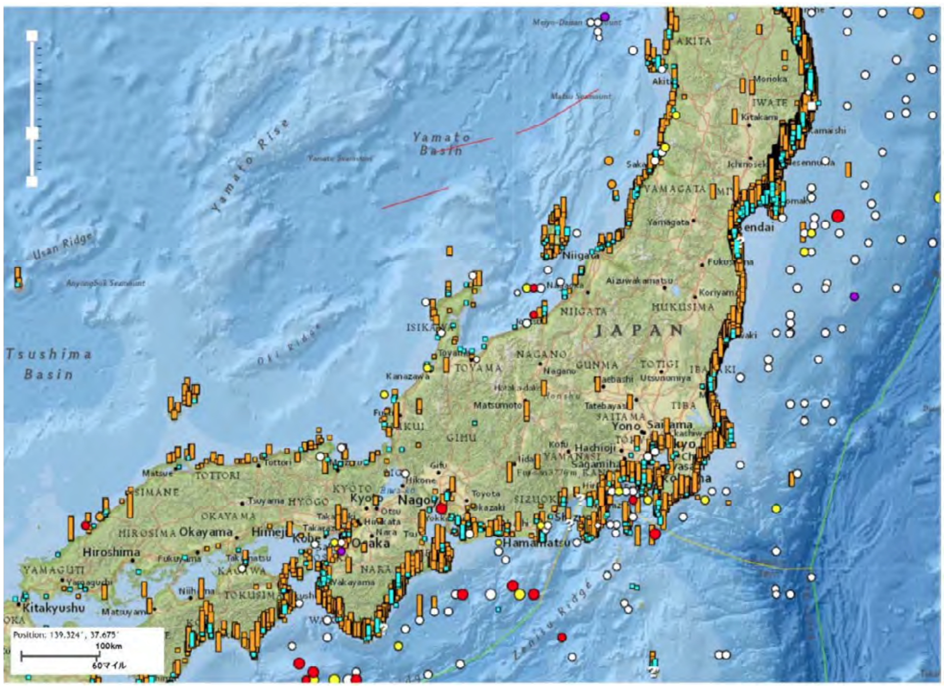


(ii) Open "Natural Hazard Interactive Map."



(iii) Display the map with checks on both Tsunami Events and Tsunami Observations and identify the tsunami hazards in the target area.



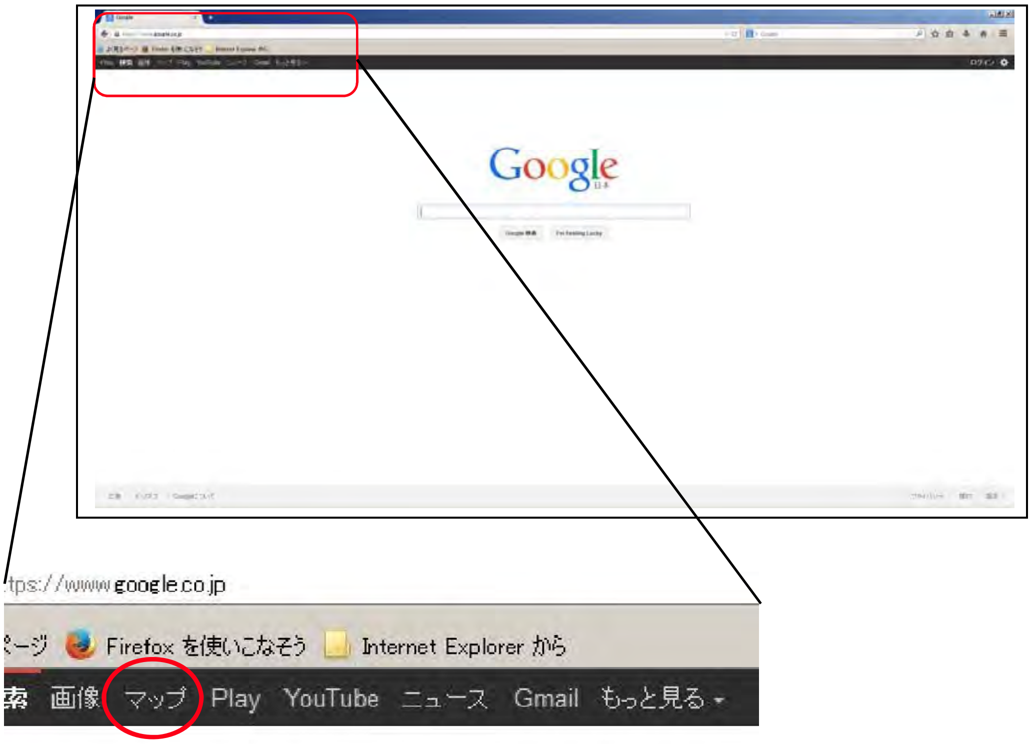


(iv) Confirmation of Topography

Using Google Maps, confirm the topography of the target area according to the entries in the screening sheet. Open the Google website and click Map to open Google Maps. The following shows how confirm the target area and topography, taking an example of an agricultural project[19] in India.

The target area is 5 districts in Himachal Pradesh State in the northern part of India.

(i) Open Google Maps in an Internet browser: https://www.google.co.jp//maps



(Source: "Google Maps")

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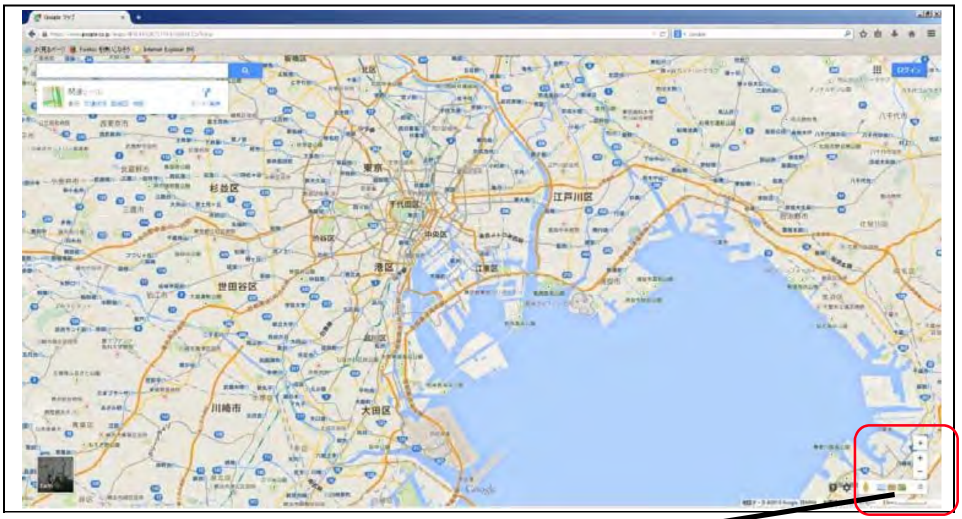
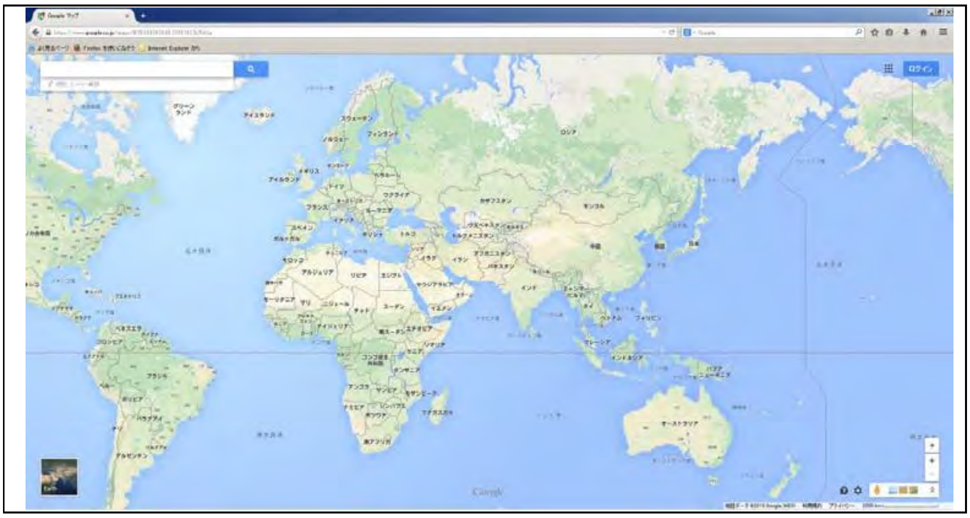
(ii) Zoom out the map to show a wider area.



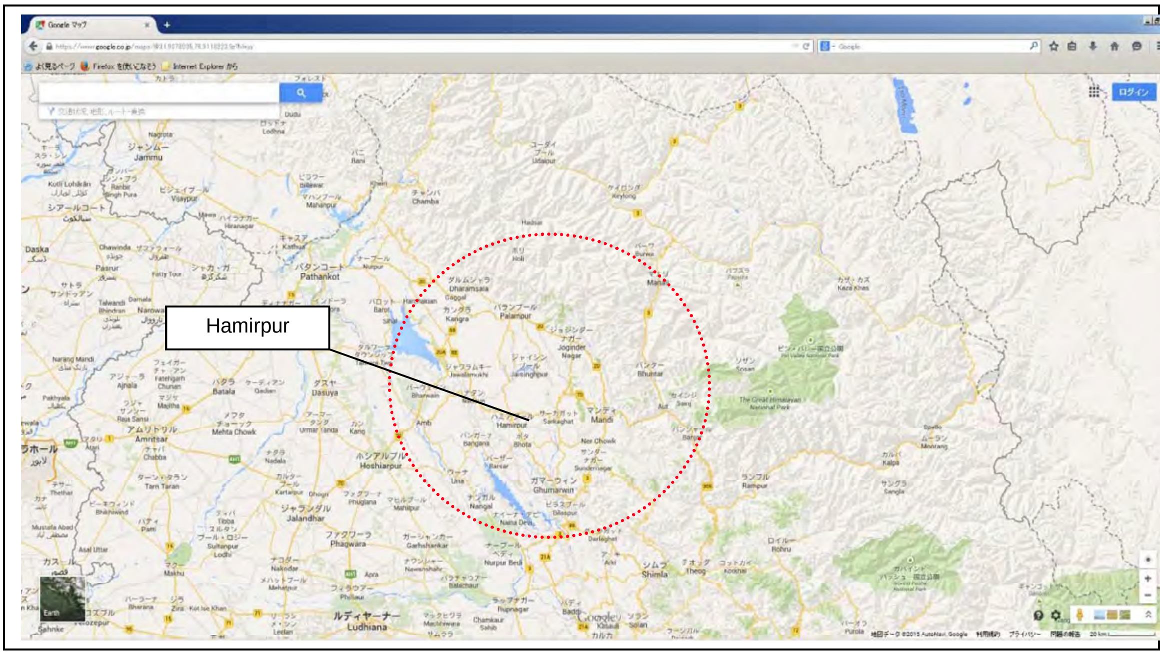
The map can be zoomed in and out using the mouse wheel. Turning the wheel away from you enlarges the map, turning it toward you shrinks the map.

(Source: "Google Maps")



(Source: "Google Maps")

(iii) By moving the mouse while the left button is pressed and also using the zoom in/out function, find the place you want to see.

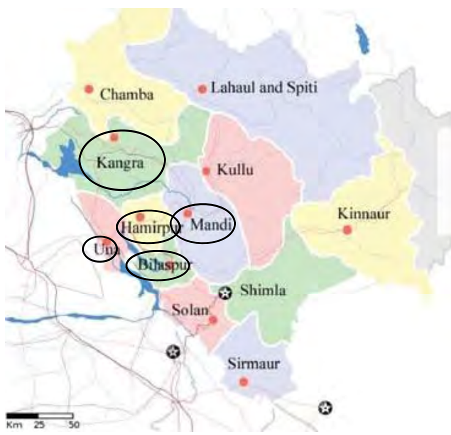


(Source: "Google Maps")

(iv) Confirm the borders of states and districts.

If it is difficult to discern state and district borders, it is advisable to confirm their general locations using an atlas, Wikipedia, and other sources.

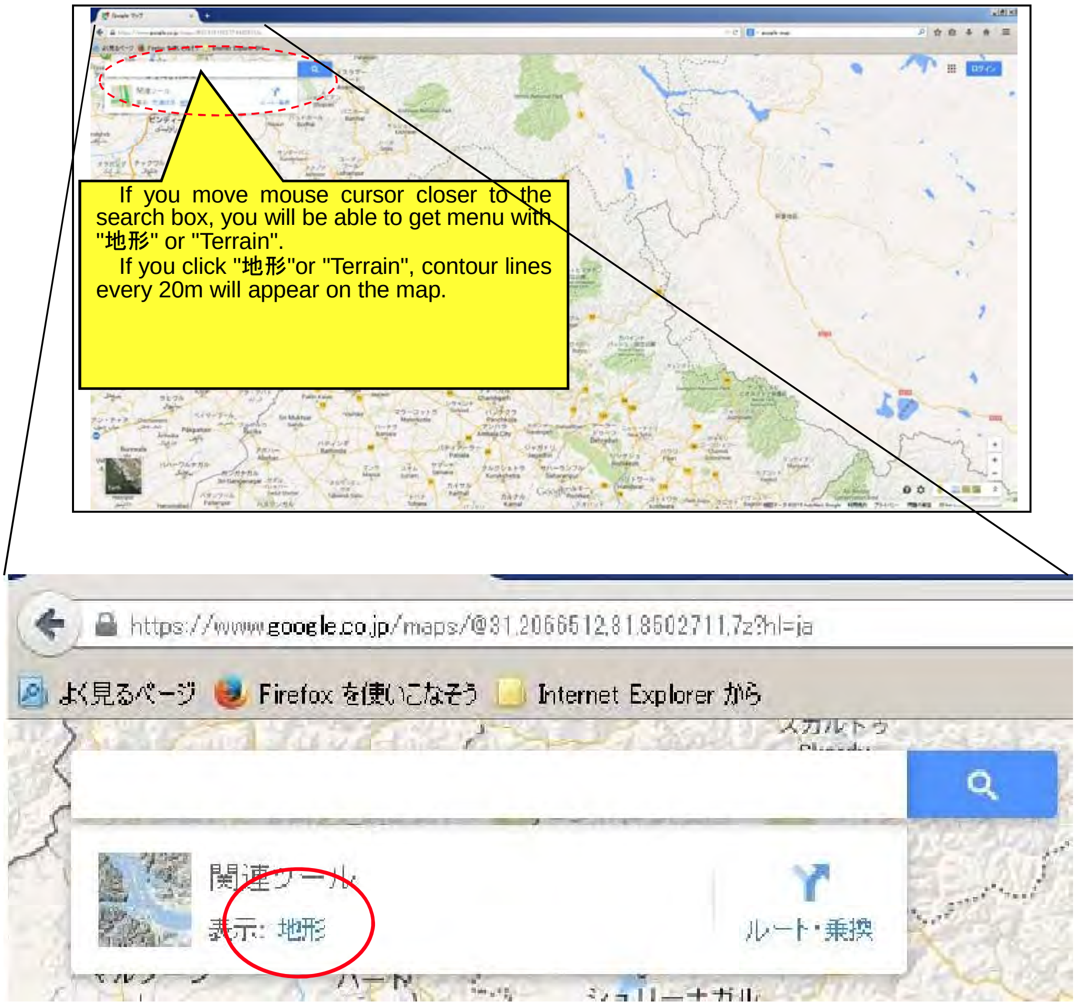
Confirm the location of the target state, and confirm the locations of the target districts.

Location of a given state	Location of given prefectures
	

(Source: "Wikipedia")

(v) Confirm elevation data.

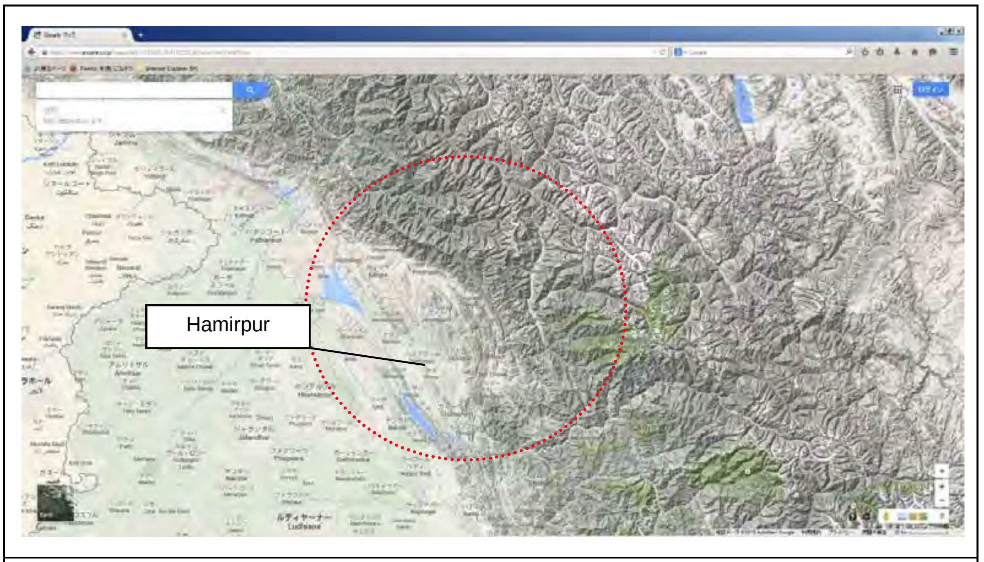
Elevation data are needed for the examination of storm surges and tsunamis. To view elevation, click on “Terrain” in the small window labeled “Getting around.” Then, adjust zoom in/out so that contours are clearly visible.

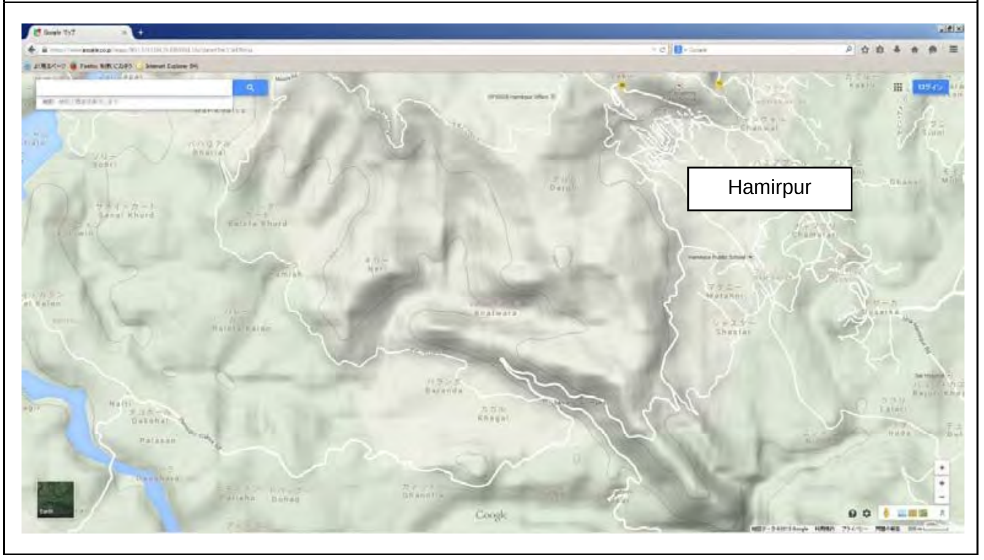


(Source: "Google Maps")

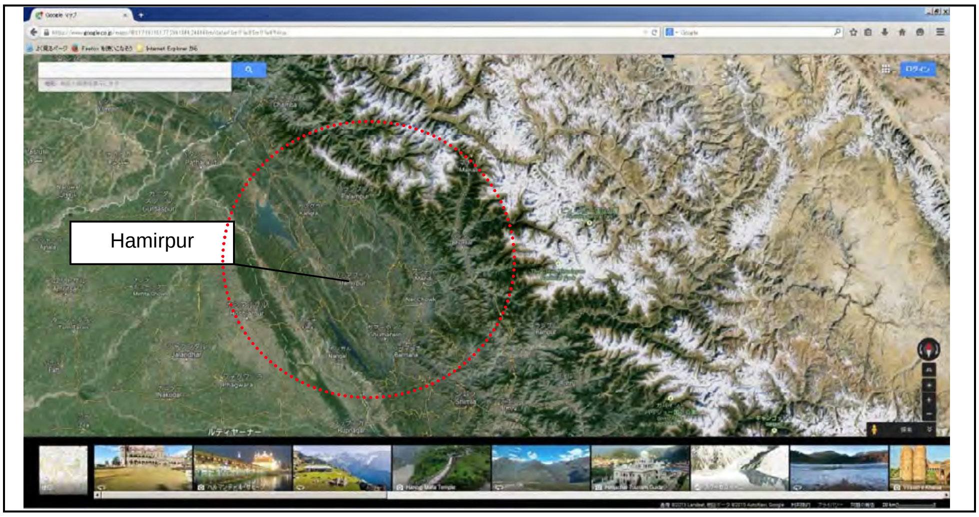
When the cursor is moved over the small window, the menu including “Terrain” appears. When “Terrain” is clicked, 20-m pitch contours are displayed.

Topography is displayed when “Terrain” is clicked and contours are shown when the map is zoomed in. Some adjustment is needed, because contours become invisible when the map is zoomed in too much.



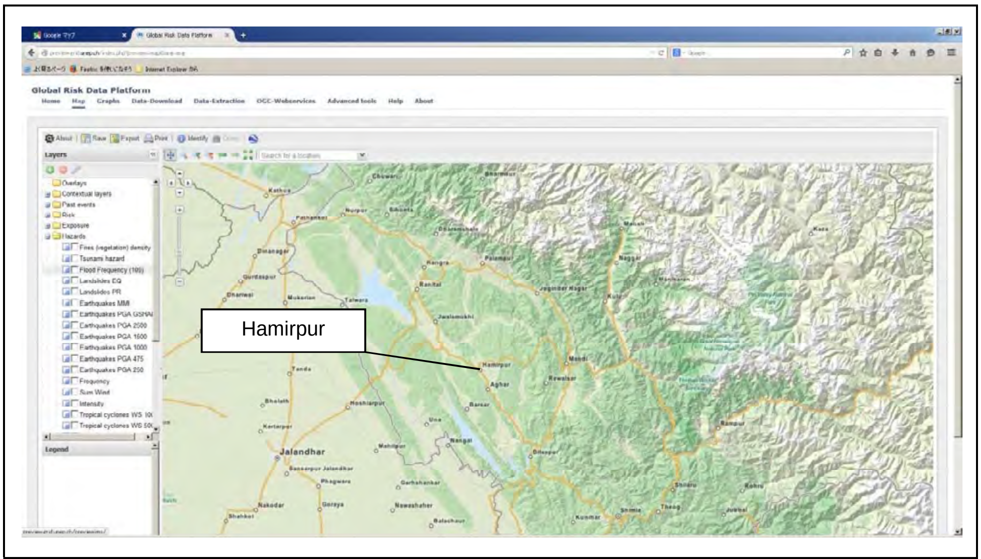


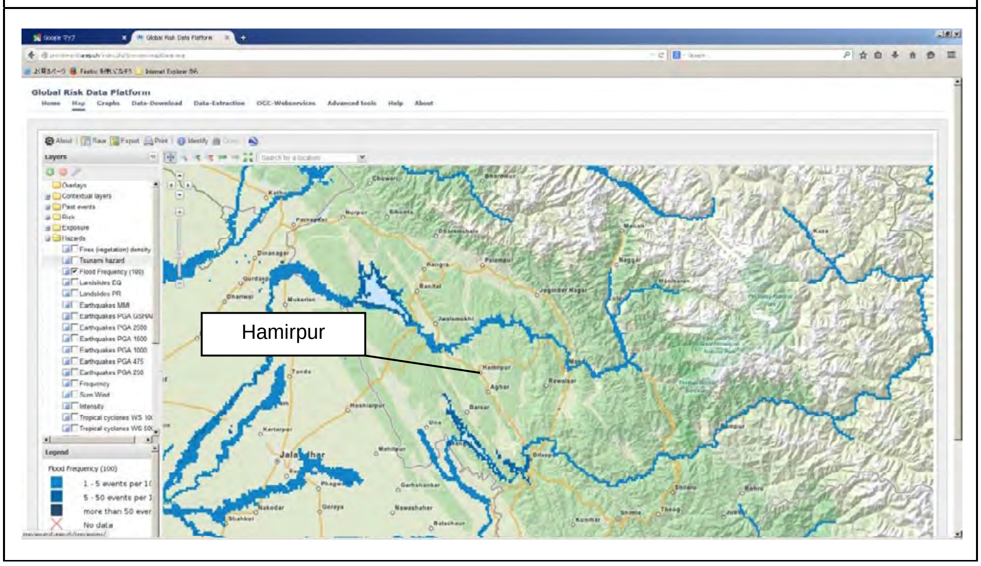
(Source: "Google Maps")



Source: “Google Maps”

(vi) After locations are confirmed, use GRDP, SEDAC, etc. to confirm hazards.





(Source: “Global Risk Data Platform”)

4.2.3. Examples of Screening

(1) Example 1. Preliminary Study for the Project for Improvement of Educational Facility in Madriz and Nueva Segovia Departments

The following shows an example of screening conducted for the Preliminary Study for the Project for Improvement of Educational Facility in Madriz and Nueva Segovia Departments in Nicaragua.

This project was a preliminary study for grant-aid cooperation in the educational sector, which aimed to construct 148 classrooms at 50 sites in Madriz and Nueva Segovia Departments.

Because the project area was located in mountainous terrains, it was necessary to consider disaster prevention and mitigation. The study team therefore included the members in charge of disaster management, covering “river survey/flood management and landslide management,” “landslide management,” and “anti-seismic measures,” who usually do not participate in the study for the project concerning educational facilities. The types of disasters considered in this project were “flood,” “landslide,” and “earthquake.”

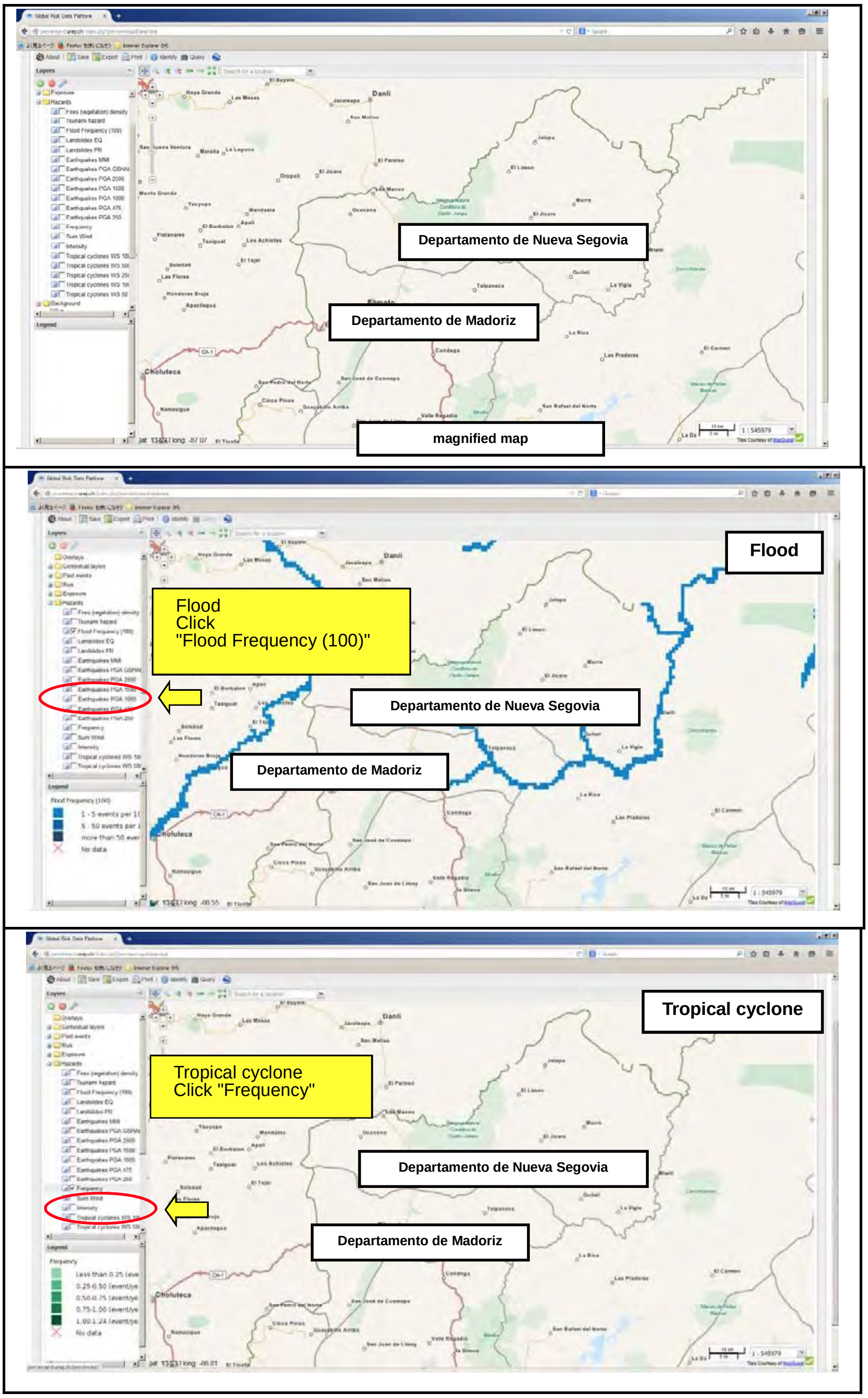
(i) Confirmation of Locations

Locations are confirmed directly in GRDP. Although GRDP displays department borders, it does not show the names of departments. If the locations of the two departments are unknown, they must be confirmed in advance using other material.

Locations of *Departamento de Madoriz* and *Departamento de Nueva Segovia*

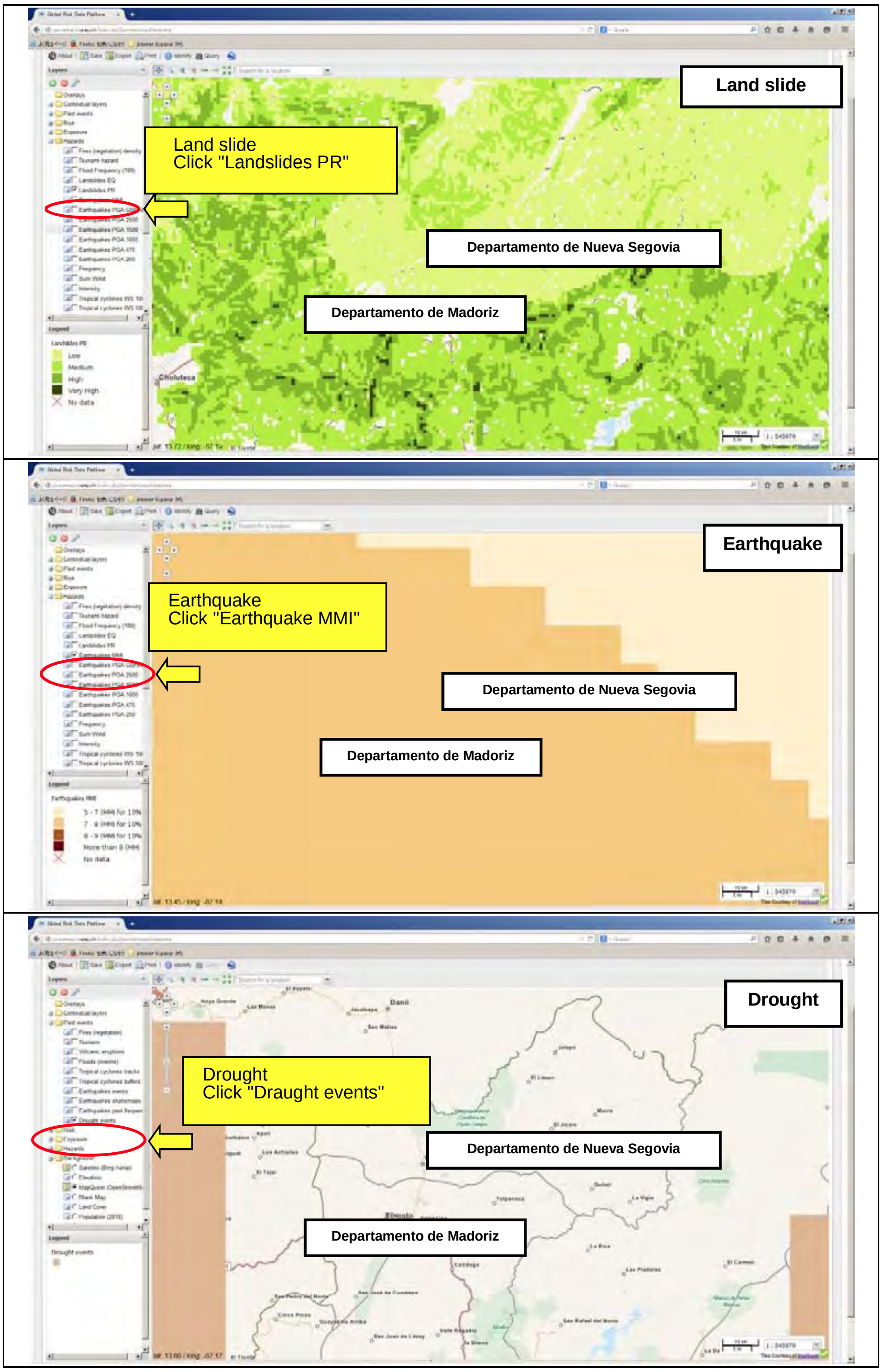
(Source: "Global Risk Data Platform")

(ii)Identification of hazards



Identification of hazards（middle : flood lower :tropic cyclone）

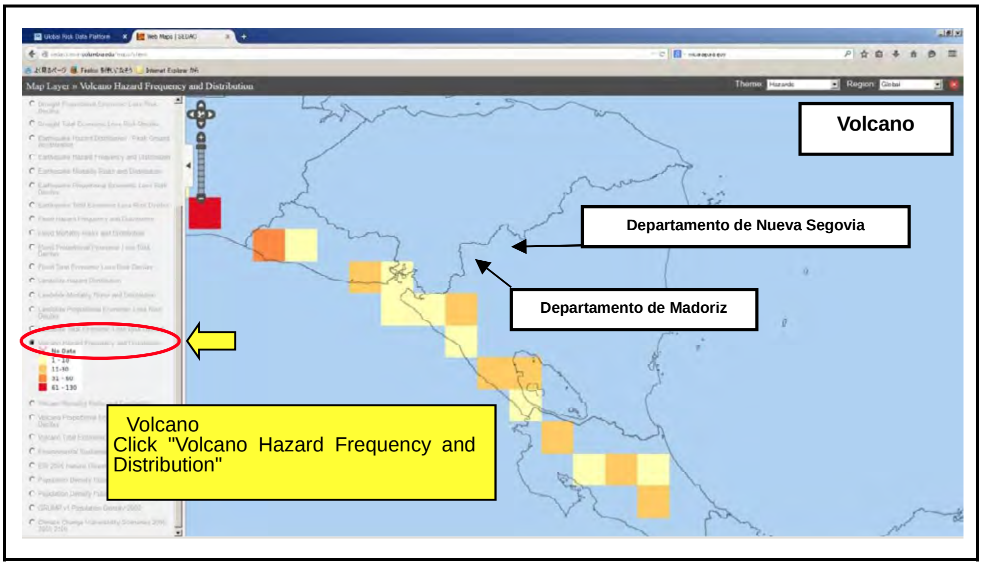
(Source: “Global Risk Data Platform”)



Identification of hazards（upper : landslide middle : earthquake lower : drought)

(Source: "Global Risk Data Platform")

(Note) Drought is examined for Agriculture project only, actually in this case, i.e. education project, identification of drought hazard is not necessary.

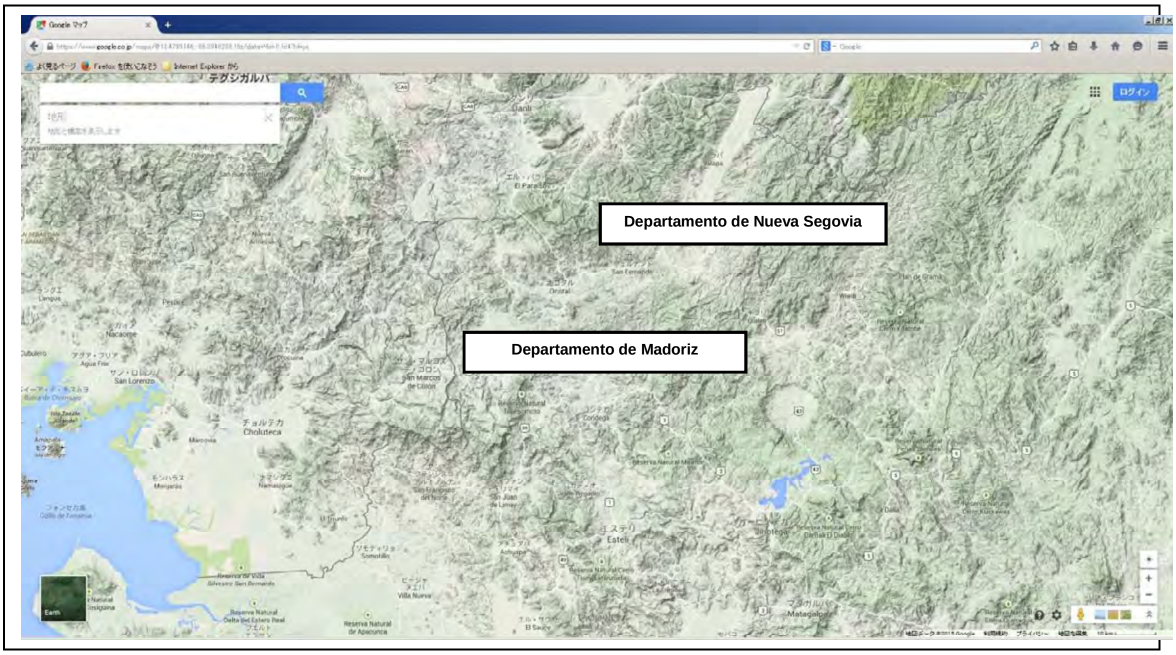


Identification of volcano hazard

(Source: "NASA Socioeconomic Data and Applications Center" website)

(iii) Confirmation of Topography

The terrains are mostly mountainous and hilly. Also rivers are recognized. The sites are not in coastal areas.



(Source: "Google Maps")

As the result of screening, the need for forethought to DRR for each type of disaster was judged as listed below. “Flood,” “landslide,” and “earthquake” were identified, similarly to the types of disasters considered in the project. The screening sheet is shown on the next page.

- **Flood: “Forethought to DRR needed,”** because hazards are expected along rivers.
- Typhoon: “Forethought to DRR not needed,” because no hazards are expected.
- Storm surge: “Forethought to DRR not needed,” because the sites are not in coastal areas.
- **Landslide: “Forethought to DRR needed,”** because hazards are expected in most sites except for those in lowlands.
- **Earthquake: “Forethought to DRR needed,”** because hazards are expected to occur.
- Tsunami: “Forethought to DRR not needed,” because the sites are not in coastal areas.
- Volcano: “Forethought to DRR needed,” because hazards are expected to occur.
- Drought: “Forethought to DRR needed,” because the project is not an agricultural project.

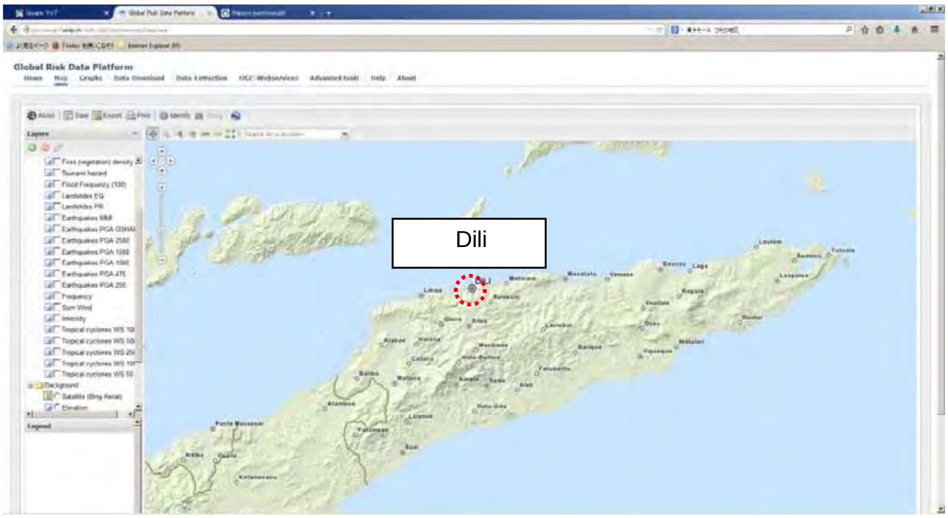
(2) **Example 2. Preliminary Study for the Project for the Construction of Upriver Comoro Bridge in Timor-Leste**

The following shows an example of screening conducted for the Preliminary Study for the Project for the Construction of Upriver Comoro Bridge in Timor-Leste.

This project was a preliminary study for grant-aid cooperation concerning the construction of a bridge and access roads. The bridge was planned to be located in a coastal area and cross the river near the mouth of the river.

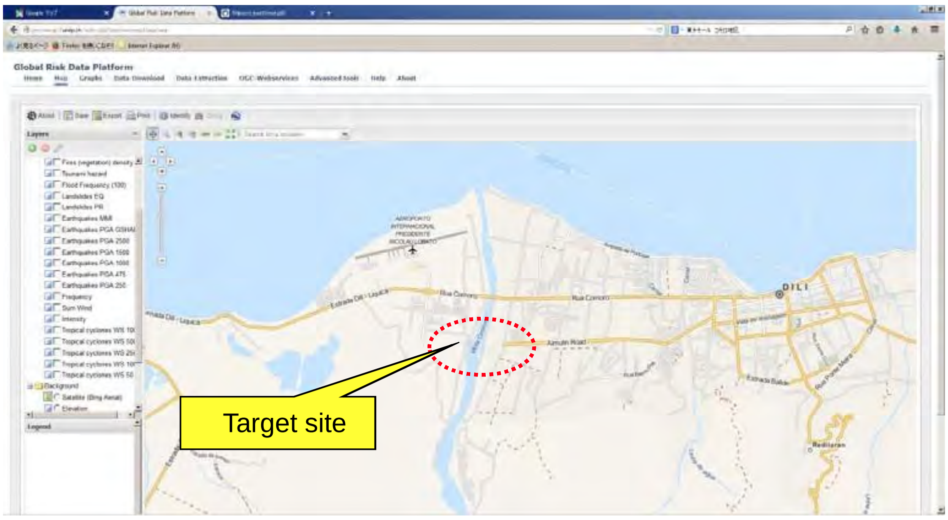
(i) Identification of the Target Site

Because it is known that the site in within Dili City in Timor-Leste, its location can be identified directly in GRDP.



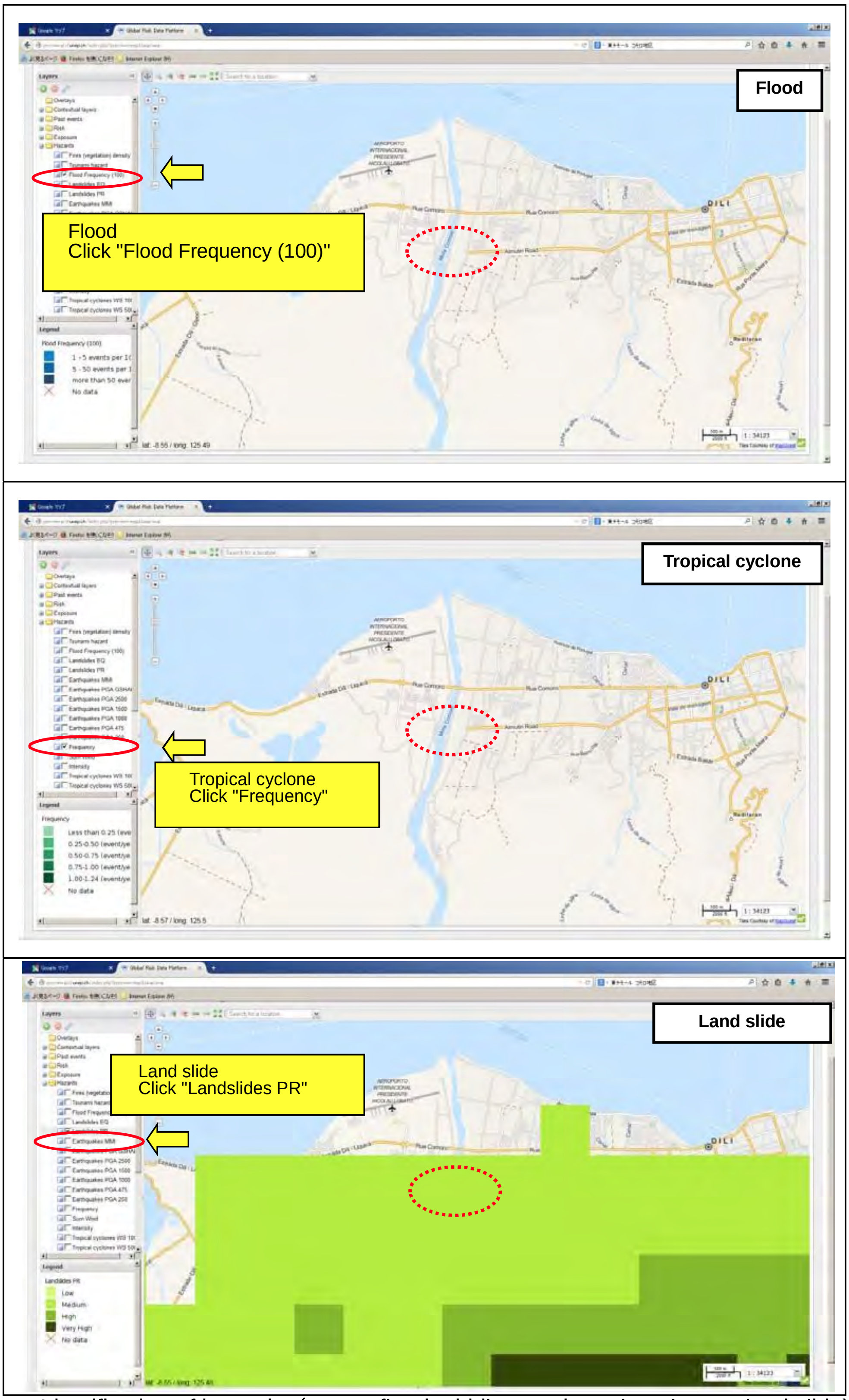
(Source: "Global Risk Data Platform")

Enlarged view of the map

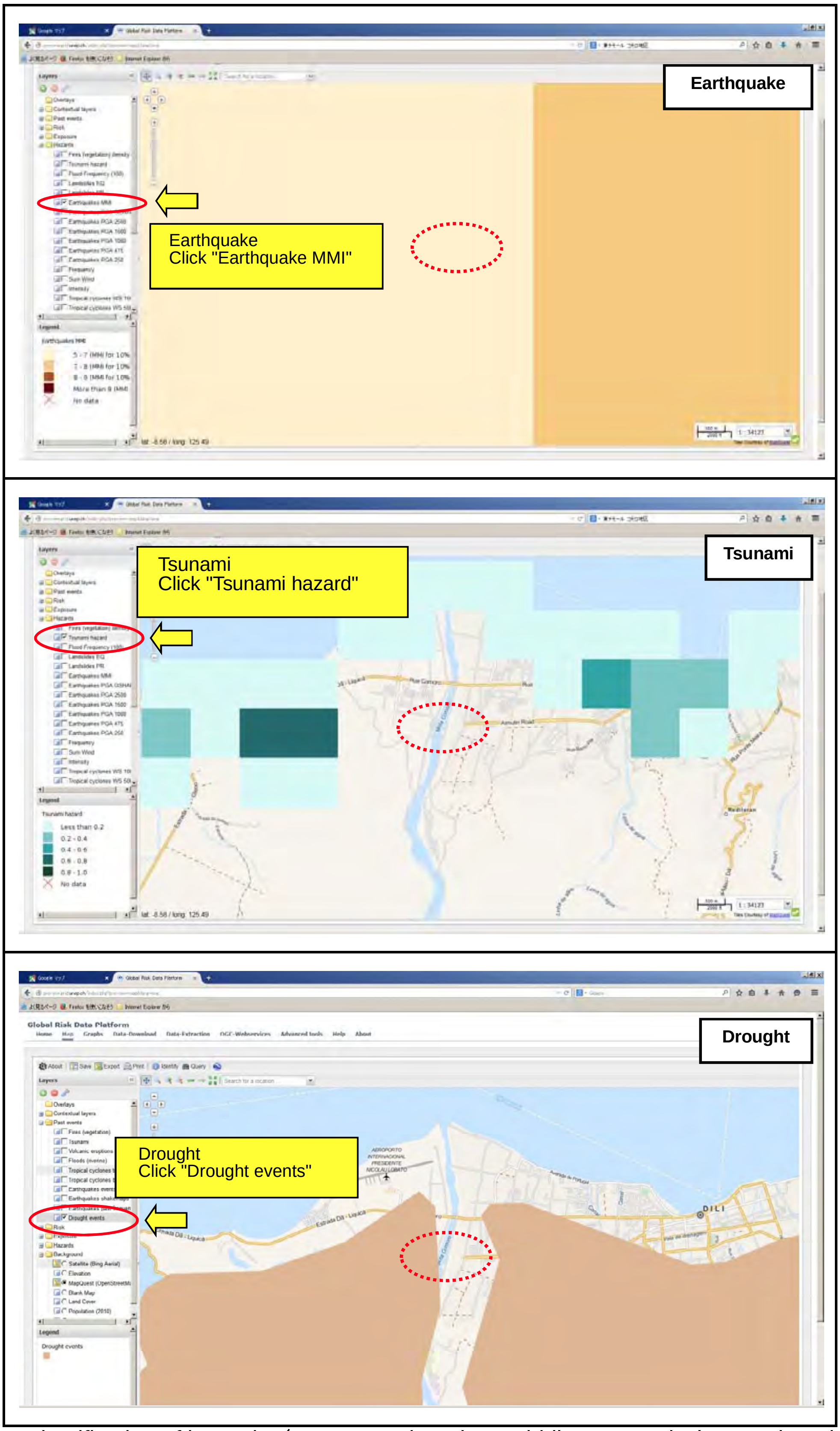


(Source: "Global Risk Data Platform")

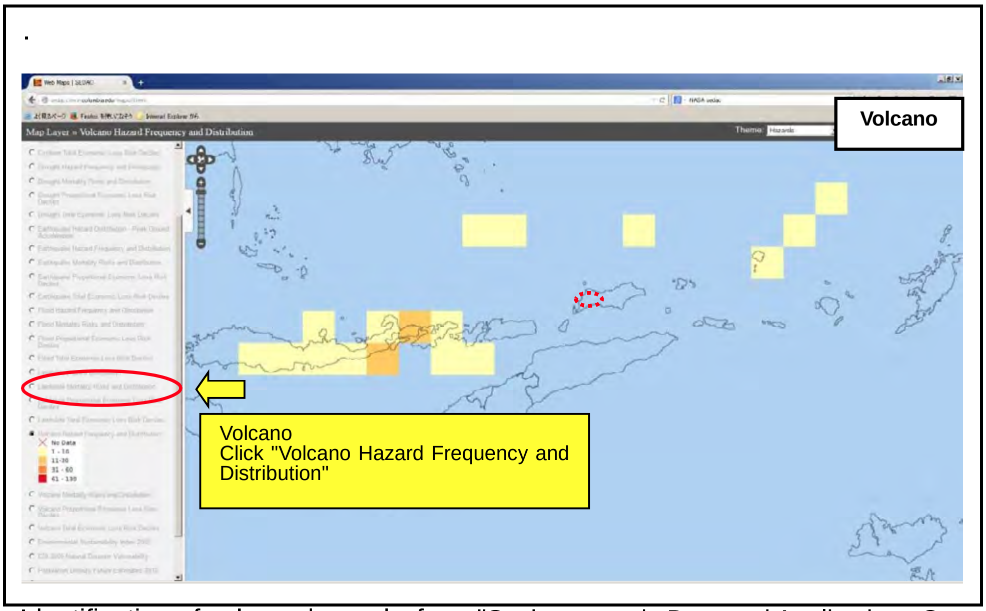
(ii) Identification of hazards



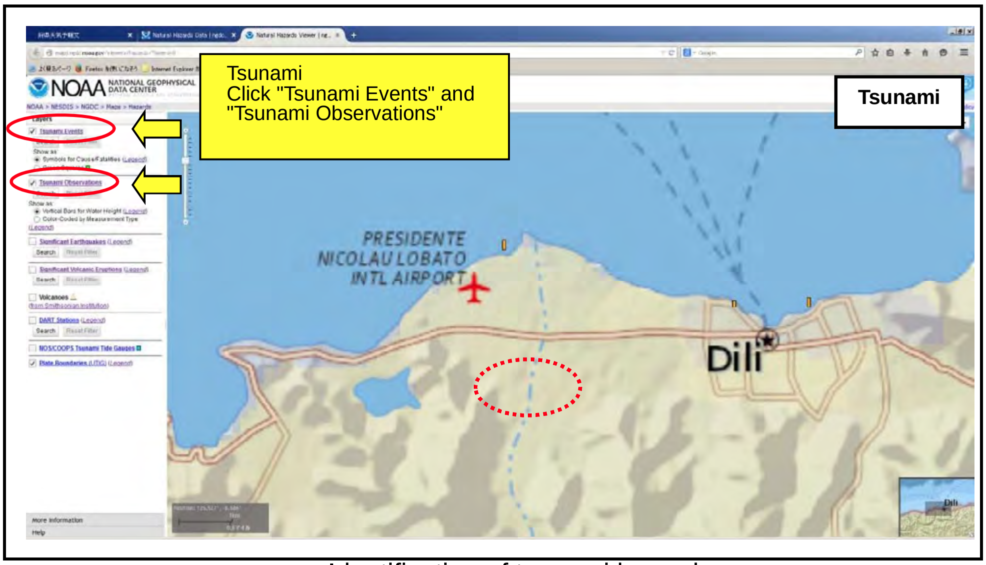
Identification of hazards（upper :flood middle : tropic cyclone lower : land slide)
(Source: "Global Risk Data Platform")



Identification of hazards（upper : earthquake　middle : tsunami　lower : drought
(Source: "Global Risk Data Platform")　(Note) Because drought is considered only for agricultural projects, confirmation concerning drought is not necessary in this project.



Identification of volcano hazard from "Socioeconomic Data and Applications Center"



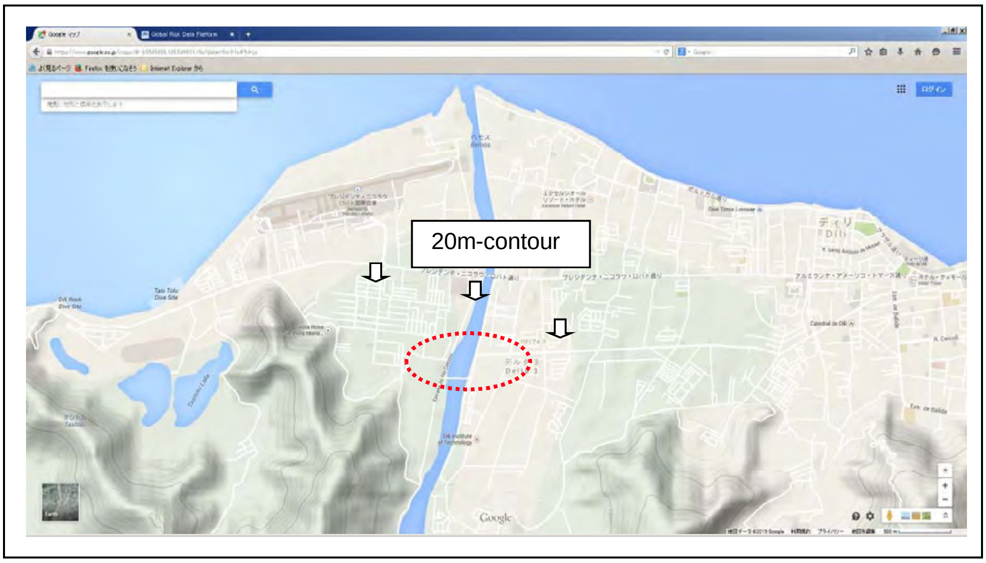
Identification of tsunami hazard

(Source: "NOAA National Geophysical Data Center")

(Note) Although this case is shown as an example, this identification is not necessary if an access to GRDP is available.

(iii) Confirmation of Topography

Topography is confirmed to examine the hazards of floods (rivers), landslides (mountainous and hilly areas), storm surges (10 m elevation), and tsunamis (35 m elevation).



Although not visible in this Figure, a 20 m contour is displayed along white arrows.

(source: "Google Maps")

(Note)The symbol "⇩" shows the described 20 m-contour on the map.

As the result of screening, the need for forethought to DRR for each type of disaster was judged as listed below. “Flood,” “landslide,” and “earthquake” were identified as requiring forethought to DRR. The result concerning tsunami varied depending on the database used. In such a case, the judgment should follow the result of screening as a rule. It is desirable to perform screening using GRDP, as time allows. The screening sheet is shown on the next page.

・**Flood: “Forethought to DRR needed,”** because the target site is located along a river, although no hazards are confirmed.

・Typhoon: “Forethought to DRR not needed,” because no hazards are expected.

・Storm surge: “Forethought to DRR not needed,” because the site is above 20 m elevation, although it is in a coastal area.

・**Landslide: “Forethought to DRR needed,”** because hazards are expected to occur.

・**Earthquake: “Forethought to DRR needed,”** because hazards are expected to occur.

・**Tsunami:** <u>“Forethought to DRR not needed,”</u> because hazards are not confirmed, although the site is in a coastal area below 35 m elevation. (GRDP)

<u>**“Forethought to DRR needed,”**</u> because the site is located in a coastal area below 35 m elevation and tsunami data are confirmed. (NGDC)

・Volcano: “Forethought to DRR needed,” because hazards are expected to occur.

・Drought: “Forethought to DRR needed,” because the project is not an agricultural project.

【References】

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- UNISDR (2011) "Global Assessment Report on Disaster Risk Reduction" Geneva, Switzerland: United Nations International Strategy for Disaster Reduction.
- U.S. Geological Survey (2014a) "The Modified Mercalli Intensity Scale"
- http://earthquake.usgs.gov/learn/topics/mercalli.php
- U.S. Geological Survey (2014b) "VHP Photo Glossary: VEI"
  http://volcanoes.usgs.gov/images/pglossary/vei.php

4.3. Scoping Methods

4.3.1. Scoping List

A scoping list is prepared when the result of screening is judged to indicate the necessity of forethought to DRR. It contains the description of study items concerning forethought to DRR that should be included in the Terms of Reference (ToR) of consultants commissioned for study.

Not all items shown in the list need to be described in the ToR; items may be included or omitted as appropriate.

4.3.2. Types of Scoping Lists

Scoping lists have been designed in three general patterns A, B, and C.

- For preparing ToR for detailed planning study concerning technical cooperation → Scoping A & A'
- For preparing ToR for preliminary study (pilot study) concerning grant aid cooperation → Scoping B
- For preparing ToR for preparatory survey concerning grant aid cooperation → Scoping C

A, A', and B are intended for describing study outline, because they are used before the main study (the main study for a technical project or a preparatory survey), and detailed examination of forethought to DRR would be conducted in the main study that would follow. Furthermore, it is considered unnecessary to use different forms for different sectors. The form shows the "Items" and "Purpose" of the study.

A' is used for a pilot project involving construction and a project such as the development of a master plan for city planning.

In the case of C, different lists are used for different sectors, because more detailed study is needed. The form shows the "Items" and "Example of Entry*" for the study. "Additional Matters*" has also been added to study items.

* "Example of Entry" is the <u>example</u> to be used when entering description in the ToR. It can be used as it is or arranged appropriately.

"Additional Matters" are the study items that should preferably be added to standard study items (items other than Additional Matters). This is mainly used for describing non-structural measures.

4.3.3. Disaster Types

A scoping list has been designed for each of the 8 types of disaster shown below.

Table 4-12: Categorized Hazards on Scoping List

Hazard	Note
Flood	Including flood caused by tropical cyclone.
Tropical Cyclone	Tropical cyclone is called several names by districts, which are cyclone in the Indian ocean, hurricane in the Atlantic ocean and typhoon in the Pacific ocean. Storm (heavy rain and very strong wind) is covered. Sometimes tropical cyclone cause flood, storm surge and landslide, but they should be seen in each hazard's Scoping List.
Storm Surge	Most of storm surges are caused by tropical cyclone.
Landslide	Landslide is including rock fall, mass movement, avalanche in rapid slope, boulder flow(flash flood), mud flow, and volcanic mud flow.
Earthquake	The history of occurrence of earthquake might be ones of tsunami or landslide. Tsunami should be seen in "Tsunami" 's Scoping List.
Tsunami	Cause of tsunami is not only earthquake but also underwater eruption or large-scale landslide.
Volcano	Volcano eruption.
Drought	Drought is applied to agriculture projects only.

Glossary

Non-structural Measures

These are disaster management measures other than those involving construction of structures to prevent disasters.

These include development of disaster management plans, preparation of hazard maps, evacuation planning for a disaster, evacuation drills, disaster management education, alarm and alarm communication systems, data monitoring systems (observation of weather, oceanic conditions, landslide, etc.) and many other actions, some of which are easily implemented while others require much effort.

Simple Vulnerability Assessment

This assessment is conducted to find out what types of natural disasters are likely to affect the proposed project site.

Table 4-13: Contents of Scoping Lists

Type	Coverage			
Scoping List A	Technical cooperation projects	All sectors	Project without construction work	Detailed Planning Study for technical cooperation projects
Scoping List A'	Technical cooperation projects	All sectors	Project with construction work	Detailed Planning Study for project with pilot project or developing master plan
Scoping List B	Grant aid	All sectors	Preliminary study	Study prior to preparation survey
Scoping List C	Grant aid	Urban / regional development Private sector development	Industrial park	Mainly for Preparatory Survey for grant aid ※Also survey including designing for Yen Loan project
		Transportation	Air port	
			Harbor and port	
			Road	
			Rail way	
			Bridge	
		Natural resource and energy	Electric power transmission	
			Electric power plant	
		Education	School	
		Health	Hospital	
		Environment management	Waste water treatment plant	
			Sewer pipe network	
			Waste disposal facility	
		Water resources / DRR	Water purification plant	
			Water pipe network	
		Agricultural / rural development	Irrigation	
		Fisheries	Fisheries facility	
		Natural resource and energy Water resources / Disaster management Agricultural / rural development	Dam Reservoir	

4.4. Natural Disaster Risk Information Source

For screening for disaster management consideration, use of databases is essential for confirming disaster risks of a project site promptly and easily. The databases should provide the information stably, and since JICA projects are implemented all over the world, the database should provide information for projects all over the world.

Ideal databases should fulfill the following requirements;

- Provide information on flood, tropic cyclone, storm surge, earthquake, tsunami, volcano and drought.
- Run by reliable organizations
- Provide reliable information free of charge
- Provide information through the internet
- Provide information all over the world
- Provide information on small grids and can identify the situation of project sites
- Easy to operate
- No need to install any application software

The following are the databases available for the screening. “Global Risk Data Platform” and “Socioeconomic Data and Applications Center” are chosen as the main databases, and “Socioeconomic Data and Applications Center” and “National Geophysical Data Center” are also used as back-up database.

Table 4-14: Information Sources on Natural Disaster Risk

Data Source/Information Availability	Disasters/ Icon to be refereed	Grid scale/Classification/Explanation	Notes
Global Risk Data Platform by UNEP/UNSIDR TOP page： http://preview.grid.unep.ch/ Refer to： http://preview.grid.unep.ch/index.php?preview=map&lang=eng All over the world	Flood (Hazards→ Flood Frequency (100))	Grid: about 1km 3 classifications (1-5 events / 5-50 events / more than 50 events) (based on frequency of flood occurrences in 100years which is calculated from flood distribution modeling using global scale runoff analysis (Herold & Mouton, 2011) and the record of floods occurrences	There are some cases of flood occurrences in the areas where the possibility is categorized as low. The actual situation of the project site should be carefully taken into account.
	Cyclone (Hazards→ Frequency)	Grid: about 2km 5 classifications (less than 0.25 event / 0.25-0.50 event / 0.50-0.75 event / 0.75-1.00 event / 1.00-1.24 events) (based on annual occurrence distribution which is calculated from Saffir-Simpson Hurricane Scale. The scale is based on the tropical cyclones which occurred during 1969-2009 and revised model of Holland (1980).	Even if the hazard of Scale 4 hurricane is relatively small, it does not indicate that there is no risk of hurricane of a smaller Scale. The levels should be considered as a relative value.
	Landslide (Hazards→ Landslides PR)	Grid: about 1km 4 classifications (Low / Medium / High / Very High (based on annual distribution of landslide occurrences mainly in Europe from multivariate analysis using 6 parameters (response variable, slope, geological condition, soil water, vegetation, rainfall, earthquake)	It is preferred to use topographical maps and satellite image additionally to confirm the hazard in detail.
	Earthquake (Hazards→Earthquakes MMI)	Grid: about 10km 4 classifications (5-7 / 7-8 / 8-9 / more than 9) (based on simulation of maximum acceleration speed and amplitude speed. Distance from the epicenter, structure of the earth's crust, lithological condition and soil condition are used as the parameters.)	There is no classification for under level 4. Level 4 is defined that people may feel it when they are inside buildings or sleeping. The actual situation of the project site should also be carefully taken into account.
	Tsunami (Hazards→Tsunami)	Grid: about 1km 5 classifications (less than 0.2 / 0.2-0.4 / 0.4-0.6 / 0.6-0.8 / 0.8-1.0) (based on distribution of occurrences in once in 500 years probability which is calculated from existing Tsunami hazard maps and numerical modeling analysis of some areas.)	Tsunamis caused by landslides, bedrock fall and volcanic eruption are not included. The actual situation of the project site should also be carefully taken into account.
	Drought (Past Events→Drought events)	Grid: about 50km No classification. The data is based on drought occurrences in the past. (based on standardized rainfall index of grid data set of world monthly rainfall)	The actual situation of the project site should also be carefully taken into account.

Data Source/Information Availability	Disasters/ Icon to be refereed	Grid scale/Classification/Explanation	Notes
U.S. Socioeconomic Data and Applications Center by NASA U.S.A TOP page： http://sedac.ciesin.columbia.edu/ Refer to： (Maps/MAP VIEWER page) http://sedac.ciesin.columbia.edu/maps/client All over the world	Flood (Hazards→Flood Hazard Frequency and Distribution)	Grid: about100km 4 classifications(1-2/ 3-5/ 6-11/ 12-25)	There could be cases that disasters were not recorded. The actual situation of the project site should also be carefully taken into account.
	Cyclone (Hazards→Cyclone Hazard Frequency and Distribution)	Grid: about 5km 4 classifications (1-5/ 6-15/16-30/ 31-65)	
	Landslide (Hazards→Landslide Hazard Frequency and Distribution)	Grid: about 5km 8 classifications(Negligible to Very Low/ Low/ Low to Moderate/ Moderate/ Medium/ Medium to High/ High/ Very High)	
	Earthquake (Hazards→Earthquake Hazard Frequency and Distribution)	Grid: about 50km 4 classifications (1-10/ 11-50/ 50-100/ 100-)	
	Volcano (Hazards→Volcano Hazard Frequency and Distribution)	Grid: about 50km 4 classifications (1-10/ 11-30/ 31-60/ 61-130) (classified into 4 classes which Volcanic Explosivity Index is 2 to 8 among the volcanos which erupted in 1079 to 2000)	
	Drought (Hazards→ Drought Hazard Frequency and Distribution)	Grid: about 200km 5 classifications (0/ 1-3/ 4-6/ 7-10/ 11-19)	
Google Map https://www.google.co.jp/maps?source=tldso All over the world	Flood, Storm surge, Landslide, Tsunami	Confirm project sites through satellite photograph Focuses should be given to the following; Flood: if the sites are located in deltas of large rivers/ if the sites are located along the rivers Storm surge: if the sites are located in coastal areas Landslide: if the sites are located on slopes of mountainous areas or hillocks Tsunami: if the sites are located in coastal area/ if the sites are locates under the elevation of 35m	There is a possibility that the current situation differs from the image shown on Google Map and Google Earth. The latest situation of the project site should also be taken into account.
Google Earth http://www.google.co.jp/intl/ja/earth/ (for install) All over the world			
National Geophysical Data Center (NGDC) By NOAA TOP page： http://ngdc.noaa.gov/ngdcinfo/onlineaccess.html All over the world	Earthquake (Hazards→Earthquake→Natural Hazards Interactive Viewer→Significant Earthquakes)	5 classifications (0/ 1-50/ 51-100/ 101-1000/ 1001-) (based on the number of death from major earthquakes)	There is a possibility that there are some disasters which are not reflected to the database.
	Tsunami (Hazards→Tsunami→Natural Hazards Interactive Map)	5 classifications (0/ 1-50/ 51-100/ 101-1000/ 1001-) (based on the number of death from tsunami (volcanic, landslide, earthquake based cause)	
	Volcano (Hazards→Volcano→Natural Hazards Interactive Map)	5 classifications (0/ 1-50/ 51-100/ 101-1000/ 1001-) (based on the number of death from major volcano eruption)	

Data Source/Information Availability	Disasters/ Icon to be refereed	Grid scale/Classification/Explanation	Notes
EM-DAT by OFDA/CRED TOP page： http://www.emdat.be/ Refer to： http://www.emdat.be/database All over the world	Flood, Cyclone, Landslide, Earthquake, Volcano, Drought	Enter period to be focused and name of country in "Advanced Search" and select "Disaster subgroup". The result shows Damage on lives Record of disaster occurrences in the past is also available by using "Natural Disasters" icon under "Country Profile" (Information available from 1900 to up today)	The data is shown in country wise and therefore it is difficult to get information specifically for the project sites.
Des Inventar by UNISDR/UNDP： TOP page： http://www.desinventar.net/index_www.html Asia: 18 countries Africa: 8 countries Europe: 3 countries Latin America: 19 countries	All major disasters Refer to： http://www.desinventar.net/DesInventar/showdatacard.jsp?clave=5644&nStart=0	Select country and disaster type, or select the area from "Province". The result page shows graph of disasters occurred in the past, information on damage on lives and damage on property	Level of information availability differs from country to country.
Dartmouth Flood Observatory TOP page： http://floodobservatory.colorado.edu/Archives/index.html All over the world	Flood Refer to： http://floodobservatory.colorado.edu/Archives/index.html ("Global Surface Water record"→Click the grid which includes project area)	The result page shows the record of flood occurrence on the map	Information from 1985 is available. However, the years with information available differ by region. The latest update is in 2010 and data from 2011 is not available
National Climate Data Center by NOAA TOP page： http://www.ncdc.noaa.gov/oa/climateresearch.html All over the world	Cyclone (Extreme Weather and Climate Events (Maps, Tables, Reports)→World wide Weather & Climate Events)	Map of cyclone and record for the periods of 1991-2000／2001-2011／2012- are available	The result shows all records in the world, and data of the country has to be identified from the list The record is available in text form. Therefore, it will take some time to obtain information
Global CMT Web Page by Columbia University and Harvard University TOP page： http://www.globalcmt.org/ All over the world	Earthquake Refer to： http://www.globalcmt.org/CMTsearch.html	Record of earthquake occurrence is available by period, latitude/ longitude and the seismic intensity	Data since 1976 is available. Information on latitude/ longitude is needed to use the database

Data Source/Information Availability	Disasters/ Icon to be refereed	Grid scale/Classification/Explanation	Notes
Composite Earthquake Catalog by Northern California Earthquake Data Center TOP page： http://www.ncedc.org/anss/ All over the world	Earth quake Refer to： http://quake.geo.berkeley.edu/anss/catalog-search.html	Record of earthquake occurrences are available by period, seismic intensity, latitude/ longitude to "Select earthquake parameters" The data which can be obtained on "Earthquake – Events" of GRDP is based on this database	Data since 1898 is available Information on latitude/ longitude is needed to use the database
	Earth quake Refer to： http://www.ncedc.org/anss/maps/cnss-map.html	Select "World Map Mollweide Projection" or "World Map Robinson Projection", and click the period. The result shows the location of earthquakes and the depth of hypocenter	Data is available for 1946-1997 There is a difficulty to identify the specific location of earthquake occurrences from the result map
Smithsonian Institution National Museum of Natural History Global Volcanism Program by National Museum of Natural History (Washington D.C) TOP page： http://www.volcano.si.edu/ All over the world	Volcano Refer to： http://www.volcano.si.edu/search_volcano.cfm	Select country in "Country", or select the location on the map. The result shows the record of volcanic eruption (the data is based on last 10,000 years)	The result can be obtained easily. However, there is a possibility of future eruption of volcanoes not listed with past records in the database.
	Volcano Refer to： http://www.volcano.si.edu/learn_products.cfm?p=9 http://www.volcano.si.edu/ge/GVPWorldVolcanoes.kml (for when Google Earth is already installed)	Install Google Earth and open the KML file which is down loaded from "Holocene Volcanoes Network" The result shows the basic volcanic information of all over the world on Google earth	
	Volcano Refer to： http://www.volcano.si.edu/learn_products.cfm?p=9 http://www.volcano.si.edu/news/WeeklyVolcanoGE.kml (for when Google Earth is already installed)	Install Google Earth, and open the KML file which is downloaded from "Smithsonian / USGS Weekly Volcanic Activity Report Network". The result shows the recent activities of volcanos.	

5. Mainstreaming Disaster Risk Reduction in Japan

5.1. The 1961 Basic Act on Disaster Control Measures: General DRR Act of Japan

In Japan, “Basic Act on Disaster Control Measures” is enacted in 1961 as a general act of natural disaster countermeasures. This enactment was triggered by serious catastrophe caused by 1959 Typhoon Vera.[20] Before the enactment of the 1961 Act, many acts had been made in Japan when natural disaster occurred.[21] However, these Acts did not have enough effect as countermeasure for Disaster Risk Reduction, because they were not consistent with other laws and acts. The demand for basic act of disaster countermeasure had been discussed in Japan after the 1952 Hokkaido Earthquake. In 1959, Tokai region get devastating damage, especially coastal area of Nagoya City[22] by Typhoon Vera. The 1961 Basic Act on Disaster Control Measures was legislated to ensure co-operation between national and local government for disaster recovery. In this section, we review the history of the 1959 Vera’s catastrophe and the main points of the 1961 Act.

5.1.1. Overview of catastrophe caused by 1959 Typhoon Vera

Typhoon Vera was landed in Cape Shiono-misaki, Wakayama around 18:00 26th September, 1959(JST). The next day, Vera moved away to North-Eastern direction. Although this is a common path of typhoon in Japan, the Barometric pressure of Vera was 929.6 hPa, forth the largest in Japanese history. Also, extensive storm surge was caused by “Vacuum Effect” when Vera intruded to Ise-wan bay area. At the time, the largest storm surge of Japan was 2.9 m height in Osaka Port which is caused by 1934 Muroto Typhoon. However, the height of the storm surge by Vera was 3.55 m in Nagoya Port, and it was beyond the assumed strength of civil engineering structures of Japan at the time.[23] 264 points of coast and river embankment were breached over in Aichi Prefecture and Mie Prefecture, and the extension length of total breach was 36.4 km. It caused serious flood and catastrophe especially in Nagoya Coastal Area.

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20 Typhoon Vera is well known as “Ise-wan Typhoon” in Japan.

21 According to the book "*Commentary Basic Act on Disaster Control Measures <Second revised edition>*" (2002, Gyosei publication, in Japanese), the number of disaster-related Acts of Japan was ranged in 150-200 around 1950s. These laws were able to be applied in line with other laws after the enactment of the Basic Act on Disaster Control Measures.

22 Around the current area of Minato-ku and Minami-ku of Nagoya City.

23 At the time, the surface of coastal embankments of Japan was not covered by concrete, but only covered by turf.

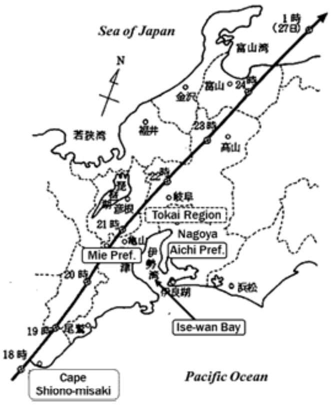

Fig. 5-1: (L) The path of 1959 Typhoon Vera (R) Flooded Nagoya City, 1959

(1) DRR problems which was revealed by catastrophe of Typhoon Vera

The catastrophe of Typhoon Vera[24] was due to flooding in wide area caused by huge storm surge and breach of embankments. In Tokai region, the damage was concentrated in Aichi Prefecture and Mie Prefecture. At that time, there were three DRR problems which expanded the damage.

(i) Insufficient notification of hazardous area

Southern area of Nagoya city is "sea level zone", which had been constructed by reclamation and landfill.[25] This area had a high risk of flooding if embankments were breached. However, the usage of hazard maps was not common at that time, and most of the people did not know the risk.

Table 5-1: Deaths and Missing by Typhoon Vera

District	Prefecture	Deaths and missing
Tokai	Aichi	**3,378**
	Mie	**1,273**
	Gifu	**104**
Kinki	Nara	**113**
Tohoku - Kinki	Other	**257**

Source: Ise-wan Typhoon Disaster Investigation Special Committee, 1961

Administrative division		Population (1959)	Deaths and missing
Aichi	Nagoya City, Minami-ku,	146,500	**1,417**
Mie	Kuwana County, Nagashima Town	8,499	**381**
Aichi	Nagoya City, Minato-ku,	91,591	**375**
Mie	Kuwana County, Kisosaki Village	2,993	**328**
Aichi	Kaifu County, Yatomi-cho	16,037	**322**
Aichi	Handa City	69,784	**290**
Mie	Kuwana City	66,804	**198**
Mie	Mie County, Kawagoe Village	7,718	**174**
Aichi	Chita County, Ueno Town	16,328	**140**
Aichi	Kaifu County, Tobishima Village	4,290	**132**
Mie	Yokkaichi City	187,978	**115**

[24] The Isewan Typhoon caused damage outside the Tokai region as well, affecting an extremely wide area that includes the Tohoku, Kanto and Kinki regions. Many landslides occurred in the mountainous areas of Nara Prefecture, which is in the Kinki region and was the only place outside of the Tokai region that lost more than 100 people in the disaster.

[25] In Edo period (1603-1868 AD), Nagoya was under the governance of the feudal domain of Owari Tokugawa-Clan (The branch clan of Tokugawa Shogunate). Owari Tokugawa-Clan promoted reclamation and development of new agricultural land in its domain. After Meiji period (1868-1912 AD), these farmlands had been diverted to industrial and residential area. It expanded the people's damage of flood catastrophe caused by Vera.

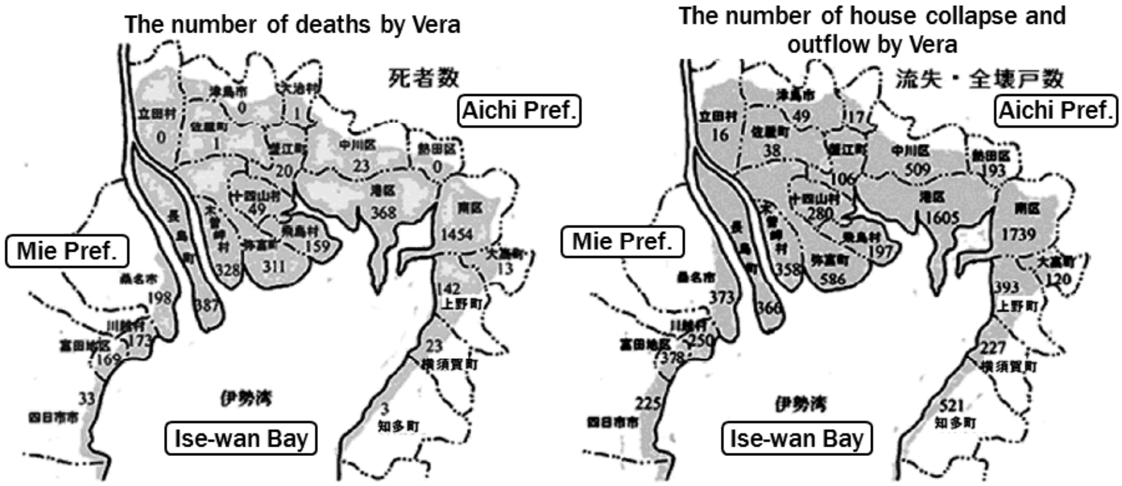

Fig. 5-2: Damage distribution of Tokai region by Typhoon Vera (Mizutani(2009))

(ii) Insufficient transfer of disaster information

Japan Meteorological Agency and Nagoya City had been intensified the system for observation and communication to prepare for typhoon. Though, weather warning at that time did not prompt people to evacuate[26]. Also, AC powered vacuum-tube radios were mainly used at home in this time.[27] Due to a power failure caused by Vera, people lost information devices because the AC radios were no longer available. Thus, people cannot get any information of typhoon Vera.

(iii) Insufficient system for disaster evacuation

At the time, Nagoya City had been developed an evacuation plan. However, this plan mentioned the hazardous area and evacuation places only with no specific plans such as evacuation announcement, etc. The water disaster risk reduction plan of Aichi Prefecture and the local water management agencies at the time did not consider rescue operations, and the coordination with police and fire department was also insufficient. Thus, Nagoya City, with no possibility of embankment breach in mind, did not indicate residents to evacuate until the end of Catastrophe. Also, the risk of timbers' outflow from many lumber yards in Nagoya Bay[28] was not known. Out flowed timbers caused destruction of buildings and houses in Nagoya, and many people died and buildings collapsed by damage of collision or strike to these timbers.

[26] Vague and ambiguous expressions such as "Take all possible measures against disasters" and "Vigilance is required" offered no specific urging toward evacuation from typhoons. ("Report on the Isewan Typhoon 1959" by the Central Disaster Management Council, 2008)

[27] The spread of battery-powered transistor radio in Japan was triggered by the catastrophe of 1959 Typhoon Vera.

[28] In Edo Period, Tokugawa Shogunate emphasized timbers as strategic resources of energy. Forests and major rivers(flow passage of wood) were direct territory of Tokugawa Shogunate. (Source: TAKEMURA Kotaro (2014) "*The mystery of Japanese history can be solved by Topography [civilization and culture]*" PHP Interface publishing, in Japanese). Nagoya was located on downstream of major rivers, and was under the administration of the Owari branch of Tokugawa clan. Thus, there were many lumber yards in Nagoya after Meiji Period.

(2) Aftermath of Typhoon Vera

There was severe damage in Nagoya City coastal area by Vera. On 26th September 1959, flooding occurred and water reached the broad area of Minato-ku at 20:00. Inundation was spread throughout the lowland of Nagoya City. All breach points were enclosed in the 21st November, although the drainage for all the inundation area was completed in late December of 1959

Fig. 5-3: (L) Outflowed Timbers in Nagoya (R) Drainage of inundation area

Fig. 5-4: The activities of disaster recovery in Nagoya City, 1959

(L) The truck of Nagoya city waterworks bureau, (R) The rescue boat of JSDF

Fig. 5-5: Emergency chemical spraying to prevent plague by JSDF, 1959

(3) Recovery through cooperation of the National and local governments

The damage of Typhoon Vera was very severe and flood damage was prolonged in Tokai region. This catastrophe gave severe damage to the economy of Tokai region, and many complex problems occurred from disaster. The Japanese government had established "Central Japan Disaster Management Headquarters" in Aichi Prefectural Office on 30th September 1959. This office handled the operations of government agencies on site and unified the countermeasures for disaster relief and recovery. Relief and recovery activities were highly effective in the flooded areas of Nagoya by municipalities (Aichi Prefecture and Nagoya City) as well as Japan Self Defense Force (JSDF)[29] and Ministry of Construction from the national government. The areas with prolonged inundation suffered from delay of restoration works, inconvenience in long term evacuation, economic loss from suspended operation of factories. Plague and hygiene problems were occurred from the spilled over of sewage sludge in flooded area. JSDF and local police were in charge of emergency spraying for disinfection or insecticides. This experience led to the enactment of the 1961 Basic Act on Disaster Control Measures, which regulates the cooperation of National and local governments for disaster countermeasures.

5.1.2. Overview of the 1961 Basic Act on Disaster Control Measures

The 1961 Basic Act on Disaster Control Measures is a general law which complement, instead of replace, existing disaster-related laws and harmonizes them with a close linkage.

The main components of this act are shown as five points as follows:

(1) Clarification of administrative responsibility in disaster management

By catastrophe of 1959 Vera, wide areas had been flooded for long time and there were significant impact on local economies. The 1961 Basic Act on Disaster Control Measures defines the contents of disaster risk reduction activities with three stages; prevention, emergency response and recovery. This Act defines jurisdiction and responsibility for disaster risk reduction of National government, prefectures, municipalities, designated public corporations and designated local public corporations.

(2) Promotion of comprehensive disaster management administration

In 1959, each Japanese ministry determines Acts and regulations about disaster management independently, and consistency was lacked between each Act. Thus, the 1961 Act defines "comprehensive coordinating organization" in the national and local governments in order to achieve the harmonization of disaster risk reduction activities. According to the 1961 Act, "Central Disaster Management Council" is set up by national government in the Cabinet Office, and Prime Minister works as a chairperson of this council. Likewise, "Prefectural Disaster Management Councils" and "Municipal Disaster Management Councils" are set up in each local government, and

[29] At that time, however, the dispatch of JSDF to response a disaster was not stipulated in the law.

chiefs work as chairpersons of these local councils. When disaster occurs, “Disaster Measurement Headquarter” is installed for prefectural or municipalities in disaster affected area. Similarly, when “Major Disaster” occurs, “Major/Extreme Disaster Management Headquarters" is set up in national government to implement accurate and rapid coordination of response operations.

(3) **Development and promotion of Disaster Management Plan and Countermeasures**

Before 1959, each ministry decreed disaster management acts and regulations after the occurrence of disaster. Local governments managed to disaster individually, thus sometime they were not organized. In the 1961 Basic Act on Disaster Control Measures, “Disaster Management Council” of each level (national and local) should make “Basic (or Local) Disaster Management Plan” to determine priority issues for smooth implementation at each administrative level. The roles and authority of responsible governments are prescribed stepwise according to the stages; prevention, emergency measures and recovery.

(4) **Financial support for disaster and “Extremely Severe Disaster”**

Before 1959, disaster countermeasure processes were performed individually by each ministry in Japan. Thus, municipalities by affected Typhoon Vera had to spend a great deal of time for request to obtain financial support from national government.[30] To solve this problem, there is prescription for cost burden between national government and local governments in 1961 Act. Generally, each municipality will pay disaster response costs, but there are exceptions with national subsidies. For “Extremely Severe Disaster”, national government should support financially for affected municipalities and disaster victims by specific Act.[31]

(5) **Countermeasure for disaster emergencies**

Before 1959, “Special Regulations to be addressed in emergencies” was defined to dispatch JSDF. Though this regulation was only assumed to handle security measures and no assumption to deal with natural disasters. The 1961 Act defines the proclamation of “Disaster Emergency State” by the Prime Minister when “Abnormal and Extremely Severe Disaster which causes serious impact to abnormal the country's economy and maintenance of social order” has occurred. The government of Japan can take necessary action with ordinance in case of “Disaster Emergency State”.

There have been many amendments for the 1961 Basic Act on Disaster Control Measures to respond the occurrence of each disaster. Though, it is important that basic framework of the 1961 Act is unchanged from the first enactment. Deaths or missing by natural disasters in Japan had been significantly reduced to less than 1,000 after 1961, except for Great Hanshin-Awaji

[30] In 1959, Nagoya city officers should go to national government at Kasumigaseki Tokyo for six times to request raised subsidies by special legislation, despite their busy situation for disaster recovery.

[31] 1962 Act on Special Financial Support to Deal with Extremely Severe Disasters

Earthquake (1995) and Great East Japan Earthquake (2011), as shown in Figure 5-6. These two earthquakes were huge natural disasters and it was difficult to correspond even by disaster countermeasure system of Japan. When considering the disaster risk reduction for developing countries, these catastrophes should be considered separately from general natural disasters.

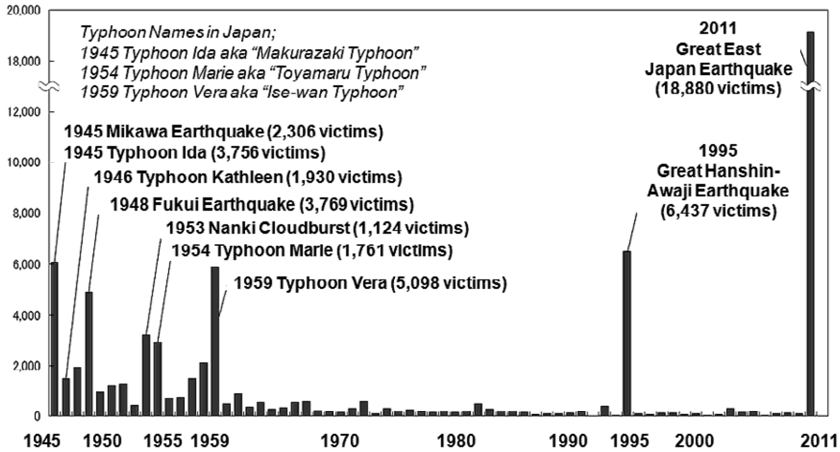

Fig. 5-6: The transition of deaths and missing by natural disaster in Japan (1945-2011)

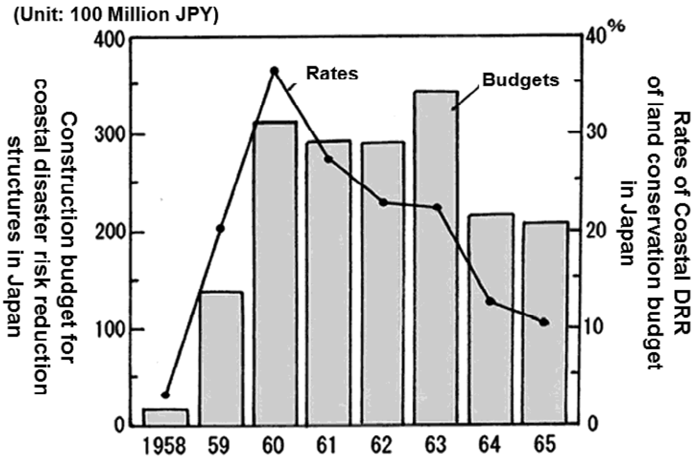

Fig. 5-7: Construction expenses for coastal DRR structures in 1960s Japan(Mizutani(2009))

Mizutani(2009) pointed out that following social factors are also important for reduction the number of death and missing persons in Japan after 1960s;

- "Building Standard Law" was enacted in Japan in 1950. This law mandates to combine the base of wooden houses with concrete foundation using metal brackets. Thus, the number of house outflow or collapse caused by floods was significantly reduced.
- The transmission of disaster information and alert had evolved in Japan around 1960. Thus, victims of typhoons that land at midnight had been rapidly decreased. Also, battery powered

transistor radios and televisions were widely spread in this time. Therefore, it had become straightforward to obtain information of typhoons.

- After 1959, construction budget for coastal structures in Japan had been increased to respond damages of Typhoon Vera. Since high-risk areas of storm surge are limited by its topographic condition, it is possible to input construction budget intensively and disaster reduction effect will quickly appear.

In September 1961, "Second Muroto Typhoon" hit the Kansai region. The scale of this typhoon was the same degree to the 1959 Typhoon Vera. There were storm surge of 3.2 m height in Osaka Bay (Sakai City) and central area of Osaka city was flooded. However, according to the development of DRR system in Japan, deaths from storm surge were significantly decreased compared with 1959 Typhoon Vera. The victims of the 1961 typhoon were 7 people in Osaka City, 4 people in Sakai City and 3 people in Kishiwada City[32].

5.2. Historical Transition of the Building Standards Act in Japan

The 1961 Basic Act on Disaster Control Measures is the core of disaster risk reduction in Japan, as we see in the previous section. Also, when disaster (especially earthquake) occurs, collapse of buildings deprives a large number of human lives and gives a great deal of damage in the recovery process. Thus, the design standard for structure is a critical factor for Disaster Risk Reduction. Nowadays, the earthquake-proof structure of buildings is recognized as important factor in developing countries, particularly for earthquake frequent area like Latin America, Southeast Asia, South Asia, Central Asia, etc. It is considered to be helpful to review the historical transition of Japan's Building Standards Act for DRR. [33] On 1 September 1923, “Great Kanto Earthquake” of magnitude 7.9 struck the Tokyo and Kanto region. More than 100,000 people died or missed by the Earthquake, and many buildings and structures were collapsed. The following year 1924, “1919 Urban Building Law” was revised and earthquake-resistant building standards had been introduced. This was the starting point of the earthquake-resistant building standards in Japan.

In 1950, “Building Standards Act” was enacted in Japan. This law targets buildings of all area in Japan and 1919 Law was discontinued. By the 1950 Building Standards Act, it is mandated to combine the base of wooden building and the concrete foundation with metal brackets. As a result, the number of housing outflow by typhoons or storm surges was significantly decreased. Thereafter, the design standards of the 1950 Law were revised by the occurrence of large earthquakes in

[32] When the Second Muroto Typhoon struck in 1961, the governor of Osaka Prefecture repeated a call to evacuate over television and the radio that morning. When the Isewan Typhoon struck in 1959, only 10% of households nationwide had a television set, but in 1961 the diffusion rate was roughly 40%. Unfortunately, the Second Muroto Typhoon caused even greater damage to Nara Prefecture than the Isewan Typhoon because transportation and communications with the southern part of prefecture were cut off. Finally, the prefecture requested the application of the Disaster Relief Act.

[33] In Japan, the Building Standards Act and City Planning Act are frequently revised to enhance standards for fire protection. Although, the subject of this handbook is disaster risk reduction for natural disasters, thus description about fire protection is omitted.

Japan. Many shear failure of Reinforced-Concrete buildings has occurred by 1968 Hokkaido earthquake[34] (M7.9). Thus, the standards of shear reinforcement of RC pillars were revised in this law. From 1972 through 1977, a study carried out to define “New earthquake-resistant building standards” as a national project. The results were acceptable according to the survey of structural damages by 1978 Miyagi earthquake (M7.4). In 1981, Building Standards Act was revised and “New earthquake-resistant building standards” were enacted. The buildings built after 1981 with "New earthquake-resistant building standards" endured huge earthquakes, such as Great Hanshin-Awaji Earthquake or Great East Japan Earthquake.

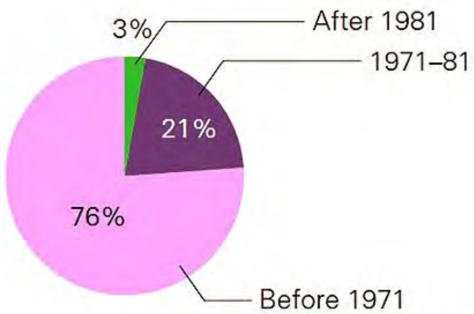

Fig. 5-8: Percentage of collapsed houses by built year in Great Hanshin-Awaji Earthquake[35]

After the 2011 Great East Japan Earthquake, MLIT introduced new standards for escalator and elevator to prevent drop-off by external stress, although “New earthquake-resistant building standards” are not changed basically. This law is still effective as earthquake countermeasure in Japan.[36] In Japan, the 1950 Building Standards Act stipulates submission of application to local governments before construction. Also, penalties are determined for violation of the 1950 Building Standards Act to enhance its effectiveness.

5.3. The development of a new DRR in Japan after the Great Hanshin-Awaji Earthquake

Great Hanshin-Awaji Earthquake on 17th January 1995 was the first inland earthquake of metropolitan area since enactment of 1961 Basic Act on Disaster Control Measures. Japan had been encountered with various problems by 1995 earthquake, because it struck large and advanced urban cities in Hanshin Area. New DRR initiatives were launched in the process of solving these problems, and they were useful corresponding 2011 Great East Japan Earthquake.

(1) After the occurrence of earthquake

The damage of 1995 Great Hanshin-Awaji Earthquake was exceeded response capacities of police and fire department, which are local organizations in Japan. However, disaster response was not clearly defined to the mission of JSDF, the organization of National government. At that

[34] Hokkaido Earthquake is as known as “Tokachi-Oki Earthquake” in Japan.
[35] The World Bank Institute(2012) “*Knowledge Notes, Cluster 1: Structural Measures - Building Performance*”.
[36] In 1995 Great Hanshin-Awaji Earthquake, many people died and injured by collapse of old houses. Seismic reinforcement has been currently conducted to buildings built before 1981, and it is a continued issue in Japan.

time, the request of local government was required to dispatch JSDF. In November 1995, “National Defense Program Guideline” was revised and disaster response had been specified in the activity purpose of the JSDF. Currently, fire department, police and JSDF can correspond to disaster with close cooperation.

The concept of disaster medical care had not been established in Japan before 1995. There were many problems occurred as the concentration of injured people in the specific hospitals or lack of knowledge about disaster medical etc. In 2004, “DMAT (Disaster Medical Assistance Team)”, the disaster dispatch medical team was established in Tokyo[37]. Next year 2005, “Japan DMAT” was founded by the Ministry of Health, Labor and Welfare (MHLW). Now, DMAT have been dispatched in large disasters and accidents of Japan and DMAT is a large force in the field of disaster medicine. (Also see chapter 6.2 “Health sector”)

(2) Reconstruction

In 1995, reconstruction of disaster-damaged housing was principally done by self-help effort, because real estate is private property. However, delays in housing reconstruction had been actualized as a barrier of local revitalization. In 1998, “Act on support for Livelihood Recovery of Disaster Victims” was enacted in Japan. It became possible to pay cash for victims who meet certain requirements. After the revision in 2007, it became possible to allocate this aid cash for housing reconstruction.

(3) Support for local economies

A large number of small and medium-sized enterprises were damaged by 1995 Great Hanshin-Awaji Earthquake. Hyogo Prefectural Government founded “Emergency disaster recovery fund for small and medium-sized enterprises” in cooperation with national government of Japan. This fund financed 33,551 loans to damaged enterprises within 5.5 months after the 1995 earthquake. Government-affiliated financial institutions “Disaster Recovery Fund” also worked from 1995 to 2005 for finance and they were widely used in the affected enterprises. Also, Hyogo Prefectural Government supported economies with local financial institutions and chambers of commerce and industry.

(4) International cooperation for Disaster Risk Reduction in Kobe

In 2005, “World Conference on Disaster Reduction” was held in Kobe City after earthquake. New city area called “HAT Kobe” had been built in Chuo-ku under the urban redevelopment plan of Kobe City. Various international organizations for Disaster Risk Reduction had been placed in Kobe City. Now, UNISDR Hyogo Office, UNOCHA Kobe Office, International Recovery Platform (IRP), Asian Disaster Reduction Center (ADRC) , JICA Kansai are in the HAT Kobe. JICA manages Disaster Reduction Learning Center (DRLC) in cooperation with the Hyogo Prefectural Government.

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[37] Thereafter, DMAT has been deploying in other prefectures.

(5) Summary

In 1961, the year of enactment Basic Act on Disaster Control Measures, Japan was still in the way of post-war reconstruction. High economic growth of Japan occurs triggered by Tokyo Olympic in 1964, with population concentration and urban growth. The 1995 Great Hanshin-Awaji Earthquake triggered number of issues which the 1961 Basic Act on Disaster Control Measures did not expect. Many new policies were implemented as a disaster countermeasure of new era during the process of reconstruction of the 1995 Earthquake, like disaster medical care, social risk reduction (SRR), support of local economies, international cooperation for Disaster Risk Reduction, etc. These policies have been effectively utilized in 2011 Great East Japan Earthquake in various respects.

[References]

Note: All the references in this chapter are provided in Japanese only. These titles are provisional translation for English. Please see Japanese version handbook to know the precise Japanese title.

- Central Disaster Management Council, the Cabinet Office of Japan (2009) "*The report of 1959 Ise-wan Typhoon*"[38]
- HOSOTA Daizo (2009) "*Ise-wan Typhoon and enactment of the Basic Act on Disaster Control Measures*"[39]
- MIZUTANI Takeshi (2009) "*Impacts of Typhoon Isewan Disaster and Secular Changes in Post-war Typhoon Disaster*" Research Report of National Research Institute for Earth Science and Disaster Prevention, Japan Vol.75[40]
- Nagoya City (1960) "*The record of Ise-wan Typhoon*" [41]
  (This movie is officially provided to YouTube by Nagoya City.)
- Hyogo Prefecture (2009) "*The experience of the Great Hanshin-Awaji Earthquake 17th January 1995*"

[Figure Source]

- Figure 5-1 Left: Aichi Prefecture(1970) "*The history of disaster in Aichi Prefecture*" (In Japanese)
- Figure 5-1 Right, 5-2, 5-3, 5-4 Left: Nagoya City (1960) "*The record of Ise-wan Typhoon*" *(Captured images from movie)*
- Figure 5-5: Central Disaster Management Council, the Cabinet Office of Japan (2013) "*White Paper on Disaster Management 2012 (In Japanese)*"[42]

[38] http://www.bousai.go.jp/kyoiku/kyokun/kyoukunnokeishou/rep/1959--isewanTYPHOON/
[39] http://www.isad.or.jp/cgi-bin/hp/index.cgi?ac1=IB17&ac2=98fall&ac3=5681&Page=hpd_view
[40] http://dil-opac.bosai.go.jp/publication/nied_report/PDF/75isewan/65-2mizutani.pdf
[41] https://www.youtube.com/watch?v=ueRc0s54fD8
[42] http://www.bousai.go.jp/kaigirep/hakusho/h24/index.htm

6. Examples of Mainstreaming Disaster Risk Reduction in Japan

In recent years, damages by natural disasters are becoming very serious. Flood damage due to extreme weather has also increased globally. Also, Japanese Government thinks the post-conflict reconstruction and peace building as priority issues in official development assistance (ODA). Though, assistance approaches to these issues have not been established enough.[43]

Each donor is exploring concrete methods of "Mainstreaming DRR". For example, World Bank and the Inter-American Development Bank (IDB) have been conducting survey and research on corresponding cases for DRR in Japan. The World Bank established the "Tokyo Disaster Risk Management hub Tokyo" in February 2014. The objective of this establishment is to expand the World Bank's development projects with DRR knowledge of Japan. IDB has been conducting a research program[44] of DRM system of multiple countries, including Japan.

JICA is promoting the involvement of overseas offices such as the project formation from the point of view of field based approach. Thus, JICA is preparing to accumulate and organize the past experience of Japan as intellectual assets of JICA and to utilize for JICA staffs. JICA is conducting the development of a knowledge management in order to take advantage of the knowledge of Japan and experience for project formation and implementation. This handbook is created as part of the knowledge management development.

JICA staffs (headquarters staffs, field offics and local staffs) and JICA experts are assumed users of this "Handbook of mainstreaming disaster risk reduction" (DRR forethought version). It has assumed as purpose of the Handbook to incorporate the perspective of "Forethought to DRR" when JICA and local staffs prepare survey ToR and other documents in the design and research stage of the JICA project or JICA experts implement international cooperation projects.

In this chapter, Japan's disaster risk reduction consideration case will be introduced for each of JICA sector classification, to indicate that DRR forethought to each issue can be implemented under the circumstances that assistance approach has not been established for mainstreaming DRR. The cases are written in plain text and avoid using technical terms as much as possible to raise awareness for DRR forethought for staff that do not specialize in DRR.

In addition, cases are selected from a wide range of references and cases of Japan including the past cases such as the Edo period (16th-19th Century), not limited to the current case. The reason is that it is beneficial in developing countries where resources are limited, thus there are cases that

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[43] M.Ishiwatari (2010) "*Study on Development Assistance Method on Emerging Issues in Disaster Management and Reconstruction*", Doctor thesis of Graduate schools of frontier sciences, the University of Tokyo.

[44] IDB: "RG-T2434 : Development Profile Public Investment in Disaster Risk Reduction" program

old technology is more useful than advanced technology. It is considered that DRR forethought is fixed and sustained as norms and culture in the all projects and operations of JICA.

It should be noted that following three JICA sectors are excluded from this chapter; “South-South Cooperation”, “Public-Private Partnership” and “Global issues”. Because the area and field of these sectors is very wide and it is difficult to assume the DRR forethought as a sector in general. Please refer to the DRR forethought case of sector that is similar for each of the projects for these three sectors.

[References]

Note: References in this chapter listed in Japanese version handbook, because they are provided in Japanese only.

6.1. Education

Evacuation drills of education sector have long been practiced in Japan. Focusing on two contrasting cases caused by the 2011 Great East Japan Earthquake, we see the need for mainstreaming disaster risk reduction in the education sector.

6.1.1. Education of Disaster Risk Reduction: “The ‘*Miracle*’[45] of Kamaishi” and the “Tragedy at Okawa Elementary School”

First, please look at the numbers below: the contrast between what happened in Kamaishi City (Iwate Prefecture) and at Okawa Elementary School, Ishinomaki City (Miyagi Prefecture). Both schools were hit similarly by a tsunami caused by the 2011 Great East Japan Earthquake. Also, both cities are on the Pacific coast of the Tohoku Region in similar topographic conditions, as seen in the map below. What caused this difference?

	Number of Students	Dead & Missing Students	Survival Rate
Kamaishi City (Iwate Prefecture)	2,926 (1,927 elementary school & 999 junior high school students)	5 (including students who were absent on the day)	99.8%
Okawa Elementary School, Ishinomaki City, (Miyagi Prefecture)	108	74	31.5%

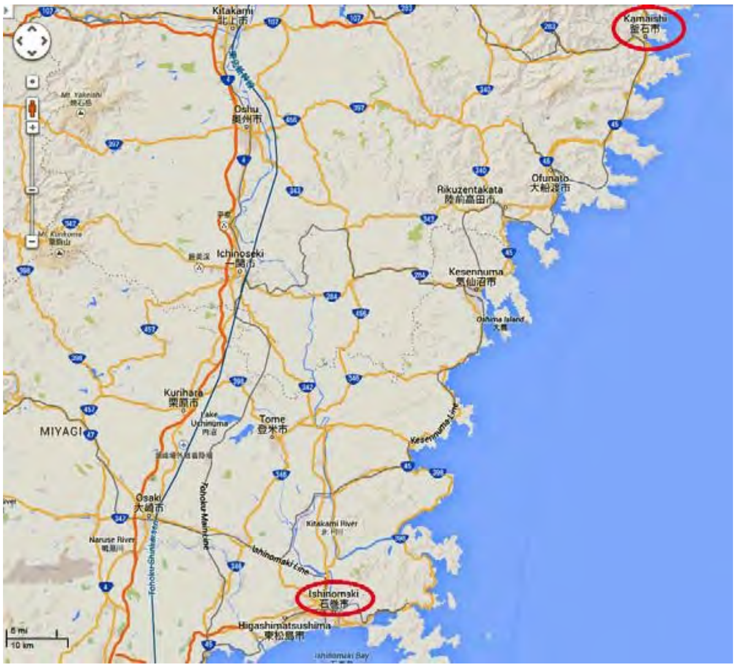

Fig. 6-1: Location of Kamaishi and Ishinomaki (Source:”Google Maps”)

45 Kamaishi City authorities want to avoid the word “*miracle*” but instead to say “experience of Kamaishi,” because they consider the very small death toll among the students in Kamaishi was a result of daily efforts in disaster education and evacuation drills.

The critical factor that brought about this contrasted results was the existence of disaster education against the disaster risk caused by tsunami.

Since 2004, Kamaishi City has been developing the "*Interactive Tsunami Hazard Map*" in collaboration with the group of Professor KATADA Toshitaka[46] from Disaster Social Engineering Laboratory, Gunma University. In 2005, Kamaishi city conducted "*Tsunami Awareness Survey*" of students, parents, and teachers. Since 2008, various activities against tsunami hazards have been practiced at elementary and junior high schools supported by the development of concrete Disaster Education Curricula in this city.

As a culmination of these efforts, "*The Manual for Tsunami Disaster Education in Kamaishi City*" (90 pages) was published in 2010 by the Education Board of the City, Disaster Management Section, Citizens' Affairs Department and Disaster Social Engineering Laboratory of Gunma University. In the background to the publication of this Manual there were several problems experienced in the fields of education, which may also apply to schools in other areas. These were:

- Many teachers are from the inland areas of the same prefecture and they lack knowledge of tsunami disaster education.
- It is difficult to find time for tsunami disaster education and to obtain textbooks and teaching materials.
- Teachers do not know what to teach in disaster education.

Considering these problems, the Manual picked up the curricular units related to earthquake, tsunami, and disaster risk reduction from the subjects taught in every grade, and indicated what could be taught as supplements to relevant classes. In addition, it summarized the knowledge the teachers should have in order to teach students. "The Kamaishi City Liaison Conference for Promotion of Tsunami Disaster Education" was established in the same year. On the other hand, to foster affection to the area, education is done in a way that does not emphasize tsunami hazards alone, but promotes the recognition that Kamaishi City receives many gifts from the sea, while it is "only very occasionally (at the probability of once in 50-100 years)" exposed to the disaster of tsunami. [47] Like other municipalities, Kamaishi City was issuing a tsunami hazard map. However, the group of Professor KATADA taught schoolchildren not to be overconfident for the hazard map from the city authorities. Their intention was to teach children that hazard maps were the products of human efforts and had limitations in the accuracy of estimation.

[46] Present positions: Professor at Gunma University Graduate School of Science and Technology and Director of Research Center for Disaster Prevention in the Extended Tokyo Metropolitan Area.
[47] Mentioned in a lecture material by Professor KATADA.

Of the 14 elementary and junior high schools in Kamaishi City, pupils of several (mostly elementary) schools were already back home when the 2011 Great East Japan Earthquake hit on March 11. For example, Kamaishi Elementary School was located on high ground and staying there would be a better protection from tsunami, but 184 of its students chose to evacuate and urged their families to leave home, saving many lives as a result.

On the other hand, Okawa Elementary School also had a disaster response manual. However, it was mainly dealing with earthquakes, fires and intruders with little reference to tsunami. Furthermore, there was almost no discussion of an evacuation plan for a tsunami disaster or a tertiary evacuation site[48]. Tsunami had reached the school ground of Okawa Elementary School, which was outside of the expected flooded area in the hazard map produced by Ishinomaki City. Thus, disastrous results ensued of 70 students and 10 school personnel dead and 4 students missing.

In Kamaishi City, the proactive disaster risk reduction efforts were effective. However, many schools in various parts of Japan at the time were in a situation similar to that of Okawa Elementary School. After the 2011 Great East Japan Earthquake, "*the Expert Council on Disaster Education and Disaster Management*" was organized by the Ministry of Education, Culture, Sports, Science and Technology (MEXT). Information was collected and analyzed from the schools affected by the disaster and an interim report issued on the revision of disaster education and disaster management in September 2011. The revised version of "*The Guide to the Development of School Disaster Management Manuals (Earthquake and Tsunami Disasters)*" was published in 2012 to provide a systematic basis for the implementation of more effective education at schools.

6.1.2. **Structural countermeasures of schools**

While MEXT had been promoting anti-seismic improvement of school buildings, the catastrophe arising from the 2011 Great East Japan Earthquake caused damage beyond expectations. MEXT directed the working group for Building Disaster-resistant School Facilities (Chair: NAGASAWA Satoru, Professor Emeritus, Toyo University) to inspect and examine the damage conditions at schools all over the country, and the report "*Disaster-resistant School Facilities*" was issued in March 2014. Considering not only the need for structural measures in school facilities but also the fact that they functioned as evacuation shelters for local residents, the report proposed how school facilities in tsunami-prone areas should be built and how they should be used for communities.

[48] In educational settings, earthquake evacuation is generally divided into three stages: primary (under a desk), secondary (the schoolyard or elsewhere outdoors) and tertiary (a different evacuation location if the secondary evacuation location has become dangerous).

Table 6-1: Process from establishing an evacuation shelter to dissolution in school facilities

	Functioning as a safe and secure environment	Functions as a school	Necessary facilities / equipment
Life-saving and evacuation stage (just after the disaster to evacuation)	Evacuation site for local residents	Ensuring the safety of children	Evacuation routes Barrier-free environment
Life-securing life stage (several days from just after the evacuation)	Opening, managing and operating evacuation sites	Confirming the safety of children and their parents or guardians	Storage, stockpile; Toilet Communications equipment Photovoltaic installation Pool water purifying device etc.
Ensuring sheltered-life stage (for several weeks from a few days after the disaster)	Launch of self-governing organization/ start of volunteer	Preparing for resuming of school functions	Gas installation; Japanese room Changing room; Nurse's room etc.
School function resumption stage	Coexisting of school functions and evacuation functions -> dissolution of the function as an evacuation site	Resuming school functions	Facility improvement with consideration of coexistence of school functions and emergency evacuation

Fig. 6-2: Example of structural measures against Tsunami in Schools[49] (Source: MEXT)

The report emphasizes that the measures against tsunamis must be planned and implemented based on the accurate understanding of the actual situation of each school. This is because the locations of different schools have different conditions in terms of the elevation of the grounds, the distance from the sea and river banks, the reaches of historical tsunamis, terrains and the availability of high-rise buildings in the vicinity, and the expected time to the arrival of a tsunami.

As for the measures against earthquakes, it is sufficient to perform reinforcement according to the 1981 amendment of the 1950 Building Standards Act (see Chapter 5). On the other hand, sufficient structural measures against tsunamis can be difficult to implement because of location and budgetary limitations. In addition to the complete solution to the problem by the relocation to

[49] Original figure is in Japanese.

high ground and conversion to high-rise buildings, the report therefore recommends evacuation to high ground and evacuation to the rooftop and other appropriate places.

Many school facilities functioned as evacuation shelters at the time of the 2011 Great East Japan Earthquake. However, because they were not originally designed as evacuation shelters, there were problems such as those concerning toilets or room heating. In addition, the use of school facilities as evacuation shelters prevented the restart of educational activities.

While the survey results in this report shows that 90% of public schools have been designated as shelters, some types of disaster response equipment are provided in only small percentages of school facilities, such as emergency communications equipment in 46.8% and emergency generators in 34.2%. This reveals the inconsistency of administration between the designation of evacuation shelters and their function in disaster response. In response, the report divides the process from the onset of a disaster to the closing of the evacuation shelter (reopening as a school facility) into four phases and specifies the functions that should be developed as shown in Table 6-1. Improvement of schools according to this guideline is planned be implemented across the country.

6.2. Health

The present disaster medical system in Japan has been established from the experience of the 1995 Great Hanshin-Awaji Earthquake. In this chapter, we see the DMAT activities in Japan and the applicability to developing countries in this chapter. (Please refer "5.2 Building Standards Act" for the structural countermeasures in hospitals and other facilities)

6.2.1. Disaster medical system of Japan

6,434 peoples were died by the Great Hanshin-Awaji Earthquake. A subsequent survey found that 500 deaths were thought to be as "Preventable Disaster Death (PDD)". The experience of the 1995 earthquake showed the problems of medical system in that Japan as shown below;

- Incomplete field medical system in acute phase (within 48 hours after the onset of disaster)
- Incomplete hospital system for disaster base medical
- Absence of wide-area transport system for critically ill patients
- Issue of the transmission system of medical information

A new disaster medical system was established based on the review of these problems. Specific implementation was "1. Establishment of DMAT", "2. Development of disaster base hospitals", "3. Development of "wide-area medical transport" with planning", and "4. Development of "Emergency Medical Information System (EMIS)"". We overview the four points below.,

DMAT

DMAT (Disaster Medical Assistance Team) is a flexible life-saving medical team with mobility that takes charge of field care in the acute phase (within 48 hours after the occurrence of disaster). DMAT members have trained as specialists.[50] They reach to the disaster affected area and deliver medical care rapidly, such major earthquakes, airplane or train accidents, etc. DMAT is self-sufficient and corresponding medical transport of wide-area. The function and tasks of DMAT are as follows;

- Collection of medical information and communication in the disaster affected area
- Triage,[51] emergency treatment, and transport in the disaster affected area
- Support the medical institutions in the disaster area, particularly disaster base hospitals
- Medical support at the Staging Care Unit (SCU)
- Working as an flying medical team on helicopters or airplanes during wide-area transport
- Medical control on the disaster affected site

[50] "Training for Japan DMAT Members" is conducted by National Disaster Medical Center and Hyogo Emergency Medical Center.

[51] This word is derived from the French word meaning "selection". In the context of disaster medicine, triage means the process of determining the priority of patients' treatment and their destinations of transport at the scene of a disaster with many patients based on the urgency and severity of their condition considering the capabilities and equipment required.

The activities of DMAT are legally based on the following two arrangements;

(1) Agreements between prefectures and medical institutions signed at ordinary times

(2) Disaster management plans developed by MHLW, MEXT, prefectures, National Hospital Organization, etc.

DMAT is dispatched on request from the prefecture affected by disaster. However, when the MHLW decides as an urgent need, MHLW can request the dispatch of DMAT in appropriate prefectures without the request from the affected area[52].

The Disaster Management Basic Plan based on the Basic Act on Disaster Control Measures includes the roles of the national government, prefectures, and Japan Red Cross Society in the request to dispatch DMAT. National and local governments are expected to develop and implement disaster management operation plans and local disaster management plans based on the Japan DMAT Activity Guidelines.

Disaster Base Hospitals

The 1995 Great Hanshin-Awaji Earthquake revealed that Japan did not have sufficient hospitals for providing disaster medicine in large scale. In 1996, Ministry of Health and Welfare (at that time) prescribed “the medical institutions for the reinforcement of the system for primary emergency medical care at the time of a disaster.” “Disaster base hospitals” provide the following function;

- The disaster base hospitals have the ability to perform 24-hour emergency response to disasters and to receive and transport patients in the disaster area.
- The disaster base hospitals have the ability to receive and transport critically ill patients using helicopter or other means.
- The disaster base hospitals have a system for dispatching medical relief teams in collaboration with firefighting organization (emergency firefighting support teams).
- The disaster base hospitals have the ability to dispatch doctors to work onboard helicopter.
- The disaster base hospitals have sufficient medical facilities, medical care system, information collection system, heliport, emergency vehicles, and the materials and equipment for self-sufficient dispatch of medical teams.

There are 610 disaster base hospitals in Japan in 2012 as the central base for disaster medical care. National Disaster Medical Center is organizing “Disaster Medicine Worker Training” every year for the personnel of disaster base hospitals.

[52] DMAT activity is described a measures "for the time being" on DMAT Activity Guidelines.

Wide-area Medical Transport

While a major disaster produces a large number of patients, it also restricts the function of hospitals in the affected area and causes shortage of personal and material resources. The system for wide-area medical transport was created so that the patients requiring emergency treatment may receive advanced medical care outside of the disaster area and the burden on the healthcare providers in the area may be lessened in such situation.

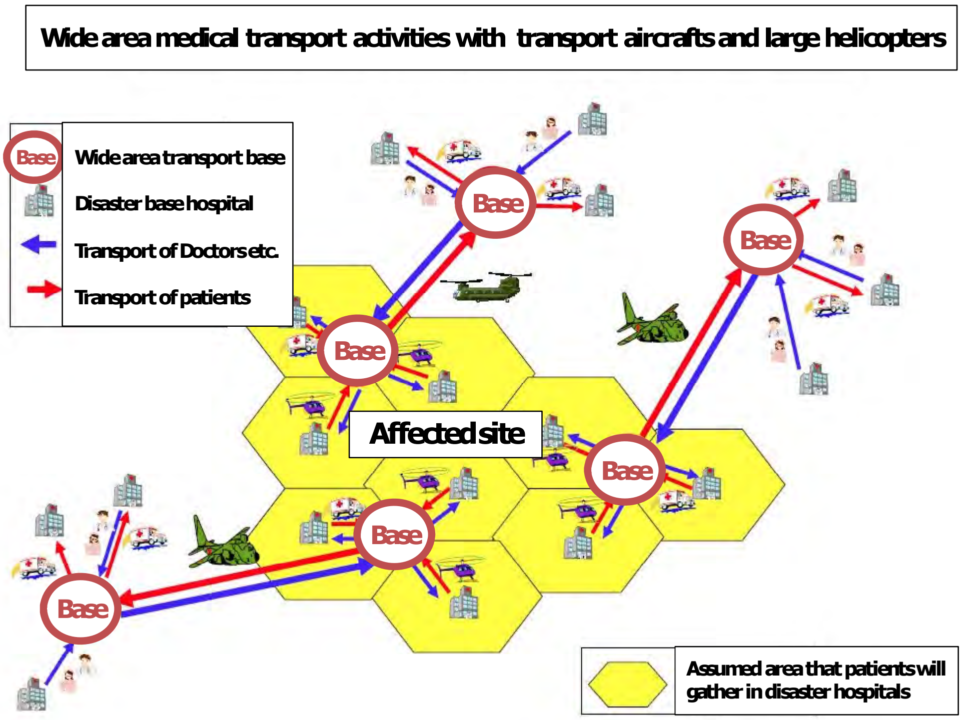

Fig. 6-3: Concept of Wide-area Medical Transport[53] (Source: MHLW)

In the practice of wide-area medical transport, a temporary medical care facility (staging care unit: SCU) is set up in a place such as an airport in the disaster area to secure the base for patient transport. DMAT teams sent from outside of the disaster area perform “stabilization” for ensuring safety in wide-area transport of patients and “triage” for transport. The patients considered to need wide-area transport from the disaster area are transported by large airplanes, such as those of Japan Self-Defense Forces, to airports outside of the disaster area. The safety of patients during transport is ensured, as DMAT and SCU members have been specially trained for onboard medical care. This enables the patients to receive advanced medical care promptly at the emergency medical centers they are transported. Emergency medical teams wait at the destination airport to transport injured and sick people to emergency medical centers as soon as possible. Injured and sick people are able to receive prompt, advanced medical care at the emergency medical centers to which they are transported (Figure 6-4).

[53] Original figure is in Japanese.

Emergency Medical Information System (EMIS)

At the time of the 1995 Great Hanshin-Awaji Earthquake, Hyogo Prefectural Government already had an operational emergency medical information system. However, the surge of many patients arriving at the medical institutions around the disaster area exceeded their ability to respond. Furthermore, there were many problems such as the damage to administrative offices and the disruption of telecommunication and lifeline networks. In response, the (then) Ministry of Health and Welfare formed the Study Group on Disaster Medical System Following the Great Hanshin-Awaji Earthquake in April 1995 to consider how information systems could support the emergency medical system during an extensive disaster such as an earthquake. Thus, Emergency Medical Information System (EMIS) had introduced in 1996.

At the time of a disaster, EMIS enables the people both in and outside of the disaster area to share information concerning disaster medical, such as the availability of medical institutions, making it possible to gather and provide diverse care and relief information in the disaster area.

- Collection of nationally standardized disaster medical information via prefectural systems
- Collection of disaster medical information from medical institutions and securing the capabilities of the medical care system, such as patient transport during a disaster
- A reliable network with two centers, east and west
- The role as the portal site on disaster emergency medicine at ordinary times and during a disaster

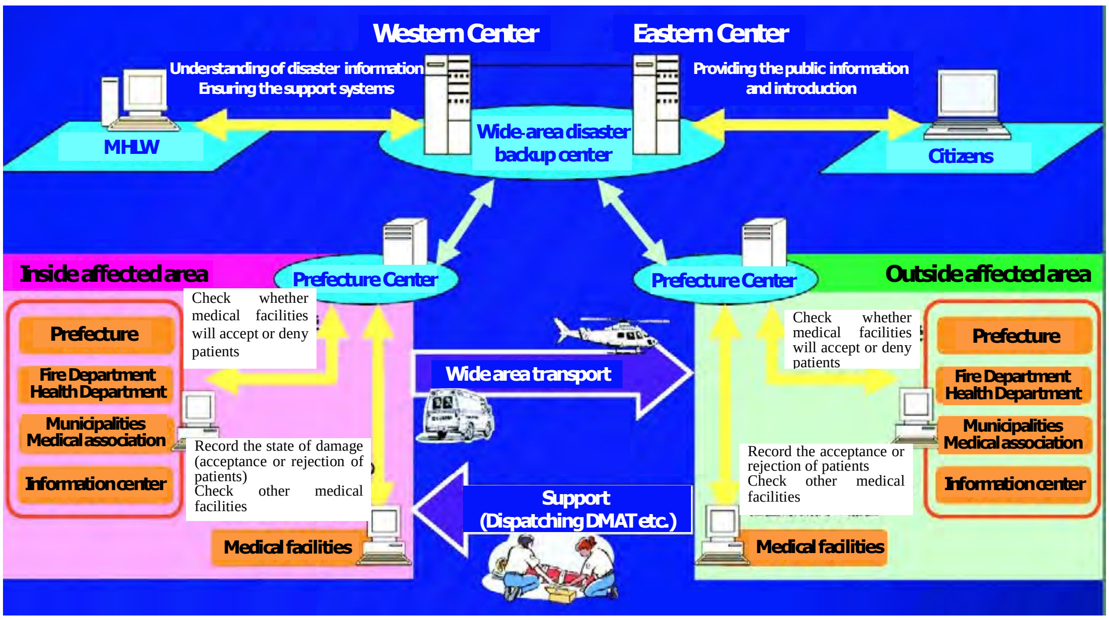

Fig. 6-4: Concept of EMIS[54] (Source: EMIS)

[54] Original figure is in Japanese.

EMIS was constructed with the participation of NTT DATA Corporation, which had experiences in developing emergency medical information systems since the 1970s. Starting from the collaboration in the stage of system concept development, NTT DATA has been taking charge of the actual operation of the EMIS system and the operation of the backup centers.

EMIS offers the following activities in disaster medicine;

- Providing up-to-date medical resource information to relevant organizations (prefectures, medical institutions, fire departments, etc.)
- Promptly gathering and providing hyper acute-phase medical information (urgent information)
- Continually gathering and providing information on the reception of patients in acute and later phases (detailed information)
- Gathering and providing the activity status of DMATs sent from DMAT-designated medical institutions

The above four points form the basis for the disaster medical system in Japan, and these played an important role during the disaster caused by the 2011 Great East Japan Earthquake. However, unlike the localized earthquake that hit the Hanshin and Awaji areas, the Great East Japan Earthquake affected a vast area and forced the transfer of a very large number of in-patients. Building on the experience obtained from this disaster, the disaster medical system in Japan is going to develop with further enrichment and strengthening of the command and coordination function, telecommunication systems, logistics support, etc.

6.2.2. Possibility of Developing Disaster Medical Systems in Developing Countries

While the previous section discussed the disaster medical system in Japan, many of the developing countries receiving JICA assistance do not have basic medical care systems. This section presents the mobile clinic project in Sudan conducted by a joint venture of Japanese private companies and an NPO in cooperation with JICA, as it is considered informative for the development of disaster medical systems in developing countries.

AXIOHELIX Co. Ltd. is a private company mainly working in IT solutions in the life science sector. This company conducted a demonstration project on the mobile clinic “Dr. Car” in Kesennuma City, Miyagi Prefecture for a year starting from 2011. The president of the company, Mr. Sivasundaram Suharnan from Sri Lanka was looking for an opportunity to develop and operate services and systems that would be beneficial from an international perspective. He had worked in software development jointly with Professor Fathelalem F. Ali of Meio University (Nago City, Okinawa Prefecture), and when he visited Sudan, the home country of Professor Ali, he came across a possibility of a new service.

Sudan is a very sparsely populated country, the population density of 16 per km^2 with insufficient doctors. Thus, there are many areas with no access to medical care. Looking at this situation, he devised a system embodied in the "Pilot Project on Mobile Car Clinic," which combines a remote medical information system and Dr. Cars, and founded a joint venture with Technology Seed Incubation Co., Ltd., Smart Energy Co., Ltd., and NPO Rocinantes. The proposal of the joint venture was adopted by the Ministry of Foreign Affairs as a "Project for Disseminating SME's Technologies to Developing Countries" under the Governmental Commission on the Project for ODA Overseas Economic Cooperation in FY 2012.

The Dr. Car used in this verification was based on a Japanese one-box car[55] In addition to general medical care equipment, the car was equipped with a tent for patient waiting space suitable for use in Africa, telecommunication tools, a generator, a solar panel, and a water purification system. Although the medical specialties in the original plan were internal medicine, dentistry, pediatrics and obstetrics-gynecology, the demonstration experiment showed that there is a demand for ophthalmology.

A new telecommunication system was developed for this project based on the specifications for an existing TV conference system. In the demonstration project, the Dr. Car was carried to a doctor-less village in Sudan and was connected via the Internet to the GEMP[56] headquarters in Gezira State and Okinawa Health and Longevity Research and Development Center, an incorporated foundation in Okinawa Prefecture. Patients' medical data (ultrasound images, electrocardiograms, etc.) were sent over these connections and medical care was provided. According to the report of the demonstration project, this new telecommunication system was found to be sufficiently effective in the telecommunication environment of the doctor-less village in Sudan. The medical equipment onboard the Dr. Car was also generally useful, except that a few problems were noted.

Fig. 6-5: Scenes from the Demonstration Experiment of Dr. Car

(Source: Final Report of the Pilot Project on Mobile Car Clinic)

55 The demonstration experiment used a car based on Toyota Hiace Super Long High Roof 2WD (200 Series) fitted by Toy Factory International Co., Ltd. in Uruma City, Okinawa Prefecture.

56 Gezira Family Medicine Project. A remote medicine project team established in Gezira State in 2010 under the assistance of Faculty of Medicine, University of Gezira.

The existing health centers (HCs) in Sudan each requires an initial cost[57] of 7,500,000 yen (about 60,000 USD) and covers a population of 5,000, but it does not have an ultrasound imaging system or electrocardiograph (ECG). On the other hand, although a Dr. Car requires an initial cost of 20,000,000 yen (about 160,000 USD), it covers a population of 33,000 and is equipped with an ultrasound imaging system and an EGC, which an HC lacks.

In the process of the verification, it was found that the severe environment in Sudan causes a long-term durability problem in the one-box car. Recommendations for improvement was made, which included the replacement of interior furniture and flooring with more durable ones, making it possible to use air conditioning while the engine is off, using a 4WD vehicle that can drive on rough roads in the rainy season, and increasing the riding capacity to 6 persons. In response, JICA provided seven Dr. Cars based on 3-ton reefer trucks[58] to Khartoum State, Sudan in August 2014. These are now used effectively in delivering medical care in the field.

For a developing country lacking a basic medical care system, it is difficult to build an advanced disaster medical system comparable to DMAT in Japan. However, mobile phone connections (GSM, 3G) are nowadays available in almost all developing countries, and these can be used in combination with ICT technologies for the transmission of a large amount of information to remote sites. The four components of the disaster medical system in Japan, i.e., DMAT, disaster base hospitals, wide-area medical transport, and EMIS can be combined with various technologies held by Japanese enterprises, as is the case with Dr. Car from AXIOHELIC, hopefully resulting in the development of appropriate technologies for healthcare in developing countries paying attention to disaster management.

Fig. 6-6: Dr. Cars Donated to Khartoum State, Sudan under the Assistance of the Government of Japan (Source: The Japanese Embassy in Sudan)

[57] Initial cost including medical equipment in both cases.
[58] Based on Mitsubishi Fuso Canter Double Cab 4WD fitted with a refrigeration system that can operate independently of the engine and a sturdy cargo compartment used as the consulting room. Various medical equipment units have been installed in the interior.

6.2.3. Example of Disaster Risk Reduction consideration by JICA in the Health sector

In this section, the example of disaster risk reduction consideration carried out by JICA in the health sector. JICA has been carried out “The Project for Cordillera-wide Strengthening of the Local Health System for Effective and Efficient Delivery of Maternal and Child Health Services” in Philippines by since 2012. The object of this project is strengthening local health system in the region to deliver effective and efficient Maternal and Child Health (MCH) services. In this project, JICA supports to strengthen the emergency transport system in the event of an emergency related to maternal and child health in "barangay mother and child emergency plan" in association with the "barangay disaster risk reduction response plan" of Philippines Department of the Interior and Local Government (DILG). The prototype of “barangay mother and child emergency plan” was developed in this project, and orientations had been carried out for the state health office, town health centers, chiefs of barangay, and so on. 355 barangays in the target area (98%) had been developed the plan. This plan includes the agreement of cooperation in emergency transport with buses and three-wheeled motorcycle drivers’ union in barangay, as well as mode of stretcher transport operation by volunteers. Also, restoration and reconstruction is planned for Eastern Visayas Regional Medical Center (outpatient building) and regional health facilities by JICA’s “The Project for Rehabilitation and Recovery from Typhoon Yolanda” (FY2013 Grant Aid) since 2014. These facilities have been designed by the consideration of resilience (resistant for earthquake and storm) under the Build Back Better policies. Healthcare facilities in communities are provided with relatively large multi-purpose spaces that can be used for stockpiling and emergency rescue activities as compared with the specifications of the Department of Health (Figure 6-7). The area hit by Typhoon Yolanda was in the process of implementation of the Project for Strengthening Maternal and Child Health Services in Eastern Visayas (2010-2014, technical cooperation) at the time of the disaster. While aims of this project were the improvement of maternal and neonatal care services at town and district public health centers, the support for establishing of financial foundation for facilities, the promoting the use of maternal and child health services at the inhabitant level, capacity development of healthcare administration staff, etc., we provided emergency aids in this project after the disaster. Considering the fact that the availability of basic emergency obstetric care equipment affects the quality of services and the authentication by PhilHealth (Philippine Health Insurance Corporation), we examined the conditions of facilities and equipment after the disaster and provided information to relevant organizations including other donors. In 2014, the government introduced a special measure granting exemption from the renewal procedures for PhilHalth facility authentication, and we monitored how this action was carried out. In addition, we provided office equipment and assisted in the reconstruction of health data to support the reopening of health administration organizations (regional and provincial health bureaus) receiving little support from donors.

Fig. 6-7: Health facilities of Philippines with the concept of Build Back Better;
(L) Eastern Visayas Regional Medical Center
(Source: Philippines National Economic and Development Authority)[59]
(R) Local health center and government buildings
by piers structure with resistance to flood (Source: JICA)

JICA conducted the Project for Capacity Development on Mental Health Services for Reconstruction Support of Sichuan Earthquake (2009-2014) in China. This project aimed to support mental health care during recovery and restoration phases. Since the 2008 Sichuan Earthquake left many people with “mental traumas” (alcohol dependence, depression, post-traumatic stress disorder, etc.), we assisted in the construction of a sustainable community-based system for support through the training of human resources in the field of mental health and psychosocial supports and the establishment of a monitoring system in the disaster-stricken area.

[59] http://nro8.neda.gov.ph/rdc-viii-endorses-php2b-evrmc-modernization-program/
(Modified partly from original figure)

6.3. Water Resources and DRR

Water is an indispensable resource for human life. Although, there are aspects that water causes natural disasters such as floods, landslides, etc. In Japan, there is an important word "*Chi-Sui*"[60]（治水）, which means to prevent natural hazard caused by water such as floods and to make conservation of rivers. "*Chi-Sui*" has associated with "*Sabo*"（砂防）, the erosion and sediment control by the laws in Japan. In this chapter, we see the water management in Japan.

6.3.1. Water Management of Feudal Lords in *Sengoku* Period (Late 16th Century)

The Buddhist priests of *Asuka* Period (6th-8th Century) had brought the civil engineering technologies to Japan[61]. After the expansion of the manor "*Sho-En*", water management had been declined. Thereafter, many civil wars occurred and long unstable era had been continued. In late 15th Century, Muromachi Shogunate lost the governance and *Sho-En* was declined. The improvement of water management had been started in the last stage of Sengoku Period (Late 16th century). Feudal Lords had been stabilized their territories and improved the quality of people's life by water management and irrigation development. The pioneers of Japanese water management were two feudal lords, TAKEDA Shingen and KATO Kiyomasa.

TAKEDA Shingen (1521-1573) was a Feudal Lord of Kai Province (Current: Yamanashi Prefecture). In the west Kofu Basin in Kai, Kamanashi River and Midai River are merged. Although, the flooding had been occurred in the merging point frequently, and there were flood damages in this area. Triggered by large flood that occurred in 1542, Shingen carried out water management over 20 years. Shingen split the flow of Midai River and built new "Hon-Midai River" and also moved the merging point and built rock dam to weaken the water flow. Also, he built the rock embankment called "*Shingen-Zutsumi*" to mitigate the water stream. Shingen developed flood forests, farmlands, irrigation system, road etc. to maintain the function of dam and embankments. Also, he periodically conducted festival to publicize the importance of water management to People in Kai Province.

Fig. 6-8: Outline of Shingen-Zutsumi (Source: MLIT)[62]

[60] "*Chi*（治）" means "To control" and "*Sui*（水）" means "water" in Japanese.
[61] These Buddhist priests brought the civil engineering from *Sui* and *Tang* dynasties of Imperial China. Priest *Doto* built a bridge over Uji River of Kyoto in 646 AD. Priest *Dosho* (629-700 AD) had been involved in civil engineering works such as bridging Yodo River. Priest *Gyoki* built many farm ponds in various places, especially west Japan.
[62] Original figure is in Japanese.

KATO Kiyomasa (1562-1611) was a Feudal Lord born in Owari Province (Current: Western area of Aichi Prefecture). Kiyomasa became a Load of Higo Province (Current: Kumamoto Prefecture) in 1588. Before the entry of Kiyomasa, Higo Province was desolate land under the battle of local warlords. Particularly, Shirakawa River had frequently caused floods and brought volcanic ash of Mount Aso in the upstream. Thus, the basin of Shirakawa River was devastated.

Kiyomasa gathered a large number of civil engineering experts from all over Japan and had grasped the local situation. He landfilled old Shirakawa River path which had been meandering south of current Kumamoto Castle and built a linearized new flow path to eliminated flooding. Kiyomasa developed a castle town[63] in new land between new Shirakawa River and Tsuboi River. Floodgates and weirs were established along the lower reaches of the Shirakawa River, and the Tsuboi River was diverted from the Shirakawa River by the stone levee known as “Sewari Ishidomo,” which still stands in the Nihongi area. The Tsuboi River was used to transport goods over water to the town around the castle (Figure 6-10).

The Reign of Kiyomasa in Higo Province was only just 25 years and his civil works was done about 10 years. Flood disaster in Higo Province was reduced by water management policy of Kiyomasa, and vast farmlands have been developed with utilization of water. Higo people actively cooperated Kiyomasa’s river works, and he paid wages and rice to men and women equally. Higo Province changed from flood and barren land to the dominant province of 540,000 Koku[64] of rice in Edo Period. The yield ranking of paddy rice in current Kumamoto Prefecture is 15th of the 47 prefectures in Japan (FY 2013). And Kumamoto City, the capital of Kumamoto Prefecture, has become a government-designated city with a population about 750,000 people.

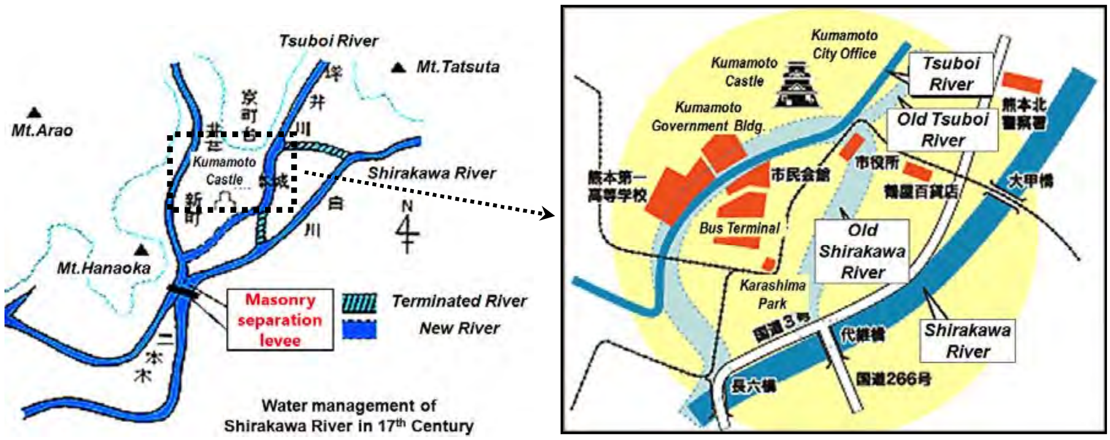

Fig. 6-9: Construction work for water management of Shirakawa River by KATO Kiyomasa[65]

(Source: Kumamoto City)

63 The structure of current central Kumamoto City is based on the castle town of Kiyomasa. As shown above, the Kumamoto Bus Terminal is the center of castle town.

64 Approximately 81,000 MT harvest of rice per year.

65 Original figure is in Japanese.

6.3.2. Water Management of Edo Period (Eastern relocation of Tone River)

TOKUGAWA Ieyasu (1542-1616) was a leading Feudal Lord of the late Sengoku Period. In 1603, Ieyasu was appointed Shogun by Emperor and founded "*Tokugawa shogunate*" as known as Edo Shogunate. Tokugawa shogunate was a samurai regime which governed Japan about 260 years until its extinction by the Meiji Restoration.

After the "*Siege of Odawara*" in 1590, Shogun TOYOTOMI Hideyoshi gave the territory of "*Kan-Hasshu*" (current Kanto region) which was ruled by Hojo clan to Ieyasu. Ieyasu was headquartered in Edo Castle[66] (current Chiyoda-ku, Tokyo), not in Odawara Castle (current Odawara City, Kanagawa Prefecture), the home of Hojo clan. When Ieyasu entered the castle, Edo was a desolate wetland. Though, he decided to develop the Edo, not returning to Mikawa (his hometown, current Aichi Prefecture) or Kansai. In 1592, Ieyasu reclaimed the "*Hibiya Cove*" which was wetland surrounding the Edo Castle by the earth and land of previously existing Mt. Kanda[67]. In 1594, Ieyasu closed the Ainokawa River that was in northern 60km of Edo.

Ieyasu founded the "Construction help system"[68] by all feudal lords after being appointed to the "*Shogun*" through the "Battle of Sekigahara" in 1600. Under this system, he carried out large-scale river works such as development of Chujo-Tei Bank[69], excavation of Akahori River and Edo River, enclosure of Moto-Arakawa River, replacement of Arakawa River, Kinugawa River, Kokaigawa River, etc. According to this development, the flow path of Tone River moved significantly to the east, and it is now flowing to the Pacific Ocean.

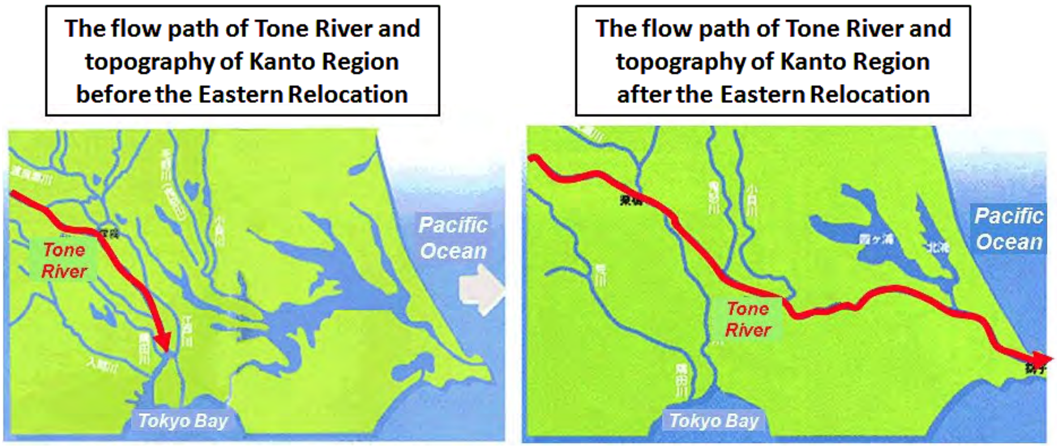

Fig. 6-10: The outline of "*Eastern Relocation*" by TOKUGAWA Shogunate[70]

(Source: MLIT)

66 The Emperor had been moved from Kyoto to Tokyo after the Meiji Restoration in 19 Century. Former Edo Castle site has become the Imperial Palace now.

67 This mountain was located near the present JR Ochanomizu Station in Surugadai, Chiyoda-ku.

68 Tokugawa Shogunate developed this system to perform large-scale civil engineering or construction works by financial and human resources of all feudal lords in Japan. The feudal loads lost their power to revolt by Shogunate had become stable until 260 years.

69 See also "Chapter 6.13. Natural Environmental Conservation".

70 Original figure is in Japanese.

Although Ieyasu did not leave clear records for "Eastern Relocation" of Tone river, the hypothesis of Ministry of Land, Infrastructure, Transportation and Tourism (MLIT) and Mr. TAKEMURA Kotaro[71] is shown below;

1. To protect the Edo from flood damage by Tone River.
2. To promote the paddy field development in the Kanto Plain.
3. Open the ship transportation to establish a transport system of Tohoku and Kanto.
4. To prevent a DATE Masamune's invasion to Kanto area.

Before the "*Eastern Relocation*", Tone River had flown into Tokyo Bay and Edo was a large-scale marshland. Ieyasu changed the flow path of Tone River and dried marshland. Thus, arable and useful lands in Kanto Plain was greatly expanded. Furthermore, Ieyasu created a new land by civil engineering works such as landfill and developed a metropolis Edo.[72]

The project "*Eastern Relocation*" of Tone River was a complex large-scale development. From the viewpoint of disaster risk reduction, this project was investment for flood control of Edo, the metropolis. After the "*Eastern Relocation*", the floods occurred in Edo were only just twice about 150 years until the riverbed of Tone River had been rose by the 1783 eruption of Mt. Asama. Also, the floods in Edo were caused by the upstream embankment breach, not a breach in downstream. Thus, "Eastern Relocation" in effect prevents the flood in Edo.

Table 6-2: History of civil engineering and disaster in Tone River[73]

Year	Construction work and disaster	Disaster Condition in Edo
1594	Enclosure of Ainokawa River	
1621	Excavation Shinkawa and Akahori River	
1625	Widening Shinkawa and Akahori River	
1629	Connecting Arakawa River in Kuge point	
1635	Starting excavation of Edogawa River	
1641	Completion excavation of Edogawa	
1643	Enclosure of Asama River	
1654	Widening and excavation of Akahori River	
1698	Widening and excavation of Akahori River	
1704	Breach in Kami-Kawamata	Flooding in Honjo, Gyotoku, Fukagawa, etc.
1728	Old Tonegawa coastal flooding	Ryogoku Bridge destructed
1742	Dike break in various places of Tone River	Flooding in whole Edo area
1757	Gongendo River outburst	Flooding in Furukawa and Sekiyado
1783	Eruption of Mt. Asama	Riverbed rise of Tone River
1786	The flood over Tone River	Flooding in whole Edo area,Ryogoku Bridge heavily damaged
1791	Breach of Chujo-Tei bank	Damage to the upstream of Tone River
1802	Gongendo bank and Nakagawa river breach	Flooding in whole Edo area
1809	Further widening the Akahori river	
1843	Widening of Akahori River	
1844	Gongendo bank breach	Flooding in whole Edo area
1846	Many embankment breach	Flooding in whole Edo area
1859	Flood in the Tone River, Arakawa River, etc.	Damage throughout Tone River basin
1871	Widening of Akahori River	
1909	Modern rehabilitation start of the Tone River	Flow facilitated to middle and lower stream, preventing flood on upstream

(Based on Japan Society of Civil Engineers(2003) and Sekiyado Castle museum in Chiba)

[71] He is a president of "Japan Riverfront research Center". Former Director-General of River Bureau, Ministry of Land, Infrastructure, Transportation and Tourism (MLIT).
[72] According to Mr. TAKEMURA, Japan is the only developed country which carried out urban development of wetland.
[73] Original Tables are in Japanese.

6.3.3. *Sabo*, the Erosion Control (Tateyama Caldera)

In Japan steep terrain forms most of the land area, thus landslides are caused by various factors. Therefore, the original Japanese concept "*Sabo*" was born in Meiji Period to control the erosion and sediment. The word "*Sabo*"（砂防）literally means "To prevent the earth and Sand", and it is correlated with "Chi-Sui", the water management. In this chapter, we see the Tateyama Caldera (In Toyama Prefecture), the *Sabo* construction has been continued until now and well known globally. (Also see "Chapter 6.13. Natural Environmental Conservation" for forestation related to Sabo.)

Tombi-Yama (Mt.Tombi) in Tateyama Mountain Range had been corrupted by the 1858 Hietsu Earthquake. Large quantities of earth and sand had been flowed into Joganji River and it caused frequent floods in Toyama Plain. Triggered by the 1891 large-scale flood of Joganji River, Toyama Prefecture invited Dutch civil engineer Johannis de Rijke, [74] and started Sabo construction since 1906. However, most of Sabo facilities had been ruined by series of massive floods and landslides since 1914 until 1922. It became difficult to continue *Sabo* construction by Toyama Prefecture alone due to the budget problem. AKAGI Masao,[75] technical officer of Home Ministry (at that time) had inspected the site in 1925. Next year, *Sabo* construction of Tateyama had been conducted under the direct control of the National government.

Even now, a large amount of sediments exists in Tateyama caldera. If this sediments outflow, Toyama Plain is covered by 1 - 2 m thickness layer of sediments. Thus, large-scale *Sabo* construction is carried out currently to prevent the discharge of sediments. Due to the large amount of snowfall in winter, *Sabo* construction work in Tateyama is conducted only half a year of April to October. Tateyama Caldera is monitored 24 hours a day by monitoring cameras mounted in various places when construction is suspended in fall and winter. Evacuation routes are also ensured for unexpected hazards. Toyama Prefecture created a landslide hazard map and also implemented awareness activities to the residents.

Fig. 6-11: Toyama Plain and Sabo construction area in Tateyama (Source: MLIT)[76]

[74] Also see "Chapter 6.13. Natural Environmental Conservation" about Johannis de Rijke

[75] AKAGI Masao (1887-1972) was a technical officer of Home Ministry flood control Bureau and he leaded the flood control constructions, such as Yoshino River, Shinano River, Kizu River, etc. Then, he had studied the flood and erosion control technologies in Austria. AKAGI advices the Sabo construction of Mt. Rokko, and he is calld "the father of *Sabo*" for his achievement of development Japan's Sabo technologies.

[76] Original figure is in Japanese.

6.3.4. Water Management and River Development from Meiji Period (around late 19th to early 20th century) to the Post-War High Economic Growth Period (1970s)

The water management in Japan before Meiji Period mainly aimed at reduction of disaster in small areas. In the case of the Tone River, flood area was configured in upstream and downstream area. Thus, upstream area like Chujo-Tei Bank (current Kumagaya City, Saitama Prefecture) and downstream area such as northern Shimousa Province (current Chiba prefecture) and southern Hitachi Province (current Ibaraki Prefecture) were suffered by flood of Tone River instead of flood prevention in Edo.

After Meiji Restoration (1868), floods occurred frequently in large rivers such as Tone River, Kiso River, Yodo River etc. Thus, it was necessary to develop fundamental flood control countermeasures in Japan. The River Act was enacted in 1896. The Sabo Act and the Forest Act were enacted in 1897. After the enactment of the 1896 River Act, all rivers in Japan had become as national property and maintained by local administrative agencies of National Government. Also, regulation was flamed to eliminate the private rights for the use of rivers, riverside areas and flowing water when it is of critical public interest. In 1910, "the first phase of water management plan" was developed to correspond the large-scale floods nationally occurred in the same year. "The second phase of water management plan" was developed in 1921. In 1933, "the third phase of water management plan" was developed, which includes subsidized projects for small and medium-scale rivers. The construction of Shin-Yodogawa floodway in Osaka is mentioned as a typical example of the river improvement work by the 1896 River Act.

After the conclusion of World War II in 1945, Japanese land was devastated as a defeated nation. Though, many typhoons attacked and many floods had been occurred Japan in this period, such as the 1947 typhoon Kathleen, the 1949 typhoon Kitty, etc. In 1949, the Flood Control Act was enacted and the 1908 Flood Prevention Association Act was revised. In 1960, the Soil Conservation and Flood Control Urgent Measures Act and the Soil Conservation Special Accounting Act were enacted and water management plan (10-year or five-year plan) based on the Acts had been developed. For landslide disaster, the 1958 Landslide Prevention Act and the 1969 Act on Prevention of Disasters Caused by Steep Slope Failure had been enacted.

①Replacement of Uji River
②Development of Kema water gate
③Excavation of New Yodo River
④Dredging of Seta River
and development of weir

Fig. 6-12: Improvement work of Yodo River by the 1896 River Act (Source: MLIT) [77]

[77] Original figure is in Japanese.

6.3.5. **Water management of urban area at present (Example: Tsurumi River)**

In 1964, the River Act was entirely revised with the economic development and administrative system reform in 1950-60s in Japan. Formulation of “master plan for construction work” had been obliged to river administration by the 1964 Act. The system had been drastically changed from sectional river management to comprehensive river management for each drainage system from upstream to downstream. The 1964 River Act was enacted in high economic growth period of Japan and urban area had undergone a rapid development. With the industrial development and concentration of population in urban area, various problems had been occurred such as water pollution, acute water shortage, urban flood caused by poor water management and sediment disasters. In this chapter, we review Tsurumi River flowing Tokyo and Kanagawa Prefecture as an example of the water management under the 1964 River Act.

In 1958, 45,000 people live in Tsurumi River watershed area and urbanization area rate was only 10%. The urbanization of this area had rapidly progressed by the development of National Railways and Private Railways, and the opening of the Tokaido Shinkansen. Thus, in 1966, the population increased to 720,000 people and urbanization area rate had become 20%. The urbanization process of this area had been continued. In 1975, the population had become 1.2 million people and urbanization area rate was 60%. In 2003, the population had been reached to 1.88 million people and urbanization rate was increased as 85%. Tsurumi River watershed area becomes one of the measure metropolitan areas at now.

However, Tsurumi River is basically “Rampage River” and floods had repeated since Edo period. Before the urbanization progress, paddy fields and reservoirs in this area had a function to hold or retard water. Pavement area had been enlarged with rapid urbanization and it prevents the water soaking through earth. Therefore, many floods had been occurred after the 1958 typhoon Ida.[78]

Date	Causes	House Number of inundation	
		Above floor level	Under the floor level
1938, June 28 - July 3	Typhoon	4,000	7,800
1941, July 19-23	Typhoon and heavy rainfall	2,140	4,590
1958, September 26	Typhoon No. 22 (Typhoon Ida)	More Over 20,000	
1966, June 27	Typhoon No. 4	6,779	11,840
1971, August 31	Typhoon No. 23	93	1,240
1973, November 10	Front line heavy rainfall	34	
1974, July 08	Typhoon No. 8	330	780
1976, September 09	Typhoon and heavy rainfall	1,210	2,730
1977, September 10	Typhoon No. 9	440	650
1979, October 19	Typhoon No. 20	80	370
1981, October 22	Typhoon No. 24	6	280
1982, September 12	Typhoon No. 18	910	1,800
1989, July 31	Front line heavy rainfall	7	190
1991, September 19	Typhoon No. 18	27	30
1994, August 20	Front line heavy rainfall	1	11
1998, July 30	Front line heavy rainfall	1	73
2004, October 09	Typhoon No. 22		190

Fig. 6-13: Watershed area and flood history of Tsurumi River[79]

(Source:MLIT)

[78] The 1958 Typhoon Ida is known as “Kanougawa Typhoon” in Japan.
[79] Original figure and table are in Japanese.

In general, it is considered as a countermeasure to prevent the river flooding such as widening of the river channel, raising the embankments, development of flood control dam, etc. However, it is difficult to prevent floods with such approaches for city areas where urbanization is under progress. Also, there is a problem that regulating ponds that had pooled rainwater are landfilled for residential development in urban area.

In Japan, flooding in urban area had also occurred such as the 1999 Fukuoka city flood, the 2000 Tokai region flood, etc. These floods in urban area cause significant damages such as halt of city functions, inundation of underground mall, and so on. The MLIT had formulated "Act on Countermeasures against Flood Damage of Specified Rivers Running Across Cities" to implement an integral flood management countermeasure in the river basin of urban areas and the act was enacted in 2003.

The function of the 2003 Act is to take integrated and accurate countermeasure for flood damages in urban areas with coordination among the 1964 River Act, the 1949 Flood Control Act, the 1958 Sewage Act and the 1968 City Planning Act (see Figure 6-14). When MLIT assigns "Specified urban river", river administrator, sewer administrator and local governments should develop "watershed flood control plan" and "flood assumption urban area". In Tsurumi River watershed area, comprehensive watershed development plan "Tsurumi River watershed Master Plan" had been developed in 2008 and it includes the "watershed flood control plan". This master plan includes multiple river management plans such as normal condition plan, natural environment conservation plan, disaster management plan (not only flood but also earthquake, fires, etc.), open-area watershed plan, and so on. Therefore, this master plan manages disaster risk reduction and natural environment conservation at the same time

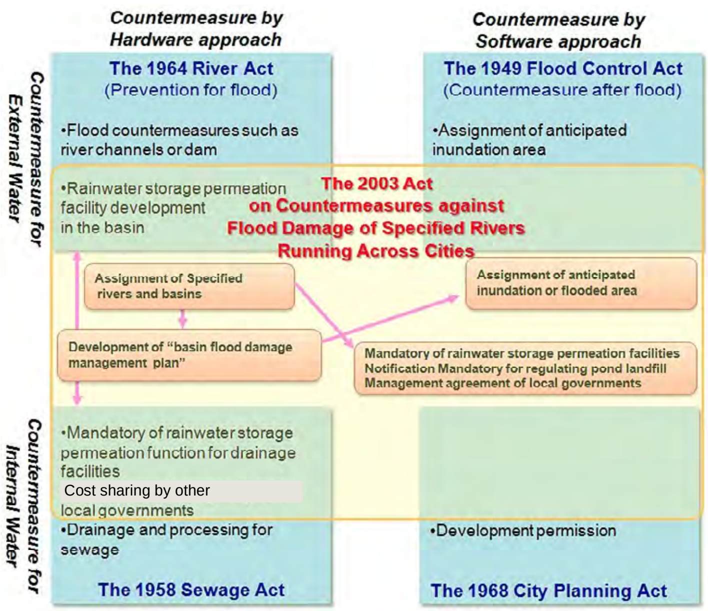

Fig. 6-14: The scheme of the 2003 Act on Countermeasures against Flood Damage of Specified Rivers Running Across Cities" (Source: MLIT) [80]

[80] Original figure is in Japanese.

6.3.6. International Cooperation of Disaster Risk Reduction (water resources management)

Among the about 1,000 natural disasters that resulted in tremendous damage in 1900-2009, water-related disasters such as flood, drought, rainstorms accounts for nearly 90%. Also, disasters due to floods and rainstorms have rapidly increased in the last 15 years due to the effect extreme weather of the recent year. In development countries, there were many disaster caused by the 2004 Indian Ocean Earthquake and Tsunami, the 2007 Cyclone Sidr, the 2008 Cyclone Nargis, the 2009 Typhoon Ketsana, the 2011 Thailand Flood, the 2013 Typhoon Haiyan (as known as Typhoon Yolanda) . These natural hazards affected severe damage to Bangladesh, Indonesia, Malaysia, Myanmar, Philippines, Thailand, Vietnam, and many development countries.

In 2002, UNESCO and the World Meteorological Organization (WMO) started preparation activities of the "International Flood Initiative (IFI)" to cope with water-related disasters that continues to increase all over the world. In 2005, the launch of the IFI has been declared officially under the participation of the United Nations University (UNU) and the United Nations International Strategy for Disaster Reduction (UNISDR). During the 33rd UNESCO General Assembly (October 2005), Japanese government proposed to establish "International Centre for Water Hazard and Risk Management under the auspices of UNESCO (ICHARM)" in the Public Works Research Institute (PWRI), external agency of MLIT. This proposal was approved by 191 countries members of UNESCO, and ICHARM was established on March 2006.

ICHARM supports government and all stakeholders involved in water-related disaster risk reduction from international level to national and local level. Also, ICHARM is aiming to serve as a global knowledge hub for water-related disaster risk reduction for observation and analysis of natural and social phenomenon, support for capacity building, development of intelligent network, transmission of information, etc. ICHARM conducts the activities of three pillars; "1) Innovative Research", "2) Effective Capacity Building", and "3) Efficient Information Networking" with keeping in mind of reflecting the needs, important issues, development stage of each region and local diversity, such as natural, social and cultural conditions.

Fig. 6-15: The three pillars for activities of ICHARM (Source: ICHARM)

6.3.7. Global Disaster Risk Reduction Cooperation by JICA in Water Resource Management

JICA has conducted various water resource management projects worldwide. When the 2011 Thailand floods had occurred, JICA started the "Project on a Comprehensive Flood Management Plan for the Chao Phraya River Basin" from December 2011 immediately after the floods. In this project, JICA supported the development of the master plan by Thai Government as a medium- to long-term flood control along with the short-term support. However, it is difficult to obtain the awareness of the developing countries for prior investment in disaster risk reduction, as mentioned previously. In this section, we see the case to be referred to as a lesson of counterpart country government officials for the future of disaster risk reduction consideration that yen loan had been canceled due to the circumstances of the counterpart country government even though the loan plan was developed for flood countermeasures of the river, and serious flood disaster had been occurred 13 years later for absence of DRR countermeasure.

Itajaí-Açu River flows through the center of the Santa Catarina State of Brazil. This river had been caused flood frequently with enormous human and economic damage. The middle part of Itajaí-Açu River is steep and downstream part is meandering with a gentle slope. Blumenau is a city, located in the downstream of Itajaí-Açu River Basin and well-known as a tourist destination, thus it is not possible to bulk up the embankment because it causes the landscape inhibition. In the consecutive years of 1983 and 1984, Itajaí-Açu River occurred flooding of 50 years return period and the economic damage of the river basin was reached in 16% of gross regional domestic production.

JICA formulated water management master plan of Itajaí-Açu River basin in 1986, and preliminary surveys were conducted in 1988 and 1990. It was scheduled to carry out the river improvement of Itajaí-Açu River basin after the survey for Japanese ODA loan in 1995. The total project cost was estimated 29.327 billion Yen and Yen loan finance was planned as 17.596 billion Yen for the middle part of improvement and spillway excavation in downstream of Itajaí-Açu River and flood control measures in Blumenau city, but this project had not been realized.

In November 2008, torrential rain had struck Santa Catarina state through January 2009. Itajaí-Açu River flood had caused 84 deaths and 54,000 people evacuation. Santa Catarina state government requested the technical cooperation in Japan again. Economic production of Itajaí City had been increased to about five times in eight years of 1999-2007. In order to protect these assets, it is required the implementation of water management operation and disaster risk reduction investment. In Brazil, natural disasters occur frequently such as landslides and floods in recent years. Large-scale landslides occurred mainly in Rio de Janeiro State mountainous areas in January 2011. After this disaster, the Brazilian government changed the disaster risk reduction policy with an emphasis on disaster prevention from emergency response and recovery-oriented.

From FY 2013, JICA has been implementing “Project for Strengthening National Strategy of Integrated Natural Disaster Risk Management” with Brazilian Government. This project is the first comprehensive disaster risk reduction cooperation for Japan and Brazil. JICA is planned to support comprehensively for the development of systems and institutional and human resources necessary to disaster risk management to understand the disaster risk and to strengthen DRR capability such as monitoring and information transmission.

6.4. Governance

6.4.1. "White Papers on Disaster Management"

In Japan, a "White Papers" generally account for annual reports released by the government. The definition of "White Papers" by Japanese government is the official publication compiled by the national government whose contents is to inform the public about the current state of politics, economies, societies and government policies.

"White paper" of Japan is currently classified into the following three types;

(1) Reports submitted to the national Diet as as regulated by relevant laws

(2) Reports submitted to the Cabinet

(3) Other

The first type is called as "statutory white papers" and submitted to the Diet as Cabinet matters. The second type is distributed in the Cabinet only. The third type is practically called as "white papers". "*White Paper on Disaster Management*" is statutory white papers prepared by the Cabinet Office. The following article of the 1961 Basic Act on Disaster Control Measures defines the legal basis of publishing the "*White Paper on Disaster Management*".

(Government measures and report to the Diet)

- Article 9. The Government shall undertake necessary measures in terms of legislation and finances in order to achieve the objectives of this Act.
- 2. The Government shall report each year to the Diet about its plans for disaster risk reduction together with a general account of measures undertaken for disaster risk reduction, as provided by ordinance.

The Basic Act on Disaster Control Measures was enacted in 1961 and publication of "*White Paper on Disaster Management*" was started in 1963. This white paper describes the current status of actions taken as disaster risk reduction in two years before the current fiscal year, and plans related to disaster risk reduction in the current fiscal year. Topics in response to social conditions in each year of publication are also featured in this white paper. The Japanese Diet members make discussion and study about disaster risk reduction in the publishing process of "*White Paper on Disaster Management*", and it led to the awareness raising among Diet members.

"*White Paper on Disaster Management*" is basically provided in only Japanese language. In 2012, after the 2011 Great East Japan Earthquake, summarized English version of the white paper was published for the first time. The World Bank and other donors have taken an interest in Japanese DRM in recent years. These measures have a long history since the enactment of the 1961 Basic Act on Disaster Control Measures. The publishing of "*White Paper on Disaster Management"* and other materials are expected to be translated in English in order to transfer to transfer the DRM knowledge of Japan to the world.

6.4.2. International Cooperation in Fire Management

The Fire and Disaster Management Agency (FDMA) of Japan implements various types of training for personnel of firefighting agencies in developing countries.

"Fire Management Administrator Training Programs" had been implemented since 1989 which was a training course that focuses on development of fire management administrators. As for technical training in firefighting, "Rescue Techniques Training" had been implemented since 1987, in addition to "Firefighting Techniques Training" since 1988 and "Fire Prevention Techniques Training" since 1990. In 2014, "Firefighting Techniques Training" and "Fire Prevention Techniques Training" had been integrated into "Fire and Disaster Management Training". The Osaka Municipal Fire Department implements "Rescue Techniques Training", and the Kitakyushu City Fire Department implements "Fire and Disaster Management Training". "Rescue Techniques Training" has accepted a total of 242 trainees, while the "Fire and Disaster Management Training" has accepted 239 trainees through 2014. FDMA has been working together with JICA to provide country-specific training to respond to the requests of developing countries, and implemented Fire Fighting Operations Training for Iran from 2012 to 2014. FDMA has been implementing Improvement of Fire Service Administration Training for Malaysia from 2014 to 2016.

Technical cooperation has been proactively implemented by local public organizations and fire departments using the scheme of JICA Grassroots Technical Cooperation Projects. The Nagoya City Fire Department was the first to implement this type of cooperation when it provided disaster risk reduction cooperation in the grassroots technical cooperation framework to Madagascar from 2000 to 2003. The cooperation improved Madagascar's fire management organization and enhanced its capacity. Through these efforts it had succeeded in greatly reducing the frequent forest fires caused by slash-and-burn agriculture and landslides triggered by the collapse of mountains that had lost their water retention capacity.

From 2005 to 2008, the Matsusaka Fire Department in Mie Prefecture provided technical training in fire management and emergency rescue to Fiji. Saijo City in Ehime Prefecture worked together with local firefighting personnel to develop and implement a fire management education program in the city of Huế in Vietnam from 2011 to 2013. The Sapporo City Fire Department implemented a fire management Administration course for China in 2006, and started a fire management Technical Assistance Program for Ulaanbaatar, Mongolia in 2013 to run through 2015. The Kitakyushu City Fire and Disaster Management Department is implementing a Peat and Forest fire management Technology Diffusion Model Project for Balikpapan, Indonesia.

Note: The point of this handbook is to introduce examples from Japan during the development of JICA projects to serve as references for disaster risk reduction considerations, thus descriptions of emergency aid have been omitted from this section.

6.4.3. Capacity Building of Turkish Government Personnel through Training in Japan

JICA has implemented disaster risk reduction cooperation for Turkey for many years. On 17th August, 1999 the earthquake of 7.4-magnitude struck the city of Izmit in Kocaeli Province in the northwestern part of Turkey. Then on 12th November, the 7.2-magnitude earthquake struck the city of Düzce, also in the northwestern part of the country. 18,000 peoples died from these earthquakes. Turkish government agencies were unable to respond appropriately because the scale of the damage exceeded the government's expectations at that time.

The Turkish government had started various initiatives to improve its response capacity and strengthen disaster risk reduction systems. In 2001, JICA started to cooperate with the Turkish Ministry of the Interior to improve the disaster risk reduction capacity of Turkish administrative officials. In the country-specific group training course Disaster Measures and Reconstruction, key people in charge of core disaster risk reduction administration in Turkey were sent to Hyogo Prefecture from 2001 to 2002 to receive training about restoration and reconstruction efforts following the 1995 Great Hanshin-Awaji Earthquake. Trainees returned to Turkey after the course and convinced of the effectiveness of disaster risk reduction education and training for top administrative officials, worked to develop training curriculum unique to Turkey with the JICA Turkey Office. They implemented the Disaster Risk Reduction Measures Training Project, a technical cooperation project, for top local administrative officials in Turkey and trained 253 people from 2003 to 2004, which is one-third the total numbers of vice-governors and sub-governors. In addition, they implemented the Disaster Damage Control Project from 2005 to 2007, and through 2006 trained 390 mayors, urban development project coordinators and others from all over Turkey. Awareness of disaster risk reduction increased; one trainee said, "I understand that disaster risk reduction was important, but opportunities to systematically gain knowledge about it are very rare. This training was very helpful," and another said, "The disaster risk reduction map making exercise taught me that my responsibility is to take action of my own volition, not to make people in each city department take action. I want to work on this when I return home." Some trainees expressed a desire to continue their involvement in disaster risk reduction education, and suggested study sessions to trainers, and education and human resources development related to disaster risk reduction is still under way.

Since 2013, JICA started to implement capacity development of risk assessment methodology required for disaster risk reduction measures for the Disaster and Emergency Management Presidency of Turkey (AFAD). The aims of this project are to improve capacity of AFAD headquarters and the AFAD branch office in Bursa for managing disaster risk, and to ensure that disaster risk reduction based on risk assessment is implemented properly throughout Turkey.

6.5. Peacebuilding

JICA provides support for five sectors within the peacebuilding field. It is different in peacebuilding sectors by the attributes of each country and project. The items shown below are other sectors that could serve as references for disaster risk reduction considerations when developing projects.

Speed is the most important factor in peacebuilding, thus it is recommended to read examples in each sector in the order presented below. Also, it is noted that some sectors are overlapped.

(1) Development of Life Infrastructure

- 5.2 Building Standards Act
- 6.3 Water Resources and Disaster Risk Reduction
- 6.5 Governance
- 6.7 Transportation
- 6.12 Rural Village and Agricultural Development
- 6.15 Gender
- 6.16 Urban and Regional Development
- 6.17 Poverty Reduction

(2) Development of Transportation, Electric Power and Communication Networks

- 5.2 Building Standards Act
- 6.3 Water Resources and Disaster Risk Reduction
- 6.5 Information and Communications Technology
- 6.7 Transportation
- 6.9 Resources and Energy
- 6.11 Private Sector Development

(3) Enhancement of Health Care System Capabilities

- 5.2 Building Standards Act
- 6.2 Health
- 6.5 Information and Communications Technology
- 6.6 Social Security
- 6.11 Private Sector Development
- 6.15 Gender

(4) **Enhancement of Education System Capabilities**

- 5.2 Building Standards Act
- 6.1 Education
- 6.6 Social Security
- 6.11 Private Sector Development
- 6.15 Gender

(5) **Stable Supply of Foods**

- 5.2 Building Standards Act
- 6.7 Transportation
- 6.11 Private Sector Development
- 6.12 Rural Village and Agricultural Development
- 6.15 Gender
- 6.17 Poverty Reduction

It is similar or common between elements of disaster recovery in Japan and peacebuilding approaches. JICA implemented the Study of Reconstruction Processes and Large-scale Disasters in 2013, and a Recovery and Reconstruction Process Standards Document is attached to the final report. The Recovery and Reconstruction Process Standards Document includes standard types of recovery processes and measures that should be undertaken in the aftermath of disasters, in addition to concise explanations of specific examples. The content of the Reconstruction Process Standards Document could be useful in peacebuilding fields and is recommended where necessary.

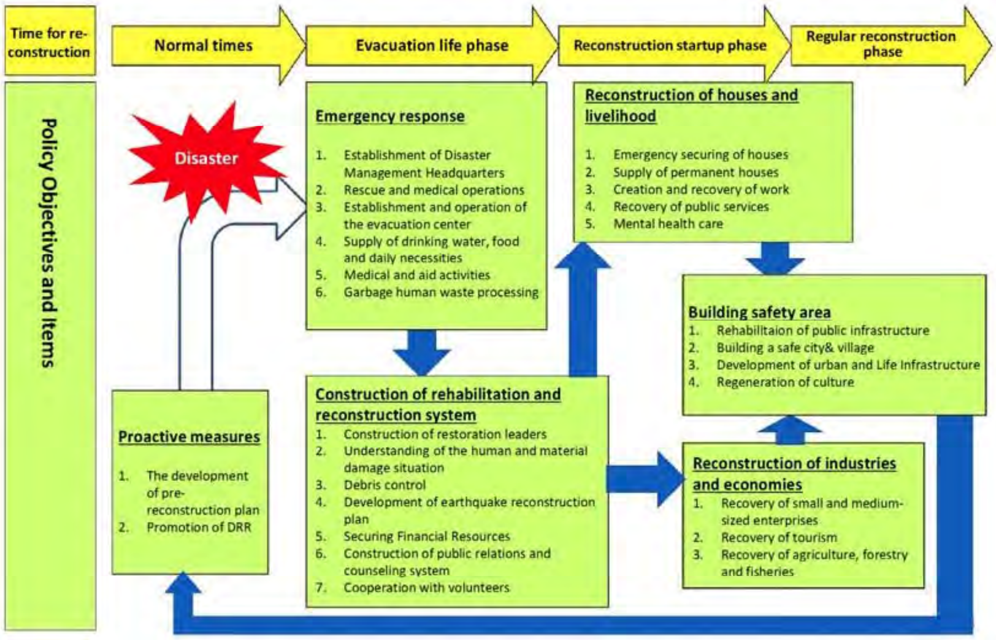

Fig. 6-16: The Recovery Process from Disasters (Source: JICA (2013)) [81]

[81] Original figure is in Japanese.

6.6. Social Security

Social security sector of JICA is divided into two areas; support for persons with disabilities, and social security. In this section, we see the examples of mainstreaming DRR in both areas in Japan.

6.6.1. Persons with Disabilities

General disaster risk reduction training and other efforts have been made in Japan for persons with disabilities and other people who require special consideration, and there is an even greater need for disaster risk reduction measure to include elderly people, persons with disabilities, infants and other people who require special consideration.[82] Given lessons from the 2011 Great East Japan Earthquake, the Japanese government amended the Basic Act on Disaster Control Measures in 2012, and the amendment reflected diverse opinions due to the government's efforts to encourage elderly people, people with disabilities and various other people to participate in local disaster risk reduction planning. The following amendments were added in 2013:

- Clarified the fundamental principles of disaster risk reduction, such as appropriate aid regulations in response to victim diversity and changing needs.
- Mandating for mayors of municipalities to create a register of names of people who require special consideration for evacuating in disaster situations. (Clarifying the relationship with local regulations on the protection of personal information)
- Enactment of special standards to apply if people who require special consideration are likely to stay at evacuation centers for some time.

Additionally, the Basic Disaster Management Plan wes amended in January 2014 to require municipalities to include in Municipal Disaster Management Plans measures to appropriately lead evacuations and confirm the safety of people who require special assistance upon evacuating. Structural countermeasures for natural disasters are implemented for landslides, soil erosion control and flood control that take into consideration the locations of social welfare facilities.

The following are measures implemented in the aftermath of the 2011 Great East Japan Earthquake (some are ongoing) for people who require special considerations. (Source: Annual Report on Government Measures for Persons with Disabilities (2014))

[82] Some people are of the opinion that "socially vulnerable people" includes women, but in terms of their participation in disaster risk reduction, it is essential that women are considered separate from persons with disabilities, elderly people and others who require assistance. Refer to the section on gender for more about this topic.

(2) **Reduction or Exemption of User Fees**

After the occurrence of the 2011 Great East Japan Earthquake, MHLW issued announcements and notifications to ensure that user fees were reduced or exempted for people who require special consideration, and that measures related to welfare services for persons with disabilities were undertaken flexibly.

(i) Responding to users

- Decisions on supporting long-term care benefit expenses and the like were postponed until 28th February, 2013.
- When municipalities exempted user fees for disability and other welfare services for disaster-affected persons with disabilities and others, the national government compensates them in full.

(ii) Providing welfare service for persons with disabilities

- Subsidy was not reduced even when standards for facilities or capacities were not met when capacity was exceeded temporarily when taking in disaster victims and others.
- Safety confirmation, counseling and other assistance provided to the extent possible at places to which users were evacuated when otherwise unavoidable were eligible for compensation as disability welfare services.
- At-home care services provided at evacuation centers were eligible for subsidy.
- Disability welfare services by providers at temporary facilities, on evacuation together with users, were also eligible for subsidy.

(iii) Dispatching elderly care workers, acceptance of evacuees, etc.

- The national and prefectural governments coordinated to dispatch elderly care workers from other facilities to facilities that did not have enough elderly care workers.
- The national and prefectural governments coordinated to secure destinations to which disaster victims could evacuate when further evacuate when necessary.

(iv) Assistance for restarting disability welfare services in affected areas

- Recovery assistance was implemented through government programs to subsidize expenses for recovering and reopening assistance facilities for persons with disabilities who were affected by the disaster.
- Assistance centers were established in each affected prefecture to enable disability welfare service providers in heavily affected areas to provide consistent services even throughout the reconstruction phase and to create budgetary provisions for subsidies for improvements geared toward the reopening of businesses that provide at-home care for the elderly,

in addition to:

(a) Assistance for activity of businesses that offer employment assistance to persons with disabilities (ensuring orders for work, rebuilding logistical channels, etc.);

(b) Assistance for securing manpower for welfare and other operations;

(c) Assistance for the establishment of new services according to the Services and Supports for Persons with Disabilities Act and the Child Welfare Act;

(d) Assistance for launching core counseling centers according to the Services and Supports for Persons with Disabilities Act; and

(e) Assistance for using disability welfare services and other services given the needs of children and adults with developmental disabilities.

(3) **Mental Health Care**

- "Mental health care teams" composed of a four or five of psychiatrists, nurses and psychiatric social workers had worked with municipal public health nurses to visit and serve evacuation centers in accordance with the 1947 Disaster Relief Act.
- Symptoms of PTSD can persist for years, and the number of disaster victims suffering from depression and anxiety disorders can increase even after they move the temporary housing or return to their homes. Thus, mental health care centers were established in each of Iwate, Miyagi and Fukushima Prefectures, and nurses, psychiatric social workers, clinical psychologists and other professionals providing continuous, long-term mental health care work together with health centers and municipalities to provide counseling to people who need mental health care.

(4) **Developmental Disabilities**

- The Information and Support Center for Persons with Developmental Disorders in the National Rehabilitation Center for Persons with Disabilities provided information about points to keep in mind while assisting persons with developmental disabilities to people working in affected areas, in order to help make their assistance go more smoothly.
- The center prepared a manual of required actions to take in disaster situations, posted it on their website and informed the public.

(5) **Employment Assistance**

- "Special consultation counters" were established in local employment centers for persons with disabilities in April 2011, immediately after the earthquake, and those counters provide various types of assistance.
- Local employment centers for persons with disabilities began to visit evacuation centers in May 2011 when they learned of such employment needs from government employment assistance centers that had visited the evacuation centers for consultations previously.

(6) **Ensuring Educational Opportunities, Encouraging Attendance, etc.**

- MEXT provided assistance to encourage school attendance in order to ensure educational opportunities for young children with disabilities. The ministry also ensured that prefectural boards of education would accept students from affected areas into their schools.
- MEXT provided funding for encouraging attendance among young children to special needs schools and programs that had become difficult to attend due to the disaster. In an effort to ensure that young children with disabilities would receive assistance toward attending school, the ministry also provided funding for the urgent dispatch of school counselors and other experts to schools in order to provide sufficient mental health care to affected young children, including those with disabilities.

(7) **Handbook for Teachers**

- The National Institute of Special Needs Education created a handbook for teachers in 2011, and distributed it to relevant institutions in addition to posting it on the institute’s homepage.

(8) **Understanding Young Children’s Situations, etc.**

- MEXT and MHLW have requested that prefectural boards of education and entities in charge of welfare for children with disabilities inform the public of the connection between education and welfare and of the existence of counseling centers that assist children with disabilities.

6.6.2. **Social Security**

Japan has been affected by many disasters and there are many regulations regarding the social security system for disaster situations. In addition, many regulations were revised after the 1995 Great Hanshin-Awaji Earthquake. Japan's social security system for disaster situations has drawn attention from the global community for its social risk reduction (SRR).

At a seminar held at the World Bank Disaster Risk Management Tokyo Hub on 6th November, 2014, Arup Banejri World Bank Senior Director[83] lectured that Japan has to offer the following knowledge to the rest of the world:

(1) **Livelihood protection transfer**

- Low-interest loans for pensioners
- Unpaid wage advance[84]
- Employment training and job-matching
- Their operation are decentralized to municipalities

These policies are important toward mainstreaming disaster risk reduction and are implemented as a matter of course in Japan. However, most documents have not been translated into English and thus have not been shared with the global community. In the near future, Japan should organize its social welfare policy for disaster situations and proactively share it with the rest of the world.

Reference documents:

A. Banerji (2014) "Social risk management for mitigating social and economic impacts from natural disasters", World Bank Public Disaster Risk Management Tokyo Hub Seminar, November, 6 2014

[83] Global Practice for Social Protection and Labor
[84] Refer "Chapter 6.11 Private Sector" of Maiya part for how wages are handled in disaster situations.

6.7. Transportation

Advanced safety countermeasures had been taken in the transportation sector in Japan for frequent natural disasters. There are various countermeasures such as structural or technical approaches. In this section, we focus on the safety countermeasures for natural disasters.

6.7.1. Countermeasures of Disaster Risk Reduction for railways

(1) **Tokaido Shinkansen (JR Central)**

The Tokaido Shinkansen is a high-speed rail which connects between Tokyo and Shin-Osaka established by JNR (Japanese National Railways, at that time) on 1st October, 1964. JNR was privatized and divided into seven JR companies in 1987, and Central Japan Railway Company (JR Central) operates the Tokaido Shinkansen now. The Tokaido Shinkansen is the oldest Shinkansen line in Japan, thus there are structural design issues for resilience of earthquake. JR Central has undertaken various disaster risk reduction countermeasures to solve these issues with consideration of the damage caused by major disasters.

Earthquake early warning system

The earthquake early warning system of JR Central is consisted of three components; (1) EEW (Earthquake Early Warning) provided by JMA (Japan Meteorological Agency), (2) Seismographs along the railway that directly measure shaking on railways as an independent system of JR Central, and (3) Terra-S (the Tokaido Shinkansen Earthquake Rapid Alarm System), which detects major earthquakes from distant seismic source and indicates rapid alarms.

Terra-S automatically analyzes the primary waves (P-waves) of earthquakes at 21 locations along the Tokaido Shinkansen, and indicates alarms for existence of disaster effect for trains. When Terra-S issues an alarm, the electric power supply for trains is automatically interrupted, and trains stop before the reach of secondary waves (S-waves). The systems were updated to enable the linkage of the JMA EEW and Terra-S in 2008, and further improved and enhanced in 2013.

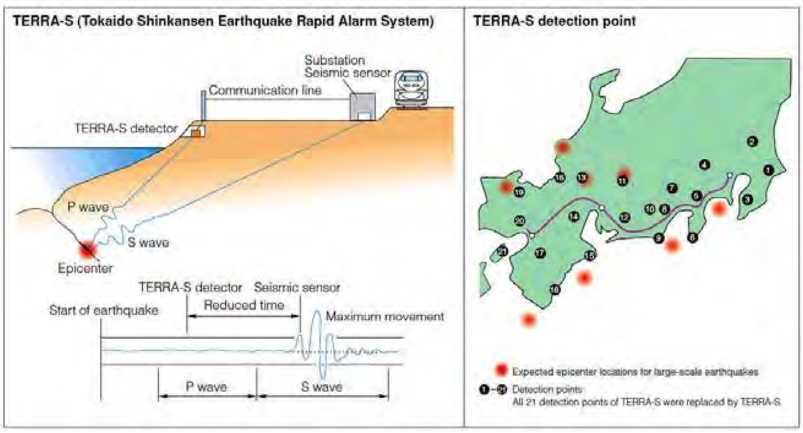

Fig. 6-17: Terra-S system of Tokaido Shinkansen (Source: JR Central)

Seismic reinforcement

The Tokaido Shinkansen runs on a region expected to get damage from earthquakes by Nankai Trough (Tokai earthquakes). Thus, seismic reinforcement work has been done to embankment, tunnels and other structures, The 1995 Great Hanshin-Awaji Earthquake destroyed viaduct piers on the Sanyo Shinkansen (operated by JR West). Therefore, JR Central proactively reinforce the piers of railway viaducts of the Tokaido Shinkansen. JR Central had reinforced 17,600 piers (around half the total) between Tokyo and Shin-Osaka by bundling steel sheets around piers of railway viaducts by 2008. In 2012, JR Central started to reinforce 2,930 piers in sections expected to be shaken strongly for long time during a Tokai earthquake in the future.

JR Central has also implemented structural countermeasures as reinforcement to prevent collapsing bridges during earthquakes, reinforcement of embankments and tunnels, etc. Most of the railway of Tokaido Shinkansen is track ballast[85], thus JR Central has been reinforcing the track using materials such as reinforced concrete blocks or geotextile bags[86] which are easy to install to prevent ballast from collapsing and spilling during earthquakes.

Countermeasures for derailment

The countermeasures are consisted three components for preventing derailment on the Tokaido Shinkansen; (1) installation of “derailment prevention guards”, (2) installation of “deviation prevention stoppers” and (3) structural countermeasures. Derailment prevention guards had been already installed on 140 km of track by the end of FY 2012, JR central is working to install them along a 456km section of track since FY 2013. Deviation prevention stoppers had been installed on all Tokaido Shinkansen cars by the end of FY 2012.

Fig. 6-18: Countermeasure for derailment of Tokaido Shinkansen

[85] Ballast is crushed stone, generally used to secure rails and other railway structures in tracked. When the Tokaido Shinkansen had opened, ballasted tracks were considered technically reliable and were used throughout the line.
[86] Geotextile is fabric material used to reinforce or protect, etc. in civil engineering typically made from polypropylene or polyester,

Countermeasures for Tsunami

JR Central had been determined potential tsunami danger zones based on tsunami hazard maps provided by each municipality. When a tsunami is expected to strike, trains will not be allowed to enter danger zone and will be moved outside. Also, their passengers will be evacuated to safe places. JR Central has been working with each municipality to revise the countermeasures according to the revision of Nankai Trough Earthquake Hazard Map in 2012.

(2) **JR East**

JR East (East Japan Railway Company) suffered damage by the 2011 Great East Japan Earthquake and tsunami. When the earthquake struck on 11th March 2011, a total of 27 trains were operating on the Tohoku Shinkansen and local lines. All Shinkansen trains were stopped automatically as a result of the earthquake early warning system. Five local trains were washed away by the tsunami, but all passengers in these trains could evacuated under the proper guidance by JR East employees and there were no deaths or injuries in station buildings or train cars by this catastrophe..

JR East had been developed earthquake countermeasures after the 1995 Great Hanshin-Awaji Earthquake, the 2003 Miyagi Earthquake, the 2004 Chuetsu Earthquake and so on. Countermeasure of JR East is consisted of three components;

- **Emergency stop**: Stop running trains promptly
- **Seismic reinforcement**: Strengthen structures to prevent collapse
- **Preventing train derailment**: Minimize damage after derailment

Emergency stop

Shinkansen earthquake early warning (EEW) system of JR East is composed by seismographs installed at 127 locations along train lines, coastlines and inland areas. When these instruments detect the P-waves of the earthquake (which precede S-waves), Shinkansen trains are stopped by this system by interrupting the electric power supply and the system applies the emergency brakes of Shinkansen automatically. In addition, the Shinkansen EEW system and JMA EEW are used in combination to enable the emergency stop of local trains. E5 series and newer type of Shinkansen train are designed to apply the emergency brakes more sharply to shortening the stopping distance. After the 2011 Great East Japan Earthquake, JR East has been enhancing the earthquake response system such as installing seismographs in 30 more locations in the Tokyo metropolitan area and inland areas, and enabling telecommunications office batteries to run for 48 hours in case of prolonged power outages.

Fig. 6-19: Reinforcement of viaducts and station building (Source: JR East)

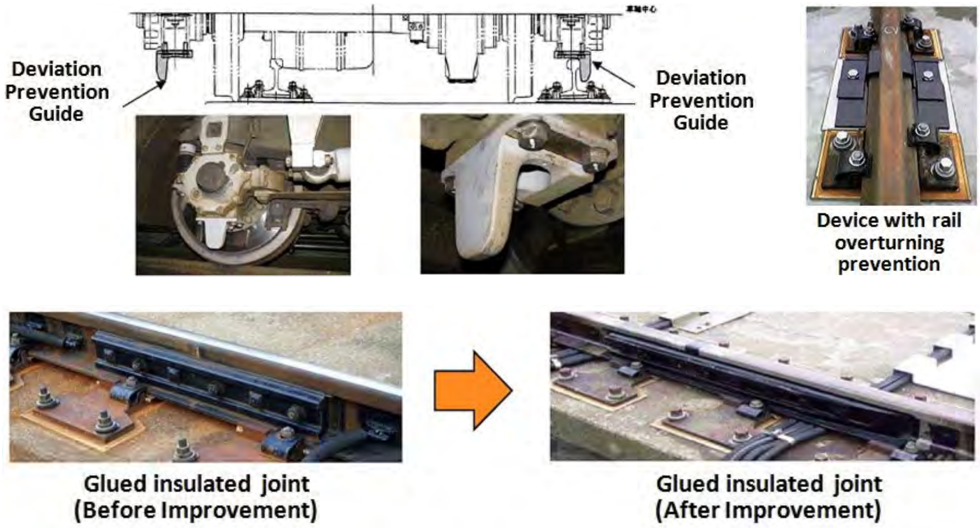

Fig. 6-20: "Deviation prevention guide" of JR East Shinkansen cars and structural improvement of rail connection (Source: JR East) [87]

Seismic reinforcement

After the Great Hanshin-Awaji Earthquake of 1995, JR East is working for seismic reinforcement to the structures such as rigid-frame bridges of both Shinkansen and local train lines in the southern Kanto area and around Sendai, which are assumed to damage by shear destruction of huge earthquakes and this reinforcement was completed in FY 2008. JR East is now reinforcing the piers of viaducts in the same areas and enhancing the earthquake resistance of station buildings, tunnels, embankments, cuttings, brick arches, etc.

Prevention of Train Derailment

A Joetsu Shinkansen train had derailed during the Chuetsu Earthquakes of 2004. JR East investigated the cause of the derailment and had installed "deviation prevention guides" to all Shinkansen cars and implemented structural changes to the rails.

[87] Original figures are in Japanese.

Tsunami Countermeasures[88]

JR East developed the "*Tsunami Response Manual*" and determined potential tsunami dangerous zones. JR East established methods of restricting operation for train when tsunami occurs. Also, JR East had been implemented seminars on tsunami and trainings for evacuating train cars. These efforts led to the rapid evacuations that occurred immediately after the struck of 2011 Great East Japan Earthquake. "*Tsunami Action Plan*" of JR East is shown below.

■JR East Tsunami Action Plan

1. When a huge earthquake strikes, assume the coming of tsunami and gather information by your own. If you cannot get into contact with anyone else, make the decision to evacuate by yourself. (It does not matter whether or not the tsunami actually comes after the evacuation.)
2. Once you decide to evacuate, check on passengers and survey the situation, then lead a rapid evacuation.
3. Join up the help of passengers and other local people in the course of exiting train cars, evacuating and gathering information.
4. Once you have evacuated, do not stay relieved and continue evacuating to upland area.
5. Evacuate together with passengers; do not return to the train or station until the tsunami warning is cancelled.

Countermeasures for landslides of slope along the railways

JR East has implemented cribwork by concrete spraying and other reinforcement to the slopes along all railways. In addition, JR East has made use of "effective precipitation", which is closely related to landslides to restrict the train operation during heavy rainfall since 2008.

Fig. 6-21: Cribwork by concrete spraying to prevent landslide
(Left: Chuo main line, Center: Yamagata Shinkansen, Right: Cribwork for natural slope
(Source: JR East)

88 As for tackling tsunami, see both sections "Saito Seika (Confectionery Company in Iwate)" and "Maiya (Supermarket in Iwate)" in "6.11 Private Sector Development"

Fig. 6-22: Installation of perforated metal fences for wind power reduction: (Uetsu Main Line, between Sagoshi and Kita-amarume (Source: JR East)

<u>Countermeasures for strong winds</u>

In 2005, an express train on the Uetsu Main Line was derailed by a sudden gust of wind and three cars were fall from the elevated bridge to the ground between Sagoshi and Kita-amarume. After this accident, JR East strengthened the restriction of train operation for blowing strong winds and installed additional wind gauges. Also, JR East installed perforated metal fences to reduce the wind power in 20 locations where high winds are likely to occur and has been researching new methods of restricting operations in strong winds.

(3) **Tokyo Metro**

Tokyo Metro Co., Ltd. is a private company that operates nine subway lines in Tokyo. Seven lines provide through service to JR and private train lines. Underground lines can suffer massive damage due to disasters. Thus, more detailed safety countermeasures are carried out compared to above-ground lines. Seismographs installed in six locations on Tokyo Metro lines detect seismic activity and send earthquake warnings to an information display in Tokyo Metro's general control center, and all trains are stopped when the Japanese earthquake scale is four or higher. Tokyo Metro introduced an online system for meteorological information to response for heavy rain and other meteorological events. Anemometers are installed near the bay area and on bridges. In order to prevent serious inundation to stations, Tokyo Metro takes following measures: (1) Water shut plates and gates had been installed at entrance and exit of each subway station. (2) Inundation-preventing machines are installed to keep water from infiltrating above-ground ventilation openings. Tokyo metro divides the complex lines into 12 regions and formed "regional disaster management networks" that work together with the government and other organizations to implement various disaster risk reduction trainings. These countermeasures worked effectively when the Great East Japan Earthquake struck on 11th March, 2011. All Tokyo metro's trains were brought to emergency stops by 14:47. All trains stopped between stations were moved by 15:36. Emergency facility inspections were conducted at 16:00, then train, operation resumed at 20:40 and trains running all night at 1:25 of the next day. These measures ensured maximum operation of Tokyo Metro.

 

Fig. 6-23: (Left) Water shut plate (Right) Water shut gate (Source: Tokyo Metro)

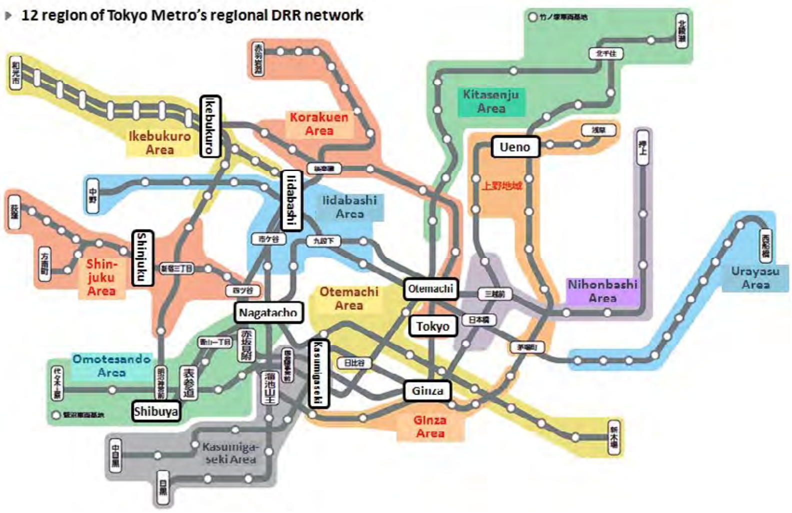

Fig. 6-24: Regional Disaster Risk Reduction Network (Source: Tokyo Metro)[89]

6.7.2. Countermeasures of Disaster Risk Reduction for Road

MLIT published "*Guidebook for Technology Transfer (Road Disaster Risk Reduction)*" in 2002. In this book, there is an interview for JICA experts who had been dispatched abroad about road development in developing countries. The table below shows the interview result of the former JICA experts who had been dispatched to the Philippines, Nepal, Laos and Tanzania. This is information of 13 years before now, but is still applicable now. It is apparent that the concept of pre-investment for disaster risk reduction is lacked for most of developing countries.

[89] Original figure is in Japanese.

Table 6-3: Results of MLIT Interview of JICA Experts

(Source: Guidebook for Technology Transfer (Road Disaster Risk Reduction))

	Disasters and road management	Support condition	Finance	Construction technology	Required technical assistance
Philippines	・Road collapse in mountainous and hilly areas (deficiency of drainage) ・Mainly the result of rainfall from typhoons, etc. ・Low-level disaster risk reduction	・Philippine- Japan Friendship Highway is very safety ・"Flood Control and Sabo Engineering Center" was established with assistance from Japan	・Insufficient budget for regular maintenance and its finances are tight	・Little expertise with technology for protecting slopes and determining geological conditions	・Risk determination ・Monitoring ・Life-cycle cost ・GIS, etc. not updated
Nepal	・Mainly cliff failure, scour, lowland flooding and other disasters caused by rainfall ・Roads supported by Donor country are well maintained ・No management capacity in Nepalese organizations	・Many assistance zones for the United Kingdom and Switzerland ・Japan providing assistance to counter landslides for roads	・Not much funding; around 7 billion yen per year, including support	・Structural specifications handled through overseas cooperation ・No maintenance plans that incorporate disaster risk reduction Countermeasures exist ・No accumulation of meteorological observations	・Photographic interpretation, hazard map updating ・Research center cooperation ・Low-cost organizational support
Laos	・Heavy traffic destroys road surfaces, poor drainage causes roads to wash away ・Cut earth collapse in mountainous areas ・Everyday maintenance is assumed, quantity over quality	・Management by World Bank and Sweden with citizen participation	・Draft of financial plan from World Bank exists, but current maintenance budget is 0	・Lacking construction machinery technology ・Swedish design standards ・No accumulation of disaster data ・Radiotelephone is used for information	・Laotian industry development ・Model project-type ・Initial and running costs ・Ensure redundancy
Tanzania	・Many sections become impassable during rainy season ・Long closures due to landslides and other sediment disasters ・Disasters occurs again by lack of sense of crisis	・Finished infrastructure was provided, but technology transfer did not take hold	・Disaster recovery is only conducted through grant aid	・Insufficient information gathering (no telephone network) ・Construction companies are foreign capital	・Accumulate foundational disaster data ・Hazard maps ・Importance of initial costs ・Opening impassable sections ・Natural disaster education

Based on these interview results, the guidebook recommends the following technology transfer for reducing disaster risk of road in developing countries.

- Concepts of construction investment i.e. life-cycle costs
- Threats and risks of natural disaster
- Countermeasure by software which can be done by relatively low cost
- Using photographic interpretation to determine dangerous areas and update hazard maps
- Importance of accumulating disaster data
- Design guidelines
- Emergency and normal recovery measure (disaster countermeasures)

- Disaster risk reduction plan (initial response system when disasters strike)

The importance of pre-investment of infrastructure for disaster risk reduction was not often discussed in the international cooperation field in 2002, before the drafting of the Hyogo Framework for Action (HFA) in 2005. It is very important for the development countries to transfer the Japanese knowledge of road disaster risk reduction gained through abundant experience of natural disasters as appropriate technology. The following is an overview of the history of road disaster risk reduction countermeasures in Japan, the recovery from the 2011 Great East Japan Earthquake and the disaster risk reduction function fulfilled by roadside station (Michi-No-Eki).

Road Disaster Risk Reduction in Japan

In Japan, many type of natural disasters occur which can cause road disasters such as earthquakes, typhoons, heavy rain, heavy snow, mudslides, landslides and volcanic eruptions. The concept of road disaster risk reduction was born in Japan in August 1968. Two tourist buses are heading for Mount Norikura on Route 41 in Shirakawa, Gifu Prefecture but they were swept into the Hida River by a landslide of 100 meter height, 30 meter width triggered by torrential rainfall. 104 people of the total 107 passengers and staff aboard the bus died by this disaster. The tragedy triggered to conduct the first “Road Disaster Risk Inspection” throughout Japan by national and local governments in the following month. “Road Disaster Risk Reduction Inspections” were institutionalized later, and are now conducted once every five years.

In Japan, the countermeasures for road disaster risk reduction are proactively undertaken by the road administrator (national government, local government, each municipalities, etc).. Road administrators are also responsible for disaster recovery with their obligation to ensure the safety on their roads. “Disaster prevention engineering” performs great roles toward minimizing the negative effects of disasters. During the development of road facilities, dangerous locations are fully understood and noted then the work is started to implement from locations that need with most urgency deliberately and sequentially. In Japan, countermeasures for slope disasters are taken such as the installation of rock sheds and rockfall prevention fences and netting. Also, disaster risk reduction manuals should be prepared for rapid response to disasters effectively.

Japanese government had amended the Road Act after the bus accident of Hida–River. The Road Act enables the road administrators to restrict or prohibit the road traffics during extreme weather conditions. The administrators can determine standards for restriction of road traffic during extreme weather. Roads can be closed in advance to prevent personal injuries by disasters. Road administrators are responsible for defining sections of road to be restricted during extreme weather events, creating standards for restriction and enforcing and removing restrictions.

When natural disasters occur, it is best to implement rapid recovery countermeasures and remove the road restrictions as soon as possible. This work is divided into “emergency recovery” and "main recovery". In addition, when major disasters occur, a preliminary step of emergency recovery of road known as "*Keikai*"[90] is implemented. The following is an example of "*Keikai*" actually implemented after the 2011 Great East Japan Earthquake.

"Operation COMB" by Tohoku Regional Bureau of MLIT

After the Great East Japan Earthquake on 11th March 2011, road infrastructure in areas along the Pacific coast in the Tohoku region was completely devastated by tsunami. Rubble and debris buried roads along the coast, and bridges were swept away. Thus, residents of coastal areas are isolated. Immediately after the earthquake, the Disaster Risk Management Office of the Tohoku Regional Bureau of MLIT contacted with other regional bureaus and branch offices to confirm the damage and plan the countermeasures. As a result, the Disaster Risk Management Office decided to restore roads that extend from the main inland route to seaward like teeth of a comb within that day

The first step of "Operation COMB" was done to ensure the north-south line of Tohoku Expressway and Route 4. Next, east-west-running roads extending from the Tohoku Expressway and Route 4 were developed to provide access to the Sanriku region. This "*Keikai*" on the comb-like network of roads provided access to areas along the Pacific coast. By 18th March 2011, 97% of Route 45 which runs along the coastline had become passable. Then the operation stage moved to the "emergency recovery". This work accelerated the recovery of the Tohoku region and helped to flow the supplies to evacuation centers more quickly and to normalize the logistics.

[90] Japanese terminology of "*Keikai*" (啓開) in civil engineering means the elimination of the road obstacles.

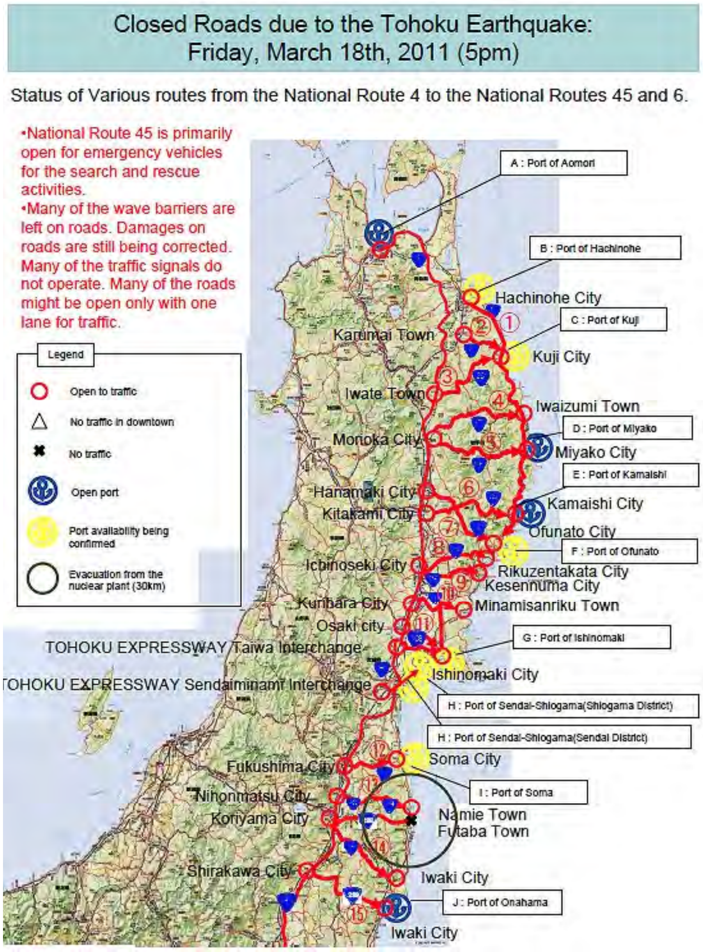

Fig. 6-25: The outline of "Operation COMB" (Source: MLIT)

Disaster shelter function of Roadside Stations (Michi-no-Eki)

A Roadside Station (Michi-no-Eki) is a government-designated rest and regional promotion facilities along roads and highways in Japan.[91] In 1993, Ministry of Construction (at that time)[92] started to develop Roadside Stations and there are 1,040 registered stations[93] in Japan now. Original intended functions of Roadside Stations were to give resting places for driver. Later, Roadside Stations had given additional function in DRR and planned to develop as disaster management centers throughout Japan after the 2004 Chuetsu Earthquake. "Roadside Station Taro" in Miyako City, Iwate Prefecture had been planned and built as a disaster management center. It played an important role after the 2011 Great East Japan Earthquake. "Roadside Station Taro" is located on upland of 140 meters elevation and listed as an evacuation center in Miyako City's disaster management plan. After the 2011 Earthquake, Miyako City and the surrounding area were suffered by power and water supply interruptions. Although, power generator had been already installed in the "Roadside Station Taro" and started to operate as an evacuation shelter. Important

[91] To register as a Roadside Station (Michi-no-Eki), a facility must provide a certain number of parking spaces, toilets, telephones and information transmission facilities, all available 24 hours per day.
[92] Ministry of Construction was merged to Ministry of Land, Infrastructure, Transport and Tourism (MLIT) in 2001.
[93] The number in October 2014.

information of this region after the 2011 earthquake was provided 24 hour per day in there. Also, many local residents were able to use the toilets of “Roadside Station Taro” washed by spring water. Additionally, other Roadside Stations without the function of disaster management center had been served as bases for rescue teams and Japan Self Defense Forces. Shin-Tomei Expressway is now under construction and all of seven service areas or parking areas are being built with functions of with emergency power generators and heliports for rescue.

Fig. 6-26: Information equipment that worked 24 hour per day in 2011 at Roadside Station Taro

Fig. 6-27: “Roadside Station Tsuyama” in Miyagi functioned as base of recovery operations in 2011

6.7.3. Port and Harbor Disaster Risk Reduction

Port of Kobe is the critical seaport of Japan. Though, the Port of Kobe got significant damage by the 1995 Great Hanshin-Awaji Earthquake and it caused a significant fall in Japan’s position in international trade and logistics. Afterward, MLIT have implemented disaster risk reduction countermeasures in port and harbor areas in Japan. But the 2011 Great East Japan Earthquake had damaged 29 ports along the Pacific coast, from the Port of Hachinohe in Aomori Prefecture to the Port of Kashima in Ibaraki Prefecture. Tsunami waves and debris destroyed breakwaters in Aomori, Iwate and Miyagi Prefectures and the seismic shaking damaged seawalls from Fukushima Prefecture to the Kanto region. Oil refineries and storage areas in port and harbor areas were damaged and oil tankers had difficulty to enter the ports by this disaster, and it affected the energy supply in some areas of Tohoku. Many compound feed factories suffered damage throughout Tohoku and Northern Kanto. Poultry farms in Ofunato, Iwate Prefecture had to slaughter one million chickens for lack of feed.[94] Damage to ports and harbors also blocked the shipment of automobile parts, and automobile manufacturers throughout the world felt the effects.[95]

94 Also see Chapter 6.11 “Saito Seika”.
95 Also see Chapter 6.11 “Toyota Motors”.

Nankai Trough Earthquakes and earthquakes occurring directly beneath Tokyo are expected to strike in Japan in the future. Thus, MLIT is proceeding with safety countermeasures for ports and harbors even more proactively than before. Specifically, the ministry's efforts are focused on structural countermeasures and systematical countermeasures.

Fig. 6-28: The outline of the DRR of ports and harbors in Japan (Source:MLIT) [96]

[96] Original figure is in Japanese.

6.8. Information and Communications Technology

In Japan, various types of disaster-related information and communications technology have been practically used such as earthquake early warning systems, community Anti-Disaster Radio Communication System, etc. Many ground communication infrastructure in eastern Japan got serious damage by the 2011 Great East Japan Earthquake than expected. On the other hand, new demands were found and developed for new disaster-resilient information and communications technology, and such technology since the 2011 earthquake. In this section,we see some of that useful technologies. (See Section 6.2 for health care-related ICT.)

6.8.1. Information communications-related law of Japan and positioning of disaster

In Japan, the disaster response of communication operators is legally defined in the 1984 Telecommunications Business Act and the 1950 Broadcasting Act. The following rules are defined in Article 8 of the 1984 Telecommunications Business Law. For specific detailed regulations, there is a provision in the Enforcement Regulations of this Act.

Article 8 (Securing of Essential Communications)
(1) Any telecommunications carrier shall, when a natural disaster, accident or any other emergency occurs or is likely to occur, give priority to communications on matters that are necessary for disaster prevention or relief efforts, for securing of transportation, communications or electric power supply, or for the maintenance of public order. The same shall apply to other communications that are specified by an Ordinance of the Ministry of Internal Affairs and Communications to be performed urgently for the public interest.
(2) In the cases set forth in the preceding paragraph, a telecommunications carrier may, where necessary, suspend part of its telecommunications activities in accordance with the standards specified by an Ordinance of the Ministry of Internal Affairs and Communications.
(3) Where any telecommunications carrier interconnects its telecommunications facilities with other telecommunications carriers' telecommunications facilities in order to cooperate with each other to ensure that the communications set forth in paragraph (1) (hereinafter referred to as "essential communications") are smoothly conducted, it shall, as specified by an Ordinance of the Ministry of Internal Affairs and Communications, take necessary measures, including concluding an agreement for preferential treatment of essential communications.

Further, the Broadcasting Act establishes the following effort specified in Article 108.

(Broadcasting in Cases of Disasters)
Article 108 In conducting the domestic basic broadcasting, etc., if a windstorm, heavy rain, flood, earthquake, large-scale fire or other disaster occurs or is likely to occur, the basic broadcaster shall transmit broadcasting which will serve to prevent such occurrence or mitigate such damage thereto.

Telecommunications carriers and broadcasting operators are private companies, though they have been designated as “designated public corporations” by the 1961 Basic Act on Disaster Control Measures, and the corresponding events for disasters are legally defined. Also refer to the section "6.9.1 energy" for the “designated public agencies”.

6.8.2. Great East Japan Earthquake and Damage to Communications Infrastructure

Ground communication infrastructure had got greater damage than previously expected by the 2011 Great East Japan Earthquake. Many communication base stations of mobile phones were destroyed or cut off from power. Also, mobile phone networks became congested,[97] and they kept people away from using mobile phones in affected areas for long periods of time.

Television, radio and Anti-Disaster Radio Communication System work to provide disaster information to residents when disaster occurs. However, most television relay stations could not transmit content[98] due to widespread power outages in the aftermath of the 2011 Great East Japan Earthquake and people could not use their television sets. Anti-Disaster Radio Communication System were thought to be the last bastion in disaster situations, but 753 outdoor loudspeakers installed as part of the Anti-Disaster Radio Communication System along the Pacific coastline were either washed away by the tsunami waves or the emergency batteries had expired because of the widespread power outage. Furthermore, eight stations for broadcasting over the radio communication systems were completely destroyed because the town office buildings that housed them were either flattened by the earthquake, or flooded by tsunami waves.

On the other hand, most of radio relay stations were able to transmit contents; only four station stopped to transmit on 18th and 19th March 2011. Therefore, 24 municipalities in the three Tohoku prefectures hit hardest by the disaster (Iwate, Fukushima and Miyagi) established “emergency disaster FM radio stations”. These stations provided information about daily living (updates on water supply, food, supplies, bus travel, etc.) and communication from town offices as well as information to comfort and calm disaster victims. The survey by Ministry of Internal Affairs and Communications (MIC) revealed that all municipalities viewed the emergency disaster FM broadcasts as extremely effective in communicating information, but many municipalities did not know how to establish FM stations for disasters. Thus, MIC created the brochure “Procedure for Establishing Emergency Disaster Broadcast Stations” and posted the document on the Tohoku Bureau of Telecommunications homepage, where it is available for download.

After the 2011 Great East Japan Earthquake, MIC is implementing research and development to revise technical standards, strengthening communications infrastructure, solving congestion and otherwise improve measures for the interruption of the power supply to telecommunication equipment. The ministry also developed the system to lend satellite phones as alternative mode of usual communication tools and streamlining establishment of disaster FM radio stations. Smartphone become widespread in recent years, thus as MIC considers the development of Asian countries that are susceptible to disasters, it is continuing to develop and devise diffusion plans for an L-alert system to serve as a communication infrastructure for sharing local disaster information.

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97 Congestion means the difficulty of sending and receiving signals as normal due to heavy traffic on networks.
98 MIC found that 120 television relay stations were unable to transmit content on March 12, 2011. All damaged television relay stations were restored by June 1, 2011.

6.8.3. Development of New Disaster-Resilient Information and Communications Technology

(1) VSAT (Very Small Aperture Terminals)

Ground communication infrastructure was affected in wide area by the 2011 Great East Japan Earthquake. Satellite phones[99] were uses as communication tools in a wide variety of fields. It proved how vital satellite communication is to ensuring communication capacity in affected areas.

It is also found that new emergency satellite communication networks must be established in disaster situations in order to connect existing satellite communication networks by the experience of this disaster. However, expert technique is required to set up the small aperture terminals (SAT) to establish emergency connections to satellite communication networks. Disruption of roads and other obstacles in the aftermath of the 2011 Earthquake made it difficult to transport VSAT equipment in some cases. Also, crustal movement by the earthquake changed the orientation of satellite antenna and it blocked communication in some cases. To overcome these problems, SKY Perfect JSAT Corporation developed compact instruments for easy, rapid establishment of emergency satellite communication networks in disaster situations.

VSAT prototype developed by SKY Perfect JSAT are equipped with automatic capture technology that enables the user to connect to satellite communication networks at one push of a button, even when an expert is not available. The spec of test model is 45 cm x 60 cm x 100 cm (when the antenna is stored) and weighs 39 kg; it is easily transportable by cars or helicopters. In addition, electric cars and plug-in hybrid vehicles[100] can serve as an external power source for the test model, and once the equipment is set up and plugged into the power source, it is ready to operate independently and connect to satellites after around three minutes of charging.

The main users of VSAT are assumed as employees of local governments or municipalities. If they lack the technical expertise, it will be able to rapidly establish a satellite communication network and secure an alternative communication means after ground communication infrastructure has been destroyed in a major disaster. SKY Perfect JSAT had demonstrated the prototype of VSAT in 2013, and many disaster risk reduction personnel of Miyagi Prefecture were receptive and positive about the VSAT. If the VSAT can be further improved and made more practical, it could be used in major disasters outside Japan as well.

Fig. 6-29: Prototype VSAT (Source: SKY Perfect JSAT Corporation)

[99] Refer also to the “6.11 Private Sector” of Maiya.
[100] Refer also to the “6.11 Private Sector” of Toyota Motors.

(2) **MDRU (Movable and Deployable ICT Resource Unit)**

The Nippon Telegraph and Telephone Corporation (NTT) is developing movable communication equipment to ensure local communication in areas affected by major disasters. NTT started making the ICT unit smaller in 2012, and NTT developed the compact ICT unit for installation in motor vehicles in 2013. The unit is officially called a “Movable and Deployable ICT Resource Unit” (MDRU). MRDU is a van type vehicle installing the small ICT unit with an air-conditioning unit and power unit with a generator. MDRU can use as an emergency communication vehicle.

When disaster occurs, Wi-Fi and other communication networks within afflicted areas can be established immediately by dispatching and installing MDRU in afflicted areas. MDRU has their own power sources with generators and can operate continuously for five days or more, even in situations where external power sources are not available due to disasters or other factors. NTT is currently developing an attaché case-style ICT Box and is striving for an even more compact unit by modularizing required functions.

MDRU is drawing attention outside of Japan as well. MIC received a request from the Philippine government after a catastrophe of Typhoon in November 2013, and is working together with the Philippine Department of Science and Technology and ITU-D[101] to test MDRU in the Philippines from 2014 until September 2015.

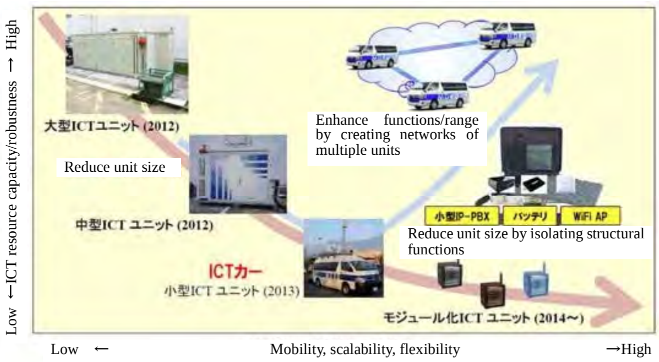

Fig. 6-30: Development Roadmap for NTT’s Movable ICT Unit and Emergency Communication Vehicles Equipped with MDRU (Source: NTT)

[101] The ITU Telecommunication Development Sector, a part of the International Telecommunication Union (ITU). ITU-D is involved mainly in developing telecommunications technology for developing countries.

6.9. Natural Resources and Energy

JICA has been working on the issue of resources and energy with consideration the "contribution to the stable and inexpensive supply of energy resources friendly to the global environment". In this section, it will be described the disaster risk reduction considerations in the energy sector and the resources sector.

6.9.1. Energy

(1) **Designated Public Corporations**

Private companies such as energy-related companies (electricity and gas) are designated as "designated public corporations" by the 1961 Basic Act on Disaster Control Measures.

The evidence of the Articles is shown below;

(Definitions) Art. 2.

(5)Designated public corporations means public corporations such as Nippon Telegraph and Telephone (NTT), the Bank of Japan, the Japanese Red Cross Society, Nippon Hoso Kyokai (NHK) and other corporations engaged in power, gas, transportation, communication and other public utility work, all designated by the Prime Minister.

(6)Designated local public corporations means the Harbor Bureau under art. 4 para. 1 of the Harbor Act (Act No. 218, 1950), Land Improvement Districts under art. 5 para. 1 of the Land Improvement Act (Act No. 195, 1949), administrators of other public corporations operating in the area of a prefecture and engaged in power, gas, transportation, communication and other public utility work, all designated by the governor of the prefecture concerned.

(Responsibilities of designated national and local public corporations)

Art. 6. Designated national and local public corporations shall have the responsibility to formulate a disaster risk reduction plan pertaining to their respective business and to implement it as prescribed by law, and at the same time, to render cooperation in their respective activities to the prefecture, city, town or village in order that the State, prefecture, city town or village may effectively formulate and implement their disaster risk reduction plans as provided by this Act.

2. Designated national and local public corporations are obligated to contribute through their respective businesses toward the cause of disaster risk reduction, in view of the fact that their business is for the public good.

While designated public corporations are obliged to create a business plans, they can request support to such as chief of administrative agencies upon the occurrence of emergency situations. Also, "designated local public corporations" are also specified by each prefectural governor.

(2) **Safety Countermeasures for City Gas**

In the case of the 1995 Great Hanshin-Awaji Earthquake, most of the victims were died by fire. Though, fire caused by the city gas was almost non-existent. In Japan, city gas pipelines are shut off at the upstream side in case of an emergency when it detects an earthquake, and it had been worked well in the Hanshin and Awaji area.

However, it took more than three months in the restoration of the city gas network in the 1995 Great Hanshin-Awaji Earthquake. Although the damage of high and medium-pressure tube was small, low pressure tube which is located in most downstream was damaged in 5223 places, and it required a long period of time to recover. Learned from this fact, the city gas industry of Japan had promoted to introduce the polyethylene pipe which has flexibility as a low pressure pipe throughout the country. As a result, in the 2011 Great East Japan Earthquake, much wide area was devastated than the Great Hanshin-Awaji Earthquake, damaged part of the low-pressure pipe decreased as 773 locations throughout the affected areas, and restoration time has been greatly reduced as 54 days.

The Japanese microcomputer city gas meter was developed in 1984. In 1995 the year of the Great Hanshin-Awaji Earthquake had occurred, penetration rate of the microcomputer city gas meter was 80%. After the 1995 Earthquake, installation of microcomputer meter with a gas shut-off function has been obliged in Japan. In the 2011 Great East Japan Earthquake, all microcomputers city gas meters installed in households to use the city gas had shut off the gas immediately after the earthquake and it was possible to prevent the occurrence of accidents due to gas leakage.

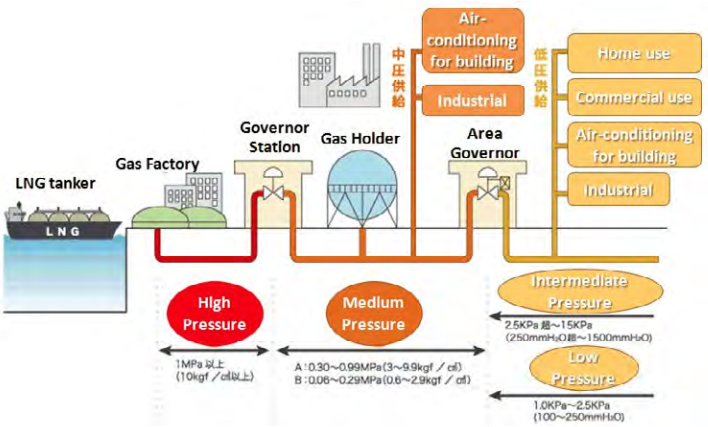

Fig. 6-31: Left: Conceptual diagram of the city gas pipe network[102] (Source: Tokyo Gas)
Right: City gas microcomputer meter (Source: Toyo Gas Meter)

[102] Original figure is in Japanese.

(3) **Safety Countermeasures of Electric Power Companies**

Electric power companies have the system as shown below to prepare for the occurrence of disasters.

(i) Development of the documentation to early recovery

Electric power companies have developed internal manuals to secure human lives and for early recovery of damage equipment and elimination of power failure.

(ii) Implementation of various training and education

(a) Operators and construction contractors have conducted the skills trainings and educations of secure skills competitions and disaster recovery trainings for young and mid-level employees in order to improve and institutionally maintain the technical capacities.

(b) Electric power companies have agreed with mutual interchange of equipment and materials or personnel for restoration support if the wide area of the damage has occurred in the power transmission and distribution facilities at the time of disasters.

(iii) Cooperation for emergency traffic with local governments and polices

Electric power companies have acquired the “emergency traffic vehicle designation” by arrangement in advance. Also, they have signed “Agreements for fuel utilization” with gas stations and oil companies to ensure the fuel under the condition of disaster occurrence.

(iv) Collaboration with construction contractors at the time of disaster

Electric power companies have contracted with construction contractors at the time of natural disasters occurrence to cooperate and collaborate (accident survey, facilities recovery, individual power outage correspondence, etc.) or to mobilize them immediately when companies suffered significant damage to their facilities.

(v) Power generator vehicles

Electric power companies own 380 power generator vehicles units in Japan with comprehensive consideration of facilities forms, regional characteristics, operators, etc. When the disaster occurs, these vehicles are used as emergency power transmission for hospital, communication, public agencies, evacuation sites that have higher priority for power recovery. When the number of vehicles is insufficient due to the expansion of damage, more generator vehicles are interchanged from the surrounding area by agreement between the electric power companies. In addition, electric power companies and associated companies have about 5,700 units of mobile power generators as emergency power transmission for households.

150kVA low voltage type   1,000kVA high voltage type   Air lift type

Fig. 6-32: Generator vehicles (Source: Shinko Zoki Co., Ltd.)

Table 6-4: Number of generator vehicles owned by electric power companies (Source: The Industrial Structure Council, METI)

Electric Company	Number	Electric Company	Number
Hokkaido	33	Kansai	16
Tohoku	64	Chugoku	42
Tokyo	62	Shikoku	20
Chubu	61	Kyushu	59
Hokuriku	18	Okinawa	5

(vi) Cooperation with the Japan Self-Defense Forces

Self-Defense Forces and the Electric power companies have the mutual cooperation agreement for securing of necessity roads to disaster recovery, transportation of the recovery supplies, electric power supply to the rescue activities of the Self-Defense Forces, provision of facilities, communication lines, etc.

(vii) Multiplexed and multi-routed power transmission line network / Interchange of electricity between electric power companies

In Japan, electricity power transmission network has been built as multiplexing and multi-route. Thus in case of disasters, it is possible to transmit the electric power without the point where power transmission facilities were unable to use. Also, it is possible to interchange electricity between electric power companies. It should be noted that Roppongi Energy Service Co., Ltd, [103] which is a local electric power supplier, provided the electricity to Tokyo Electric Power Company (TEPCO) for the power shortage after the 2011 Great East Japan Earthquake.

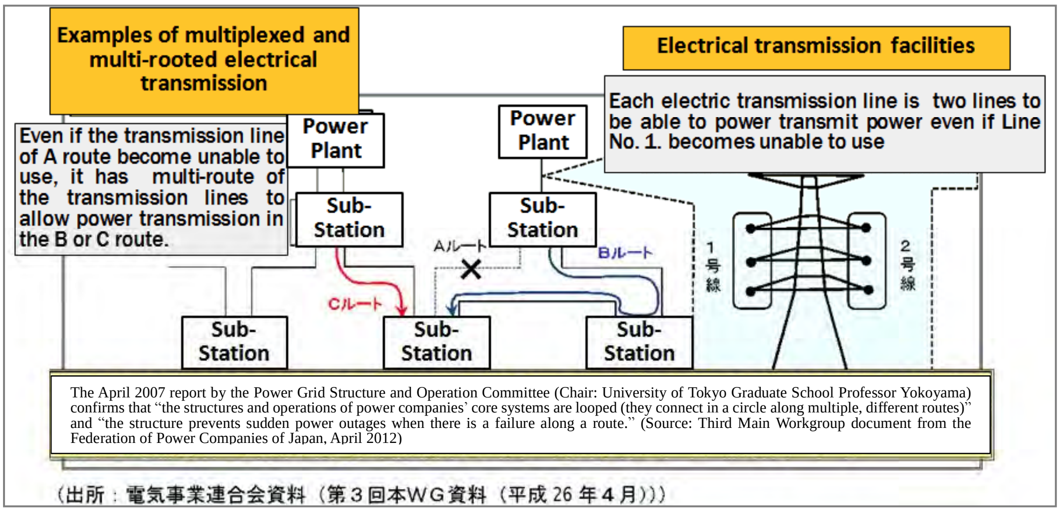

Fig. 6-33: Example of multiplexed and multi-rooted electrical transmission[104]

(Source: The Industrial Structure Council, METI)

Fig. 6-34: Power generating facilities of Roppongi Energy Services and Roppongi Hills

(Source: Mori building)

[103] Roppongi Energy Services owns the city gas power generation facility and supplies electric power to the Roppongi Hills in Minato-ku, Tokyo, building (Owned by Mori building Co,.Ltd).
[104] Original figure is in Japanese.

(viii) Prevention of electrical fires

Electrical fire is one of the most concerned disasters in urban inland earthquake. Currently, earth leakage circuit breaker is the general and popular countermeasures and its penetration rate has become 89.0% in Japan.

Single Phase
AC 100V type

Three Phase
AC 200V type

Fig. 6-35: Earth Leakage Circuit Breakers
(Source: Kanto Electrical Safety Services Foundation)

As well as other sectors, countermeasures of electric power sector have been strengthened by the experience of the earthquake disasters. For an example, we see the damage of underground cables in region liquefied by earthquake. In the 1995 Great Hanshin-Awaji Earthquake, uneven settlement of the support structures is generated by reduction of the ground reaction force due to liquefaction in many areas. Consideration of reinforce ground conditions has recommended such as using the guy anchor with the supporting structures[105] as a countermeasure for this problem. As a result, the damage had been suppressed in the 2011 Great East Japan Earthquake.

Table 6-5: Damage of support structures in liquefaction area of Urayasu and Makuhari district, Chiba Prefecture by the 2011 Great East Japan Earthquake (Source: TEPCO)

Number of support structures	Criticality of the damages		Damage rate
	Collapsed	Tilted or Sunken	
17,273	0	1,707	9.9%

[105] Steel towers and electric poles to support the overhead transmission lines

TEPCO has also conducted countermeasures of underground electric cables in the same liquefaction area. TEPCO adopted lightweight and flexible universal split steel pipe or hard polyvinyl chloride tube was as a standard for wiring underground cables. These effects were observed for the liquefaction and uneven settlement.

Table 6-6: Damage rate comparison of underground transmission cables in liquefaction area

	Number of Facilities	Number of supply trouble	Damage rate
The 2011 Great East Japan Earthquake (TEPCO area of Urayasu and Makuhari district, Chiba Prefecture	4,117	2	0.05%
The 1995 Great Hanshin-Awaji Earthquake	16,950	196	1.16%


Fig. 6-36 Left: Flexible universal split steel pipe
Right: Hard polyvinyl chloride flexible tube (Source: TEPCO)

After the 2011 Great East Japan Earthquake, the Industrial Structure Council[106] identified the types of natural disaster which should be responded in the future for electric facilities. The council is considering the issue to be addressed are the future with the evaluation by disaster resistance of current electrical facilities.

Table 6-7: Natural disasters which affect the electrical facilities and their tolerance evaluation (Source: The Industrial Structure Council, METI)

Classification of disaster	Facilities to evaluate the resistance to disaster	Evaluation item
Great Nankai Trough Earthquakes and tsunami	Fuel oil tank, LNG tank, boilers, power generation facilities such as turbines, backbone transmission and transformation facilities	Earthquake resistance and possibility of inundation
Tokyo epicentral earthquake and tsunami		
Torrential rain, etc. (Including large-scale landslides, etc.)	Transmission line tower, etc.	Measures for inundation, landslides, breakage
Storm (tornado, typhoon, etc.)	Transmission line tower, etc.	Wind resistance, measures for breakage
Large-scale volcanic eruption	Gas turbine power generation facilities	Measures for ash fall, lava flow, pyroclastic flow
Geomagnetic storm with the solar flare	The transmission and transformation facilities	Voltage drop, harmonic wave,geomagnetic inductive current

[106] The secretariat of the Industrial Structure Council is the Ministry of Economy, Trade and Industry (METI).

6.9.2. **Mining Industry**

JICA has been conducting projects for non-ferrous metals such as;

- Base metal: basic material of industries such as copper, lead, zinc, etc.
- Rare metals: essential in the current industrial equipment, including rare earth
- Precious metals

The Japanese archipelago is located in the subduction zone with large crustal movements and various mineral resources had been produced in a small scale. Mines of Japan[107] were developed since the Sengoku period (15th-16th Century) through the Edo period (17th-19th Century). After the Meiji period (19th-20th Century), the modernization of the Japanese mines had been achieved by introducing the advanced technologies of the Europe and USA. However, many Japanese mines have stopped their operation after the 1960s due to the lost of global competitiveness by depletion of resources and degradation, increasing mining costs, appreciation of the yen, etc. Thus, the number of mines under operation in Japan was much decreased. Although, Japan has the world's leading technical expertise in geological survey and mining equipment.

In this section, SATREPS[108] research "Observational Studies in South African Mines to Mitigate Seismic Risks" is mentioned as the case of mainstreaming Disaster Risk Reduction in Mining sector that is conducted by research group of Prof. OGASAWARA Hiroshi, College of Science and Engineering, Ritsumeikan University.

Mining is the major industry in South Africa which occupies the main position of the country's economy. In recent years, the depth of mines in South Africa is extended far down which reaches over 3,000 meters depth. Huge pressures take to rock in large depth and rocks are destroyed by mining. It is called as "mine earthquake" and it occurs by tomographic dislocation. The damage of mine earthquake affects not only inside of mine (cave-in of the tunnel and mining area), there is a risk of generating a collapse of buildings on the ground. Japan has been conducting the observation studies of mine earthquake to great depth gold mines in South Africa from 1993. SATREPS program from FY2009 implements the technology transfer to South Africa and observation network maintenance of the earthquake. In this project, five groups had conducted research activities in their respective fields; "Rock deformation of epicenter", "Microfracture of epicenter", "Dynamic destruction process of epicenter", "Advanced analysis of earthquake by tunnel observation" and "Rock analysis of epicenter".

Japanese technology of engineering geology technology that was developed in mining is currently transferred to the Disaster Risk Reduction areas in the many cases. [109] It is expected to support the Disaster Risk Reduction of the developing countries by the Japanese technology of Engineering Geology.

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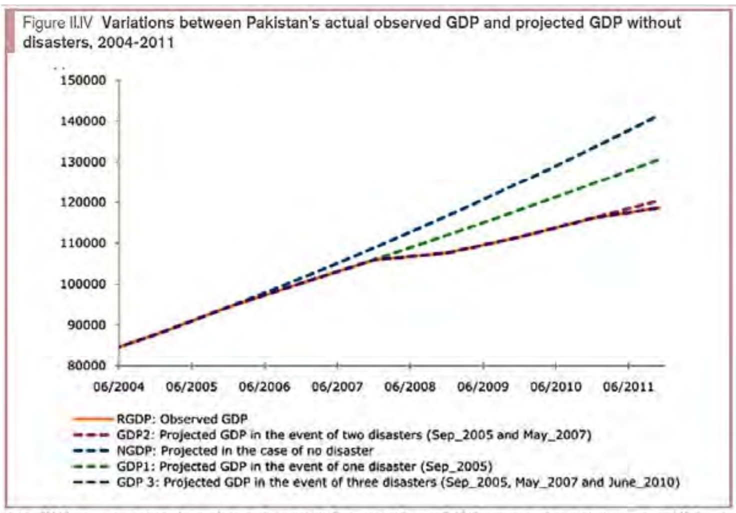
[107] Here includes coal mines those are not subject of the JICA project
[108] SATREPS is a Japanese government program that promotes international joint research, which is conducted as collaboration between JST (Japan Science and Technology Agency) and JICA.
[109] For example, it is possible to identify such as underground landslide points by non-destructive measurement.

6.10. Economic Policy

In Chapter 2, we viewed the relationship between disaster risk reduction and economics in developing countries. In general, developing countries focus only on the immediate issue of economic growth. They tend to allocate their budget for cleaning up aftermath of natural disaster and very little social investment for preparation of disaster risk reduction. The 2013 edition of the United Nations Global Assessment Report on Disaster Risk Reduction (GAR 2013) reports that natural disasters disrupt the economic growth of developing countries. Under the current world of globalized economy, damage caused by natural disasters of one country adversely affects the global economy. Thus, there is a need to focus on social investment in disaster risk reduction as a form of economic policy.[110] This section presents the results of estimations based on JICA's DR²AD Model[111] as well as the real-world example of Japan's period of rapid economic growth.

(1) Estimation of Economic Effects with DRR Investments in Pakistan by DR²AD Model

Estimations on the effects of natural disasters on GDP have been performed in the past. The Asia-Pacific Disaster Report 2012 – Reducing Vulnerability and Exposure to Disasters issued by the United Nations Economic and Social Commission for Asia and the Pacific (UNESCAP) and the United Nations Office for Disaster Risk Reduction (UNISDR) includes an estimate of the relationship between disasters and GDP using the ARIMA Model[112] and the GDP of Pakistan. The estimation showed that natural disasters inhibit the economic growth (Figure 6-37).



Source: ESCAP estimates based on data from the Centre for Research on the Epidemiology of Disasters, EM-DAT, the international disaster database, version: v12.07, Brussels: Université Catholique de Louvain www.emdat.be (accessed June 2012). Real GDP data, World Bank, GDP, Per Capita, Population data. http://data.worldbank.org (accessed June 2012).

Fig. 6-37: UNESCAP/UNISDR Estimation of the Relationship Between Disasters and Pakistan's GDP (Source: The Asia-Pacific Disaster Report 2012)

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110 A new goal has been added to UN Sustainable Development Goals (SDGs; development goals to succeed MDGs), which are currently being drafted: "Goal 9: Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation."

111 See the Report on Project Research: Mainstreaming Disaster Management (2013) for details about the development of DR²AD.
http://libopac.jica.go.jp/images/report/P1000013629.html
For the theory behind it, see the English explanation of the DR²AD Model. .
http://www.preventionweb.net/files/globalplatform/51960aa4750af%28E%29_2_DR2AD_Model%28FINAL%29.pdf

112 Auto Regressive Integrated Moving Average Model, in which time-series analysis is used.

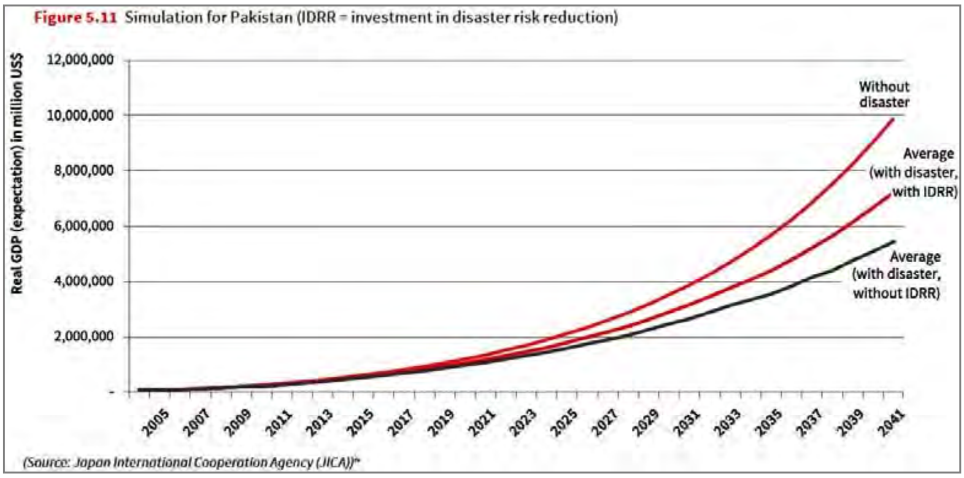

Fig. 6-38: Disaster Risk Reduction Investment and GDP in Pakistan (Calculated using the DR²AD Model, Source: UNISDR GAR 2013)

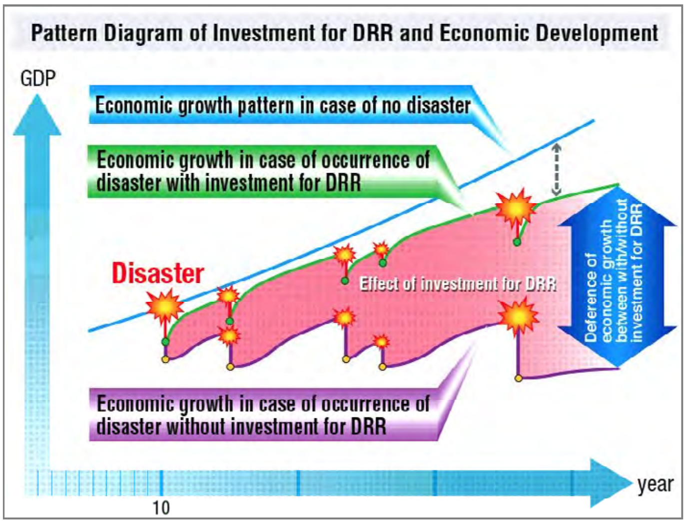

Fig. 6-39: Scheme of DRR Investment and Economic Development (Source: JICA)

JICA developed the "DR²AD Model", an economic model for estimating the effects of disaster risk reduction investment in Project Research "Mainstreaming Disaster Risk Reduction" in 2012, and used the model to estimate the relationship between disaster risk reduction investment and GDP(Figure 6-38). JICA's findings in terms of data were consistent with GAR 2013; countries that invested in disaster risk reduction experienced stronger economic growth that those that did not.

The current DR²AD Model is only for estimations thus it should be noted that GDP fluctuation becomes continuous.[113] Actually, economic activity is stagnated significantly by damage of natural disasters and it results the discontinuous GDP fluctuation as shown on the schematic in the figure 6-39. Lack of disaster risk reduction investment results the delay of recovery and reconstruction.

[113] This is the same for the ARIMA Model used by UNISDR.

The DR²AD will be improved further in order to empirically and accurately demonstrate the effects of disaster risk reduction investment to policymakers in partner countries.

(2) **Japanese Disaster Risk Reduction Investment**

Japan's High economic growth is not discussed in terms of disaster risk reduction investment. However, there is a correlation between increased coastline disaster risk reduction project costs after the 1959 Typhoon Vera or the significantly lower number of victims of natural disasters, and the country's increased GNP(Figure 6-40). Although this section does not discuss the detail, it is worth considering Japanese history as a real-world example of economic growth owing to disaster risk reduction investment.

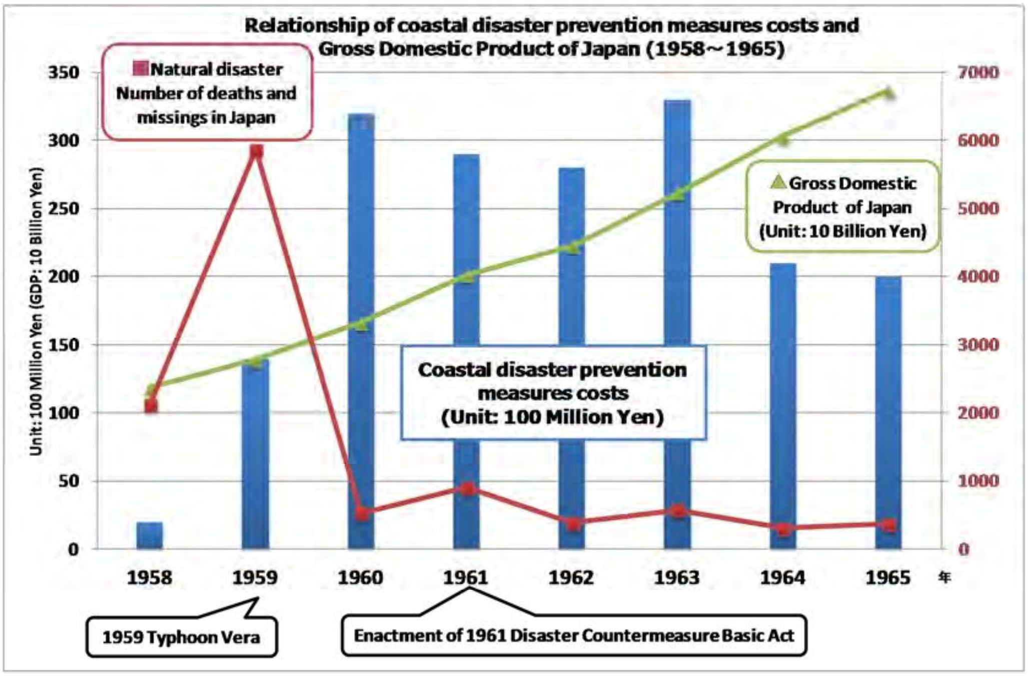

Fig. 6-40: Disaster Risk Reduction Investment and GNP in Japan (1958–1965)[114]

[114] Source of data for number of people dead or missing due to natural disasters: yearly editions of GAR
For coastline disaster risk reduction project cost: Impacts of Typhoon Isewan Disaster and Secular Changes in Post-war Typhoon Disaster, Takeshi Mizutani (2009)
For GNP: Ministry of Internal Affairs and Communications Statistics Bureau data

6.11. Private Sector Development

JICA has been promoting business of small and medium enterprises and trade-investment for the development of private sector. BCM (Business Continuity Management) and BCP (Business Continuity Planning) is associated with Disaster Risk Reduction in this sector (excluding structural countermeasures). Also, JICA has been implementing the “Wide area BCP and BCM” in ASEAN. Also, there are cases that companies kept business continuity without detailed BCP in extreme huge disaster of the 2011 Great East Japan Earthquake. In this section, we are going to review from 4 cases in Japan, two leading companies and two SMEs companies of their BCM[115] for the 2011 Great East Japan Earthquake.

(1) Toyota Motor Corporation

Toyota Motor Corporation[116] is one of the largest automobile manufacturers in the world headquartered in Nagoya City, Aichi Prefecture. Production factories of Toyota are mainly located in the Tokai region, like Toyota City, Tahara City etc. Also, there are partner companies to product Toyota vehicles, thus production factories of Toyota Group are located in all over Japan. There was no damage for Toyota’s main factories in Tokai region by the 2011 Great East Japan Earthquake. However, Central Motor and Toyota Motor Tohoku[117], group companies of Toyota, had damaged by earthquake disaster and whole Toyota group suffered enormous damage by this catastrophe. In addition, the production of crucial parts was halted due to the damage suffered by many subcontractors in the Tohoku area, which drove down domestic production by 260,000 vehicles.

Moreover, exporting ports in Eastern Japan (especially in the Tohoku region) were damaged by this earthquake and the impact had spread to overseas sites of Toyota Group. Toyota had cut 150,000 units in 14 USA factories, stopped production one month in Europe factories, 50% cut production in China and 70% cut production in India.

Toyota’s priority in disaster is shown as “(1) Humanitarian aid and assistance”, “(2) Early recovery of the affected areas or regions” and “(3) The recovery of business and production”. Toyota sets the priority to saving lives higher than the business recovery.[118] After the occurrence of the 2011 Great East Japan Earthquake, Toyota dispatched 60 employees to affected area immediately, then dispatched total 140 employees. They supported the distribution of relief supplies in affected areas. Moreover, 15 companies of Toyota group had mobilized a total of 360 employees to carry out the volunteer activities such as removal of earthquake and tsunami debris in Kesen district, Iwate

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[115] See the UNISDR(2013) “*Private Sector Strengths Applied -Good Practices in Disaster Risk Reduction from Japan*”, the case studies of Japanese companies BCM for 2011 Great East Japan Earthquake.

[116] TOYODA Kiichiro (1894-1952) was encountered 1923 Great Kanto Earthquake during his business trip to Tokyo. Kiichiro witnessed mobility and advantage of American vehicles which were rare in Japan at that time. These vehicles were used for disaster relief, reconstruction, logistics of aid supplies, etc. in disorder of disaster in Tokyo. For Kiichiro, it had become one of the major motivations for entry into the automotive industry. On 1st September 1923, the day after ten years from Great Kanto Earthquake, Kiichiro launched “Automobile production department” in Toyoda Automatic Loom Works Ltd. Later, this department becomes as Toyota Motor.
(Source: Toyota Motor(2012) “75 years history of Toyota”)

[117] The management of Central Motors, Toyota Motor Tohoku and Kanto Auto works had been integrated in 2012. The new company “Toyota Motors East Japan” was created to produce compact cars of Toyota.

[118] This point is the same as BCM of other affected companies by the 2011 Great East Japan Earthquake.

Prefecture from June 2011 through 2012. The failure of telecommunications infrastructure after the earthquake made it impossible to fully understand how local sites were afflicted. Thus, employees from each base headed to afflicted areas along the coast to determine each site's needs and deliver food, daily necessities, water, fuel and other supplies they needed.

Fig. 6-41: Toyota Prius PHV with equipment of 100V power outlets (ZVW 35, JDM model)

Fig. 6-42: Toyota's "Disaster Management Kit for automotive"

Relief supplies provided by Toyota Group has been collected to Kanto Auto Works Iwate Plant and Central Motor Miyagi Plant (both at that time) and transported to the affected areas.

After 2011, Toyota had started to add functions for their products to prepare disasters. Prius PHV[119] (JDM[120] Model) has 100V AC power outlets which can use emergency power source after the minor change in 2012. Also, Toyota developed and is selling "Disaster Management Kit for automotive" consists of radio and LED light with hand-cranked charger (with USB power outlet), water supply bag, portable toilets etc. to Japanese market as Toyota Genuine Parts.

Many production facilities of Toyota group are located around the Tokai region. This region had been attacked by massive earthquakes in the past and is concerned about the risk of the "Nankai Trough huge Earthquake" near the future. Toyota group had developed a scheme for delivering relief supplies to the affected areas using the logistics networks and warehouses of and parts distributors across Japan by applying the experience of the 2011 Great East Japan Earthquake.

119 PHV stands for "Plug-In Hybrid". PHV is hybrid vehicle with high-capacity batteries that is possible to be charged by plugging them into an electrical outlet or charging station.
120 JDM: Japanese Domestic Market (or Model).

In 2012, Toyota Motor and Toyota Motor East Japan signed a disaster assistance agreement with Miyagi Prefecture and Ohira village. The outline of the disaster assistance agreement is consisted of "Immediate rescue after disaster", "Providing temporary evacuation sites", "Providing food, water, living supplies and vehicles", "Providing storage location, for relief supplies" "Provision of disaster-related information in the Toyota East Japan school", etc. In the following year of 2013, Toyota Motor signed a disaster assistance agreement with Toyota City, the base of Toyota group. Toyota plans to sign similar agreements with all local government that Toyota's plant is located near the future.

Fig. 6-43: Toyota Land Cruiser 70 series, which are used in severe conditions worldwide

Toyota defines the BCM for the production facilities as not only "Non-breakable and Tough" but also "Easy to fix when it is broken" [121]. Automotive industry is composed of a multilayer structure of the supply chains[122]. If Toyota is going to recover the production, it is necessary to restore the entire supply chains. Toyota sets a target to recover the entire supply chains to make it possible the recovery in shortest term. Also, Toyota has built databases to grasp the entire supply chains. If the specific parts plants are affected by disaster, this database makes it able to know the effect on the entire supply chain.

(2) **Tokyo Disney Resort**

Tokyo Disney Resort (TDR) [123] is a huge resort facilities operated by the Oriental Land Co., Ltd.(OLC) with a license from The Walt Disney Company. TDR is consisted of popular theme park of Tokyo Disneyland and Tokyo Disney Sea that receives more than 30 million visitors per year. OLC conducts a comprehensive disaster risk reduction training four times a year in both theme parks. Also, OLC conducts disaster risk reduction training in each building more than 180 times per

[121] This is an implementation of Toyota's design philosophy to BCP. For example, Land Cruiser 70 series, are composed of mainly mechanical parts with high durability and easy to repair. Electronic parts are applied for only indispensable components (like fuel injection control). Furthermore, the service manual of Land Cruiser 70 series includes non-genuine parts which have compatibility of genuine parts. It enables to repair Land Cruiser 70 series if Toyota Genuine Parts are not able to be obtained.

[122] Supply Chain is a system of organizations, people, activities, information, and resources involved in moving a product or service from supplier to customer.

[123] TDR is located in Urayasu City, Chiba Prefecture.

year. Furthermore, OLC formulated “Earthquake countermeasures basic plan” and disaster risk reduction manual which is assumed the condition “Time: 6 o'clock pm in winter, Seismic intensity: 6 upper, 100,000 guests”.

There were 70,000 guests on both parks when the Great East Japan Earthquake had occurred in 11th March, 2011. After the occurrence of the 2011 Earthquake, OLC immediately conducted communication with guests for attention, emergency broadcasting in the parks, stopping facilities operation, evacuation guidance outside the buildings, confirmation of the wounded person according with the disaster risk reduction manual.

Fig. 6-44: Map of Tokyo Disney Resort (Source: Wikipedia)

OLC established the “Earthquake Management Headquarters” after 36 minutes from the earthquake and had started safety inspection of evacuation buildings. Then, OLC conducted the park broadcasting on earthquake overview and operations stop of public transport. Also, guests evacuated by OLC to building that safety inspection had been completed under the guidance of OLC. OLC distributed road information or returning home assistance map to guests that can be returned home by car or on foot, also distributed the confectioneries sold in the park and emergency aluminum blankets.

On 7:00 pm 11th March, OLC decided to close TDR on the following day due to operation stop of public transportations such as JR Musashino Line, JR Keiyo Line, etc. OLC distributed stockpiled emergency foods to guests who became difficult to go back home. At 4:00 am on 12th March, OLC had provided breakfasts and traffic information to guests in the waiting area. Tokyo Metro Tozai Line had resumed operation in this day. Then OLC run special buses for Urayasu Station. Thus, all guests in the TDR were able to come home by 4:00 pm on 12th March.

Tokyo Disney Resort had been implemented structural measures and ground improvement, therefore it was able to reopen on 18th March, after a week from the Great East Japan Earthquake..

OLC assumed the number of stranded commuters as 50,000 people under normal disaster risk reduction plan, and has stockpiled emergency foods, waters and returning home support map for the required numbers. OLC emphasizes “verbal calls” [124] for guests in disaster risk reduction training. Advanced disaster risk reduction measures for structural and non-structural measures showed a high effect in the 2011 Great East Japan Earthquake. OLC has reviewed and analyzed in detail of the correspondence, to evolve disaster risk reduction measures.

(3) **Saito Seika (Confectionery Company in Iwate)**

Saito Seika Co. Ltd. is a confectionery manufacturing company founded in 1933, headquartered in Ofunato City, Iwate Prefecture and well known by famous product “*Kamome no Tamago*” (Egg of seagull). In the 2011 Great East Japan Earthquake, Saito Seika lost the Headquarters office, 5 retail stores and 1 sweets factory by Tsunami and the economic damage was finally reached to 650 million yen.[125] However, Saito Seika had immediately evacuated the all 250 employees[126] who were working at that time to the upland, thus no employee died by tsunami[127].

In 1960, the head office of Saito Seika had been completely destroyed by the Tsunami induced from the 1960 Valdivia Earthquake.[128,129] From this experience, Saito Seika put up posters with large letters saying "Earthquake, Tsunami, Evacuation", thoroughly calling for evacuation from tsunami, led to the result that no damage of employees by this disaster.

In Japan, March is a month for graduation ceremonies, personnel changes or moving. Therefore, the production volume of gifts was large. Saito Seika had 250,000 pieces of “*Kamome no Tamago*” stocks in the factory. Despite the company was affected by disaster, Saito Seika distributed the all stocks of “*Kamome no Tamago*” in free of charge to the affected people in evacuation centers at Ofunato City and Rikuzentakata City.

Fortunately, the main factory of “*Kamome no Tamago*” was built on upland and got no damage by Tsunami. However, the capacity of the egg suppliers was significantly damaged due to the insufficiency of mixed feeds and should reduce the number of hens by the impact of the earthquake. Under such severe conditions, egg supplier decided to supply the material eggs to Saito Seika as first priority.[130] Consequently, Saito Seika was able to resume production of “*Kamome no Tamago*” from 20th March, 2011. The sales of Saito Seika was greatly depressed, 25% the year-on-year in

[124] In the disaster risk reduction trainings of OLC, Casts uses the “verbal calls” method for evacuation guide to the guest by simple and easy-to-remember phrases such as “Please crouch with protecting your head”.
[125] Total damage except for the product price by the interview of SAITO Toshiaki (President of Saito Seika Co. Ltd.)
[126] Two employees were outside work and vacation and their survival was confirmed later.
[127] In Ofunato City, 426 people were died or missed by the 2011 Great East Japan Earthquake. SAITO Kenji (Senior managing director of Saito Seika Co. Ltd.) had been released movies of this catastrophe on YouTube.
https://www.youtube.com/watch?v=0VTGY4KKpFA
https://www.youtube.com/watch?v=N58tJucmVbU
[128] This 1960 tsunami is as known as “Chile Tsunami” in Japan.
[129] In 1960, SAITO Kenji was a high school student. After the occurrence of the Valdivia Earthquake, his father shouted as “Now run away!” and he escaped to upland. He witnessed his home had been flowed in Tsunami, immediately after evacuation. Elder Brother Saito Toshiaki had to leave police academy in Morioka to take over the family business due to this disaster.
[130] President SAITO said that Saito Seika always had contacted the suppliers with the same attitude for customer and built a reliable relationship, and it led to the result that the eggs were supplied with priority.

March 2011 and 30% year-on-year in April. However, the sales were recovered in excess of 120 % year-on-year from May 2011. Consequently, Saito Seika was able to re-employ the people who had been a layoff or temporary retirement.

Saito Seika had been working actively in BCP than ever before after the earthquake. For example, this company makes their employees possible to go to the evacuation centers with their own evacuation bags.

SAITO Kenji (Senior managing director of Saito Seika Co. Ltd.) had pointed out the following factors increased the damages by the 2011 Great East Japan Earthquake.

- There was a great earthquake a few days before 11th March 2011, but tsunami did not come. Therefore, a lot of people were careless with tsunami on 11th March.
- Robust embankment in double structure had been made in the 1960s in response to the tsunami of the 1960 Valdivia earthquake. Most of the people did not think that the huge tsunami will overcome this embankment.
- For unknown reasons, the broadcasting of “Tsunami height of 3 m” was repeated by the radio on the day 11th March 2011.

From these facts, SAITO Kenji says that “When disaster occurs, it is important that everyone should make a decision to evacuate individually without confused by other information.”

Finally, we see the opinion summary for BCM by President SAITO Toshiaki in this section.

- When (natural) disaster occurs, company should not let employee to go back home. Many people had fell victims when they went back home near the shoreline or had a wait to see in their home by the 2011 Great East Japan Earthquake.
- When earthquake occurs, the occurrence of tsunami should be considered at the same time. Basically, employees should be evacuated to a place (upland) pre-determined by the company. They will return to home or workplace after the cancellation of the alarm.
- It is possible for companies to revive its activities if they can protect the life of employees.

(4) **Maiya (Supermarket in Iwate)**

Maiya is a supermarket chain headquartered in Ofunato City, Iwate Prefecture and had 16 stores mainly in Iwate Prefecture coastal areas before 2011. After the occurrence of the 2011 Great East Japan Earthquake, 6 stores in Ofunato and Rikuzentakata was affected and 5 of affected stores became impossible to operate.

Maiya conducts “fire risk management training” 2-3 times per one year. This training was started as a general evacuation training. Now, it has been carried out as full-fledged fire risk prevention training. Actual fire engines are called for this company's trainings using real fire and smoke. Maiya created and used their own disaster risk reduction manual which incorporates actual experiences, based on the manual of CGC Group[131] Headquarter.

Fig. 6-45: Maiya Rikuzen-Takada Store, ruined by the Tsunami of the 2011 Great East Japan Earthquake (Source: Yahoo! JAPAN "Photo Saving Project of the 2011 GEJE")[132]

Immediately after the occurrence of the Great East Japan Earthquake, employees of Maiya were intuitively certain that tsunami would come after the huge earthquake.[133] Employees, who worked in stores in the affected areas, immediately started running toward the upland at full speed after the occurrence of earthquake. [134] Employees of Maiya who had been at work had evacuated according to the order of store manager and no person died by this catastrophe.[135]

Supermarket in Rikuzentakata is Maiya only, and other retail stores were all destroyed by the tsunami. While many relief supplies had been delivered to the evacuation centers, households that has not been affected by disaster should go to stores to buy daily commodities. On 16:00 11th March 2011, Maiya reopened Ofunato Interchange store in Rikuzentakada, which had less damage and away from the coastal area. It was dangerous to put the customers into the store because ceilings had dropped on the floor by the earthquake. Thus, employees had picked up goods from the store and sold them outside with the form of over-the-counter sales. Maiya continued to open the Ofunato Interchange Store until 10:00 pm 11th March, using headlights of employees' private cars as store illumination.

Head office of Maiya in Ofunato City was ruined by the tsunami, thus each store should determine their management. The communication infrastructures were destroyed by the Earthquake and

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[131] CGC is a distribution group constituted of small and medium-sized supermarkets in Japan. Headquarter is CGC Japan Co., Ltd.(Shinjuku-ku, Tokyo)

[132] Shooting Date: 23rd August, 2011, photographer: kam**523.
This store is currently dismantled and become a vacant lot for re-development.

[133] This evacuation was not caused by manual but accomplished by daily evacuation trainings.

[134] Many residents survived from the tsunami with looking at the actions of Maiya's employees and evacuated to upland simultaneously.

[135] According to the interview of CEO MAIYA Haruo, 7 deaths and 30 people missing among part-time employees of off-duty day. Also, many employees lost their families by the tsunami.

Tsunami, thus telephone and FAX were not able. However, Maiya had contracted the satellite telephones, thus they were utilized for stocking goods at each store.[136]

From the viewpoint of logistics, merchandise goods had been once collected to Maiya Kitakami logistics center, then distributed to Maiya Ofunato Interchange store, the only surviving store from the catastrophe and delivered to other stores.[137] Also, Maiya had supplied merchandise to privately owned mobile groceries and deal with these operators as virtual franchisee of Maiya. The cash registers were not available in the power outage, thus Maiya had continued selling by flat price with notice of some deficits. Maiya had helped to early recovery of local area, such as providing sale location of products by Saito Seika, which resumed production soon after the earthquake (see previous section).

Before the 2011 Earthquake, Maiya had 220 full-time employees and 1,200 part-time employees. However, Maiya lost cash flow by this disaster[138], thus Maiya should lay off 50 full-time employees and 300 part-time employees in April 2011. At this time, Maiya applied employment insurance to acquire unemployment benefits with consideration to minimize the economic disadvantage of employees who had been laid off. Maiya re-employed them who wished to work again Maiya, with subsequent of business performance after the disaster. Maiya had been considering about backup the data in contract servers or inland office server.

Sales and other key data have been digitized in the logistics industry in recent years, and Maiya Co. was no different in this respect. However, the company's servers were located in the headquarters building that suffered damage, and all data were lost except some that were located on the fifth floor.

(5) **Summary**

The cases of Toyota Motor and e Oriental Land are good examples of BCP's efficiency in the disaster. On the other hand, Saito Seika and Maiya had not developed detailed BCP. However, these two companies encouraged their employees to increase the awareness of disaster risk reduction and evacuation training at normal times, encouraging their actions on their own initiative. As a result, these companies had lost no employees by the disaster and were able to continue the business. "**It is possible for companies to revive its activities if they can protect the life of employees**", as SAITO Toshiaki, the president of Saito Seika said. As shown in section 6.11.1, Toyota's priority in disaster is shown as "**(1) Humanitarian aid and assistance**", "**(2) Early recovery of the affected areas or regions**" and "**(3) The recovery of business and production**". The order is conformed to the actual disaster experience. In August 2013, the Cabinet Office of Japan had published in the "Business Continuity Guidelines". It is written as "(BCM), while closely related with the common DRR activities, has different concepts and approaches" in this guideline.

[136] According to the interview of Mr. NIINUMA Satoshi (Maiya's Manager of Administration Division, Sales Support Department), they wired the outdoor antenna of the satellite phone into the office room. Later, they noticed that satellite phones can be used outdoors. Thus, satellite phones were fully used to order merchandise goods.
[137] See also "Operation Comb" by MLIT in section "6.7.4 Road Disaster Risk Recuction".
[138] Sales of affected 6 stores accounted for 40% of Maiya's revenue before the disaster. Thus, 40% of cash income had been lost by the disaster.

However, the essential of BCP and BCM is to develop a plan for "recovery of business and production" in collaboration with disaster management plan. It should be noted that the importance of basic disaster risk reduction does not change.

Table 6-8: Comparison table of the traditional disaster risk reduction activities and BCM for companies (by Cabinet Office of Japan)

	Disaster risk reduction activities for companies	Business Continuity Management for companies
Main object	● Ensuring physical and life safety ● Mitigation of property damage	● Continuation or early recovery of priority important operations in addition to ensure the safety of the body and life
Event to consider	● Assumed disasters to occur in base areas	● Every occurrence of events that can cause business interruption (incident)
Important matters	● Minimizing these damages below; ➢ Deaths and injuries ➢ Loss amount ● Checking the safety of its employees then rescue and assist victims ● Early restoration of damaged sites	● Including the following factors in addition to minimizing the number of deaths and injuries and loss amount, confirming safety of employees, carrying out the rescue and support of victims; ➢ Achieving recovery time targets and a target recovery level of important operations ➢ To minimize the impact on business and stakeholders within the acceptable range ➢ To survive as a company to ensure profitability
Considering the scope of activities and measures	● Each site of the company ➢ Headquarter building ➢ Factories ➢ Data centers	● Company-wide(Cross-cutting) ● Business partners of dependency relationship such as supply chains ➢ Contractors ➢ Suppliers ➢ Supply destinations etc.
Units and subjects of initiatives	● Specific disaster-related departments (disaster management department, general affairs department, facilities department, etc.)	● Each business department deals with DRR around managers as cross-cutting issue
Strategies and measures to be considered	● The damage control of sites and countermeasures of early recovery after the disaster and (earthquake resistance reinforcement, stockpiling, prevention of secondary disasters, rescue and relief, recovery construction work)	● Alternative strategies (ensuring alternative sites, duplication of facilities and equipment, the implementation of the OEM, etc.) ● Site recovery strategy (Often common to measure of site disaster risk reduction activities)

6.12. Agricultural and Rural Development

Natural disasters in the agricultural sector are directly linked to famine. Therefore, a variety of countermeasures for disasters should be considered in agriculture sector such as breeding, cultivation management, measure for pests and diseases, soil, fertilizer, social policies, and so on along with countermeasures on irrigation and other structures. In Japan, agricultural development and farmland disaster risk reduction have been conducted over many years. Social system development such as “Agricultural Mutual Aid” had been contributed to poverty elimination of Japanese rural areas.

The Ministry of Agriculture, Forestry and Fisheries (MAFF) has been conducting farmland disaster risk reduction projects based on the New Basic Plan for Food, Agriculture and Rural Areas (Cabinet Decision in March 2005) and the Long-term Plan for Land Improvement (Cabinet Decision in December 2008), implementing the following programs.

These include non-structural measures such as the preparation of hazard maps and the development of systems for disaster forecasting and information communication, in addition to structural measures such as the improvement and construction of facilities (see the website of the MAFF).

○ Risk reduction of disasters affecting agricultural land and facilities

(e.g., improvement of irrigation reservoirs, construction of drainage facilities, landslide prevention)

○ Conservation of the quality of agricultural water

○ Prevention of soil pollution

○ Functional restoration of agricultural facilities (e.g. Functional restoration of farmlands affected by land subsidence)

In many developing countries, the majority of the population is farmers and 75 percent of the poor people live in rural areas.[139] In this section, some examples are picked up from the agricultural disaster countermeasures in Japan which can apply in developing countries.

6.12.1. Social Risk Reduction: Agricultural disaster compensation scheme

Japan is located in the Asian monsoon zone of the severe climate variation. In agriculture sector, there are damages caused by typhoon, floods, cold weather, snow, etc. In addition, Japanese farmers are small-scale subsistence farmers over whole of the half.[140] Therefore, it is difficult to recover the damage caused by natural disasters in the self-help efforts of individual farmers in the event of a disaster. In 1947, the Agricultural Disaster Compensation Act was enacted to solve these problems. The Agricultural Disaster Compensation Act establishes as eligible for compensation damage suffered from natural disasters, which are defined as storms and floods, droughts, extreme

[139] Source: World Bank(2008) “*World Development Report 2008 Agriculture for Development*”
[140] The average farmland area of Japan is 1.8ha per farmer in 2006 (Source: FY2008 agricultural white paper)

cold, heavy snow and other disasters caused by meteorological phenomena, as well as fires, disease and pestilence, bird and animal damage and other natural disasters.

Agricultural Disaster Compensation scheme was consisted of agricultural mutual aid, livestock mutual aid, fruit trees mutual aid, field crops mutual aid and horticultural facility mutual aid. In this scheme, the loss of the affected farmers by natural disasters is compensated by the mutual aid premiums of each farmer and the insurance of national and local governments. Farmers establish "Agricultural Mutual Aid Association" in each region and make "joint preparation assets" by mutual aid premiums in advance. When disaster occurs, mutual aid money is paid to the affected farmers from the "joint preparation assets". This scheme is based on voluntary mutual relief of each farmer. In addition, it is also possible that municipalities and administrative union to operate "Agricultural Mutual Aid Association". The national government assists the operation and reinsurance of mutual aid premiums. The country pays part of the premiums (50% as a general rule) for farmers' payment. Agricultural Mutual Aid Association carries out insurance to Agricultural Mutual Aid Association Federation. Moreover, the Federation operates the re-insurance to the country for risk dispersion in national wide (Figure 6-46 and figure 6-47).

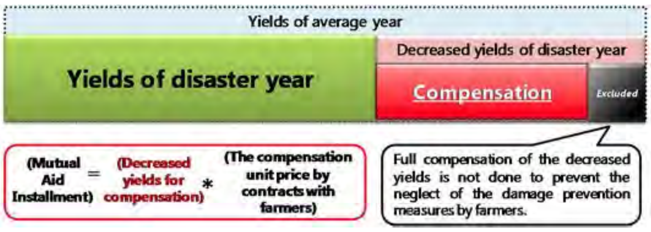

Fig. 6-46: Mechanism of agricultural mutual aid Compensation Scheme

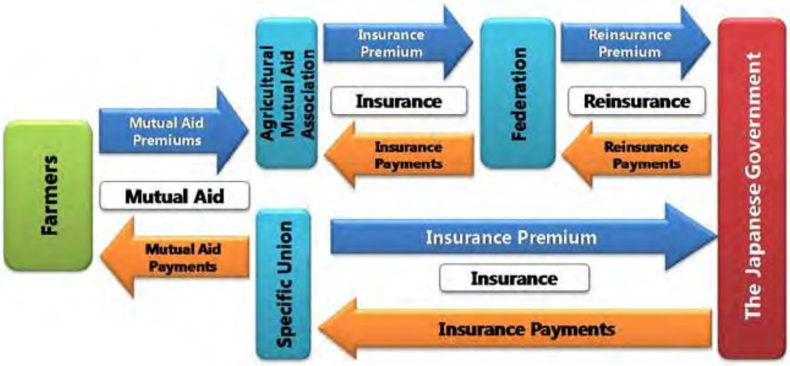

Fig. 6-47: Relationship of agricultural mutual aid system and re-insurance[141]

[141] Original figure is in Japanese.

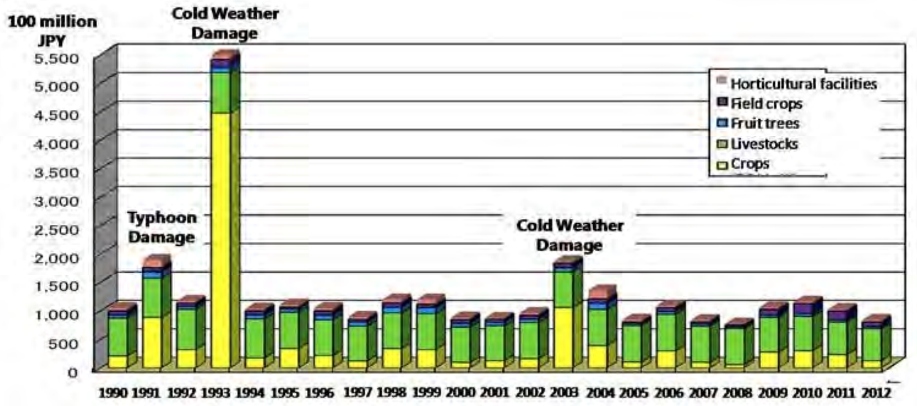

Fig. 6-48: Transition of mutual aid payments by agricultural compensation scheme (1990-2012) [142]

Figure 6-48 shows the transition of the mutual aid paid by the agricultural compensation scheme in Japan. The large cold weather damage had occurred in 1993 and mutual aid funds paid to the farmers of 548.7 billion yen (including re-insurance 438.8 billion yen). During 2003 the cold weather damage, the mutual aid money had been paid to the farmers of 187.1 billion yen (including re-insurance 111.1 billion yen). Agriculture compensation scheme has contributed to make the management of Japanese farmers more stable.

6.12.2. Irrigation development: drought and ensuring agricultural water

After Kamakura period (12th century) when samurai politics has emerged in Japan, water conservancy development was advanced beyond the framework of individual manors. The end of the Sengoku era (16-17th century), flood control technology had been progressed in general.[143] In Edo era (17-19th century), each feudal domain had actively promoted the development of new paddy fields as well as carry out the maintenance of irrigation facilities, and development of drainage technology had been advanced. However, some area had been left as not be secured enough water for agriculture due to its weather and natural conditions. The water retention capacity of rivers in Chita Peninsula area (Aichi Prefecture) was not enough for agriculture.

[142] Original figure is in Japanese.
[143] See also “6.3.1. Water Management of Feudal Lords in *Sengoku* Period”

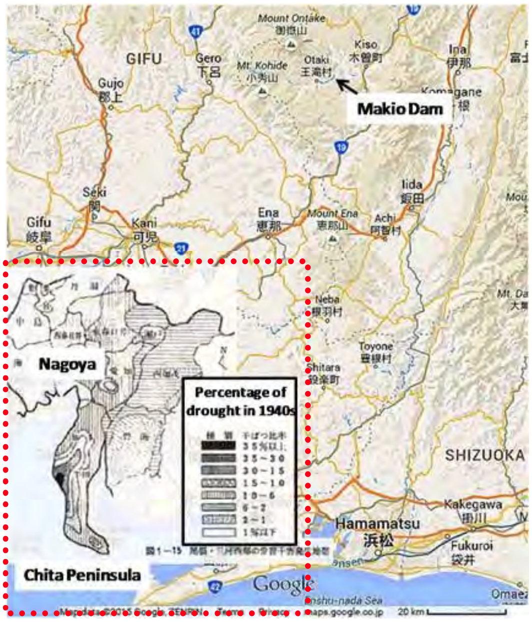

Fig.6-49: Drought area of Aichi prefecture in 1940s and Makio Dam, one of the water sources of Aichi canal

In this area, rainfall directly flows into the sea and groundwater cannot be secured sufficiently. In some cases, there had been no rainfall more than 30 days in this area. Drought was frequent in this area and significant damage had been occurred in agricultural production. After the large-scale drought occurred in 1944 and 1947, KUNO Shotaro (1900-1997), the farmer of Yawata village (currently Chita City, Aichi) had come up with an idea to develop the waterway from Kiso River to Chita Peninsula to promote the agricultural improvement. HAMAJIMA Tatsuo (1916-2013), the teacher of agriculture high school, had the identical idea at the same time. HAMAJIMA noticed KUNO by local newspaper and they started to move towards the construction of Aichi Canal.

Fortunately, local farmers including KUNO and HAMAJIMA got opportunity to meet the Prime Minister YOSHIDA Shigeru at 25th December, 1948. In this period, the food situation of Japan had been severe after the WWII. Thus Ministry of Agriculture and Forestry (at the time) was ensured the research budget of Aichi Canal from FY 1949. In addition, the Ministry of Construction (at the time) and Aichi Prefectural Government cooperated with the construction of Aichi Canal. In 1952, “Aichi Canal land improvement district” was established. Also, the survey team of FAO and World Bank visited Japan in 1952 and conduct a survey of Japan's food situation. They visited the planned site of Aichi Canal and agreed the need and the economic effects of this canal. Loans of World Bank had been admitted for development of Aichi Canal because the farmers had proactive approach to the construction of the Canal. The movement against dam construction was occurred among the villages in Nagano Prefecture which was planned as construction site of new dam (Makio dam) for water intake of Aichi Canal. KUNO and farmers of Aichi Prefecture had been carried out dialogue patiently with the farmers in Nagano.

Finally, compensation was carried out to the residents and villages of Nagano Prefecture which go under the water, and then the construction of Aichi Canal had been started. As a condition of financing loan by World Bank to Japanese Government for construction of Aichi Canal, GHQ[144] was strongly recommended the employment of American civil engineering consultant, Erik Floor (1851-1958). At the time, the Japanese government had conducted all construction projects under the direct control of technical officers thus the concept of "private technical consultants" was not well known in Japan. The Ministry of Agriculture and Forestry signed a contract with Erik Floor Company[145] under the condition of creating the report for World Bank loan since the credit guarantee the company is obtained. It was planned to build a rock-fill dam in Makio-bashi district after the discussion among the Ministry of Agriculture and Forestry, Erik Floor Co., and World Bank. The loan agreement of World Bank was signed in 1957 and Aichi Canal project had been started. Professor Avery Alvin Bishop (1913-1990) of Utah State University had played a significant role for advancement of technology on irrigation and drainage field. Japan's agriculture civil engineering technologies had dramatically improved by the implementation of Aichi Canal project which introduced the advanced technologies of U.S. The following points may be mentioned specifically; (1) Establishment of consistent construction system of project, (2) Adoption of large-scale farmland irrigation, (3) Establishment of large-scale mechanized construction, etc. Later, it became the guideline of the land improvement project and systems in Japan. However, accidents occurred such as volcanic gas ejection of Mt. Ontake during the project with limited time. 56 engineers[146] were sacrificed until completion of Aichi Canal.

Aichi Canal project was started in December 1957. Total budget of this project was 33.1 billion yen and it spent four years and fully completed in 30th September, 1961. Next year, Kuno and Hamajima established a consulting company[147] of agricultural development. The water of Aichi Canal is taken from Kiso River at the foot of Mt.Ontake in Nagano and flows to 27 cities and towns in Aichi Prefecture such as northeast Owari area, west Nishi-Mikawa area, and Minamichita town at the tip of the Chita Peninsula. The water is used with about 15,000 hectares of fields in these areas to grow crops such as rice or vegetables. As the proverb of Chita Peninsula had said "*Farmers cannot get any profits from good harvest at once of ten years*". Though, the drought of this area was dissolved by water of Aichi Canal. Now, this area can produce agricultural products of about 40 billion yen per year. In addition, water of Aichi Canal is also used as household water such as Kozoji New Town in Kasugai City, Seto City, Owariasahi City, etc. Also it is used as industrial water at southern Nagoya coastal industrial zone.

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[144] General Head Quarter/Supreme Commander for the Allied Powers
[145] JV Company that was established in Japan by Erik Floor, Inc. is the current Pacific Consultants Co., Ltd.
[146] This number includes Edward Lloyd Beezley(1896-1959), American engineer who died in angina.
[147] This is the current Sanyu Consultants, Inc.

6.12.3. Agricultural technology development for cold weather damage and disease control

After the Sengoku Period, water management in Japan had been enhanced and improved the utilization efficiency of water resources.[148] Drought problem of Japan was almost overcome in the 20th century, with the exception of some areas such as Chita Peninsula. On the other hand, cold weather damage of rice is likely to occur at high latitudes area in Japan because the origin of rice is tropical area. Furthermore, cold weather damage of rice is likely to occur at high latitudes area in Japan because the origin of rice is tropical area. In Japan, cold weather is the cause of famine as similar as drought and the impact is almost same. Therefore, in this section we see the example of technological countermeasures for cold weather damage in Japan.

Before World War II, it was difficult to overcome cold weather damage, pests and diseases in Japan. Agricultural disaster compensation scheme had developed after the end of war, thus rural areas of Japan (especially Northern region) were placed in serious situation once cold weather damage of rice occurs. [149]

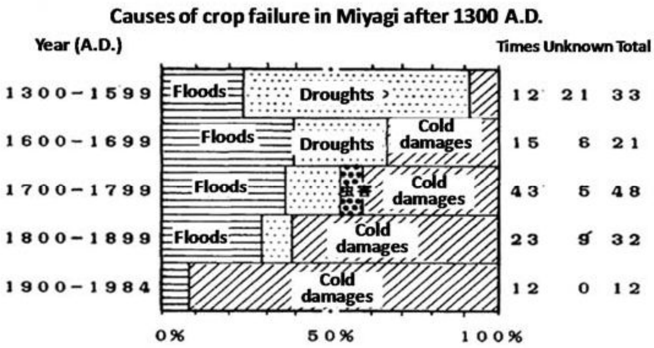


Fig.6-50: This graphic shows the proportions of causes of poor harvests in Miyagi Prefecture since the year 1300. However, years in which the cause of poor crops was unclear are excluded from the graphic. The numerical figures to the right of the graphic refer to the number of years in which the cause of poor crops was clear (the leftmost number), the number of years in which the cause of poor crops was unclear (the middle number), and the total number of years with poor crops (the rightmost number).[150]

148 See Chapter 6.3 “Water Resources andDRR”.
149 The NHK drama series “*Oshin*” (1983-1984 aired in Japan), that is aired in many countries, portrayed the heroin who was served her apprenticeship from rural area of Yamagata Prefecture in early 20th century. This drama is fiction but poverty of rural area in pre-WWII Japan was approximately similar situation.
150 Original figure is in Japanese.

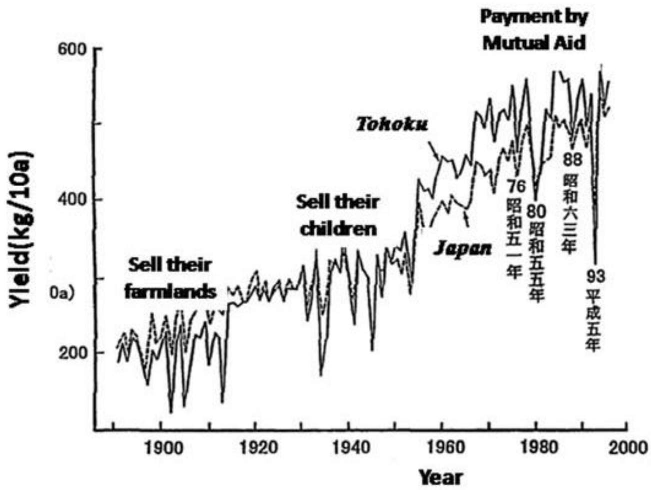


Fig.6-51: Transition of rice yield and response for cold weather damage in the Tohoku region[151]

(Note)Numbers 76, 80, 88, and 93 on the graph are meaning years when cold weather damage occurred recently.

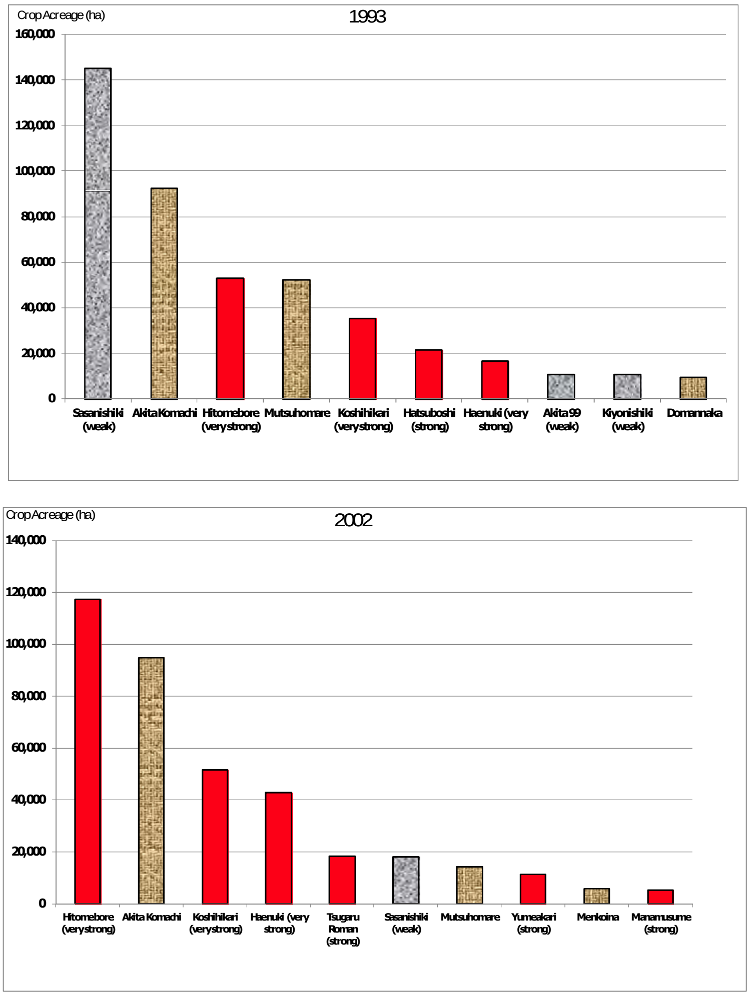


Fig.6-52: Changes in planting varieties in the Tohoku prefectures (1993 and 2002)

151 Original figure is in Japanese.

After World War II, severe cold weather damage had become less likely to occur due to the increase of rice yields by development of Japan's agricultural technologies. However, large scale of cold weather damage occurred in 1993 and Japan was forced to import rice in urgent. In Tohoku region of Japan, rice variety “*Sasanishiki*” had been widely cultivated at that time. Though, “*Sasanishiki*” is sensitive to cold weather, and it was a factor to expand the cold weather damage. Each prefecture of Tohoku region started promoting cold resistance cultivars that have been developed to respond to this problem. For example, the rice varieties were shifted to “*Hitomebore*” in Miyagi Prefecture, “*Haenuki*” in Yamagata Prefecture and so on. These new varieties have tolerance for cold weather (Figure 6-52).

In 1993, the agricultural damage of cold weather was worsened by occurrence of rice blast, the fatal plague for rice. After 1993, Japanese farmers reduced input of nitrogen fertilizer which is a factor of increasing the blast and increased input of fungicides. In 2003, cold weather damage has occurred in Japan again. The damage was significantly reduced compared with 1993 according to the evolution of farming technology.

6.12.4. Disaster Risk Reduction of reservoirs

Reservoir is used as a source of water for less precipitation areas where is difficult to intake from the large rivers. There are about 200,000 reservoirs around the western Japan. Historically, Buddhism monks introduced the civil engineering technologies of reservoirs to Japan from Tang Dynasty through the Silk Road in 7th Century. Monk Gyoki (668-749) of the Nara period made reservoirs in Japan starting from Kansai region of western Japan. In the Heian period (8th Century), monk Kukai (774-835) the founder of the Shingon sect carried out improvement construction of the reservoir Manno-Ike (Kagawa Prefecture, Shikoku region). Even now, this Manno-Ike is used as the current irrigation water source of Kagawa Prefecture. About 60% of the reservoirs in Japan is located in Setouchi region because little annual rainfall in this area.

70% of reservoirs in Japan were constructed before the Edo period (17th - 19th century). Therefore, they are often damaged due to heavy rains or earthquakes. Many reservoirs were damaged and collapsed by the 1995 Great Hanshin-Awaji Earthquake, the 2004 Niigata Chuetsu and the 2011 Great East Japan Earthquake. MAFF selected 9,000 sites from 200,000 Japanese reservoirs as “Disaster Risk Reduction Priority Reservoirs” and had conducted the disaster risk reduction countermeasures for them. The countermeasures are taken against heavy rain, which accounts for 90% of the damages on reservoirs, as well as earthquakes which cause severe damages as in the past major disasters. MAFF conducted inspection of these reservoirs from FY 2013 to FY 2014 for deciding the urgency of the renovation. According to the result of this survey, MAFF determined the countermeasure of reservoirs for earthquakes and heavy rains from the viewpoint of structural and non-structural measures. MAFF has been developing hazard maps for reservoirs. Flood control function has been added for reservoirs and safety system had been developed to pre-release the water from reservoirs before heavy rains occur. Japanese farming population had been decreased and aging, thus reservoirs management is becoming more difficult.

Therefore, MAFF is working to strengthen the conservation and management system for the reservoirs.

(Countermeasure for heavy rains)

(Countermeasure for earthquakes)

Fig.6-53: Countermeasures of reservoirs for earthquakes and heavy rains[152]

152 Original figure is in Japanese.

6.12.5. **Flood control by rice paddies (Niigata Prefecture)**

Heavy rainfall occurred in early July 2004 in Niigata Prefecture. 11 sites of the river bank were breached and vast plains were flooded by this heavy rain. 5,000 houses were all or partially destroyed and 8,000 houses and buildings were flooded on or under the floors. Disaster waste processing cost in Niigata prefecture had reached 3.3 billion yen by this disaster. Niigata Prefecture is a famous Japanese leading area of producing amount of good quality rice, and its major industry is agriculture. Niigata Prefecture had developed and spread a technique to use rice paddies as retarding basins, as lessons learned from this heavy rainfall. This technique is intended to strengthen the flood mitigation function of the rice paddies. The key point of the technique is only installing the "adjustment plate" of small diameter on the drainage outlet of rice paddies to reduce the amount of drainage water during heavy rainfall. When heavy rainfall occurs, paddies can store the rain water temporarily and suppress the peak runoff to rivers and reduce the flood damage to farmland and residential areas downstream of the rice paddies. The advantages of this technique are as follows;

- Material cost is less expensive and installation is also easy.
- For normal rainfall, drainage condition is the same before installation of adjustment plate. Thus, water management of paddy is not needed to change.
- If flooding depth of the paddy is about 10 cm, it is possible to restore the normal water level within approximately one day.

However, it should be noted that the flood control effect of this technique can be validated when the technique is installed with collaboration of a wide area of rice paddies of the river basin. In Asian region, the agriculture system is based on rice paddies and it is similar to Japan. It is worth to consider the introduction of this flood control technology by paddy fields with the flood control measures of the river.

・ How do paddy field dams work?

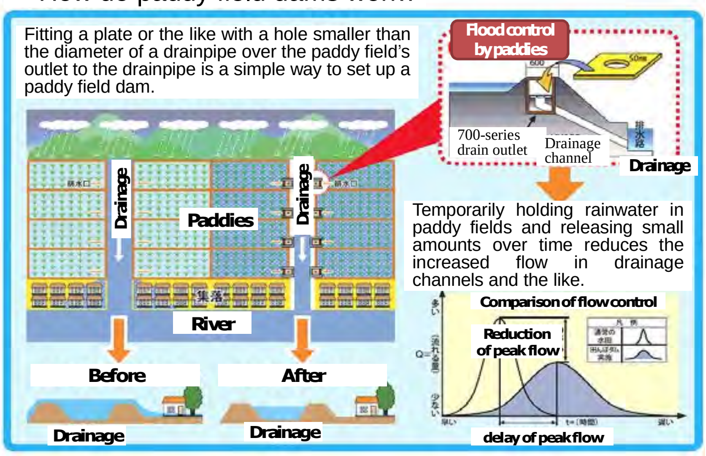


Fig.6-54: The concept of flood control by paddies

6.12.6. Strengthen disaster risk reduction of rural areas (MAFF)

It is concerned that agricultural sector and rural communities may suffer damages from environmental problems, such as global warming and desertification, in developing countries. The MAFF has been conducted the "Study of Overseas Agriculture and Rural Development countermeasures against global warming" for basic research or technology development and exchanges utilizing the expertise that has been built by MAFF's administration. The study "Strengthen disaster risk reduction of rural areas in developing countries" was conducted by the Japanese Institute of Irrigation and Drainage (JIID) in this scheme. It was carried out from 2008 to 2011, outcome products was published in March 2012 as "Guidelines of disaster risk reduction for rural areas".

This guideline is intended to improve adaptive capacities of rural communities to natural disasters such as floods that occur in Southeast Asian countries. Surveyed countries were Indonesia and Laos. In developing countries investment in infrastructure is generally considered to be important such as roads, ports, power generation etc. and low priority for disaster countermeasures. Additionally, urban area has a priority in disaster countermeasures and rural areas are generally left with lower priorities. This guideline considers rural DRR projects with community participation. In addition to DRR activities required in urban areas such as capacity development training, strengthening communication system and life-saving facilities, Rural DRR requires evacuation of livestock, early recovery of agricultural industries and other types of activity as well.

PCM workshops had been carried out in rural areas in the survey of this guideline. Also, it was examined and implemented the development of early warning systems and hazard maps that utilize existing facilities that can be maintained even at the local government. The research approach of this guideline had been utilized when JICA developed the "Strong agriculture and rural development guidelines to disaster" in response to the flood disaster that occurred in Thailand in 2011

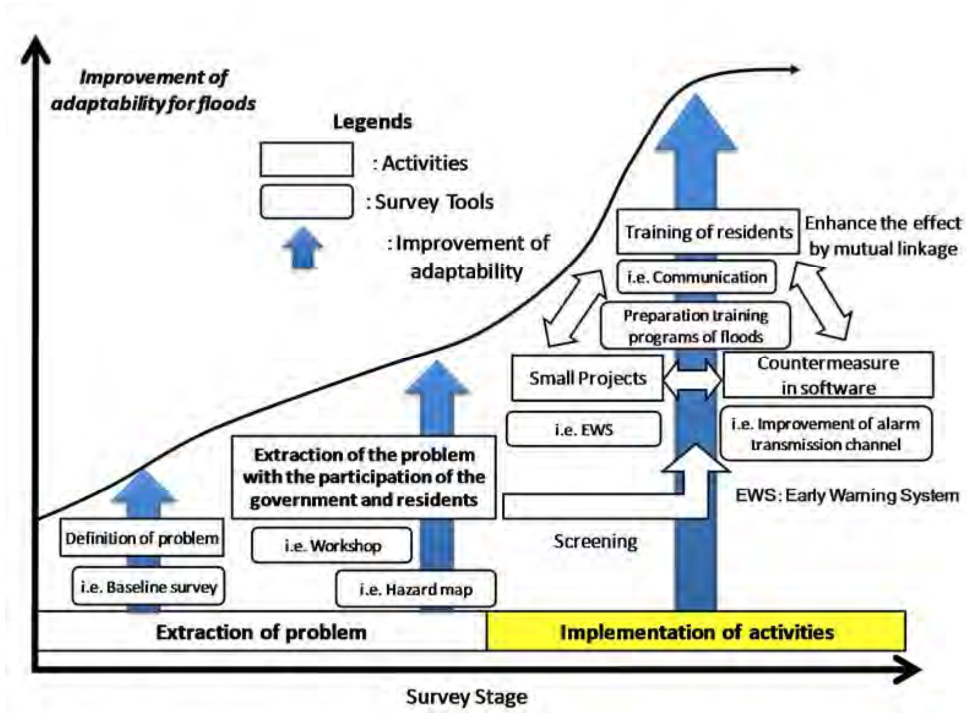


Fig.6-55: Survey method of Guidelines for Disaster Risk Reduction for Rural Areas [153]

[153] Original figure is in Japanese.

6.13. Natural Environmental Conservation

Green Infrastructure (GI) is a concept spread in the United States in the 1990s. GI is applied in relation to various methods of incorporating water and nature into urban planning [154]. Comprehensive measures for the natural environment have been implemented in Japan since the enactment of the 1993 Basic Environment Act.[155] The Environmental Impact Assessment Act was enacted in 1997 and it is required to implement the assessments for large-scale public projects.

In 1990, MLIT started to implement a “hydraulic engineering with diverse nature” under which all plans, construction and management of rivers was to strive to preserve biodiversity by using natural attributes and mechanisms, and proceed with work – even post-disaster recovery work – using methods that allowed for the preservation of riparian environments. Since 2001, MAFF has reduced environmental burdens and impact to the extent possible in its efforts to improve agricultural productivity and achieve in rural farmland improvement projects.

In recent years, the concept of using environmental preservation and ecosystem management in disaster risk reduction (Eco-DRR) has been advocated throughout the world. In HFA, it is written that appropriate ecosystem management is a measure for reducing potential risk factors. This section includes a summary of the approach to disaster risk reduction in the JICA Environmental Preservation Field Project Strategy (2014–2020) devised by the JICA Global Environment Department, and past examples of Japan’s soil conservation projects and flood control through the establishment of flood control basins that can serve as a reference to help developing countries consider disaster risk reduction.

6.13.1. JICA Environmental Preservation and Disaster Risk Reduction

JICA has implemented various projects involving the preservation of forests and the environment. In the natural environment field, JICA will implement “Sustainable forest management for improving disaster risk reduction and resilience” as part of its measures to combat climate change. Its approach is to implement disaster risk reduction and watershed management that makes use of the various functions of natural forests in areas often afflicted by landslides, coastline disasters, forest fires and other natural disasters.

Some of the envisioned initiatives include using Japanese satellite technology to monitor wildfires, and watershed management and soil conservation through coastline revegetation and coastline disaster risk reduction through tree planting and forest management to prevent damage and shoreline erosion caused by typhoons. The focus will likely be on Vietnam, Myanmar and India, with East Timor and China. With South-South cooperation from Panama, where participatory environmental preservation was implemented, the watershed management will be rolled out in

[154] U.S. Environmental Protect Agency described GI:“Green infrastructure uses vegetation, soils, and natural processes to manage water and create healthier urban environments. At the scale of a city or county, green infrastructure refers to the patchwork of natural areas that provides habitat, flood protection, cleaner air, and cleaner water.”

[155] Prior to 1993, pollution measures were carried out under the Basic Law for Environmental Pollution Control, and measures for the natural environment were carried out under the Nature Conservation Law. The Basic Environment Law replaced the Basic Law for Environmental Pollution Control. The content of the Nature Conservation Law was revised to match the Basic Environment Law.

Honduras, Paraguay and other Central and South American countries often affected by natural disasters, and disaster risk reduction (watershed management, soil conservation, etc.) will be added in training courses. Coastline development and other proposals for reducing disaster risk will be proactively made. Goals to reach by 2020 include watershed management through participatory forest management in four countries across 200,000 km^2, at least two cases (across 1.9 million km^2) of forest fire control using Japanese satellite technology, and forest development (across 100,000 km^2) for DRR.

6.13.2. Forest Conservation Projects in Japan

Currently 70 percent of Japan is covered with forests. Although, Japanese forests had been frequently destroyed or even disappeared due to excessive logging before World War II. Japan moved toward using mainly fossil fuels by the energy revolution during the Meiji Period (1868-1912) and the Taisho Period (1912–1926), but lumber was often used as firewood and charcoal before the energy revolution. Indeed, during Japan's diplomatic isolation in the Edo Period (1603-1868), all the wood consumed was provided from Japanese forests. Some feudal domains (i.e. Tosa, Akita, etc.) managed their forests by establishing orders and restriction for quantities and area of logging, but Japan consumed huge quantities of lumber as its population swelled from 12 million people at the beginning of the Edo Period to over 30 million at the end, and forests were repeatedly cut down faster than they could regenerate.

During the latter half of the Meiji Period, an increase in demand for lumber to be used as material for making paper, fuel for industry and structural support for mines devastated 10 percent of the total area of Japan. Landslides frequently occur on bare mountains that have been stripped of trees, thus the Forest Act was enacted in 1897. From 1899 to 1922, a special operation for forests and fields on government-owned land was implemented to promote reforestation of devastated land owned by the government, and measures to rehabilitate devastated land that began in 1911 eventually developed into a soil conservation project. Civil engineering technology provided by European countries and the United States was a major contribution to traditional Japanese technology applied since the Meiji Period to prevent soil erosion and replant mountain forests.

In this section, we see two example of the “60 Forest Conservation Projects Entrusted to Future Generations” (soil conservation projects selected by the Japanese Forestry Agency in September 2013) that can serve as references for forest preservation in other countries.

Kaze-no-Matsubara **in Noshiro, Akita Prefecture**

Under the Akita Feudal Domain of the Edo Period the forest along the coast of Noshiro was generously protected. Though, during the Meiji Period the forest was logged heavily for use as fuel for salt production. The forest became devastated, and sand blew into people’s houses and damaged them. In 1921, the Japanese government began to develop the land as a coastline forest to reduce disaster risk, and the work continues today. The forest serves to block wind and prevent sand from blowing inland, and its effect at disarming the threat of tsunami waves following the 7.7-magnitude 1983 Sea of Japan Earthquake has been verified.[156]


Fig. 6-56: *Kaze-no-Matsubara*

Left: In 1958 before replanting; Right: Present Status **(Source: Forestry Agency)**

Mt. Tanakami Range Erosion Control and Soil Conservation in Otsu, Shiga Prefecture

Mt. Tanakami (Tanakami-yama) Range is located in the eastern part of Otsu, Shiga Prefecture. About 1400 years ago, Japanese cedar and cypress trees used to cover the Mt. Tanakami, but starting in the Nara Period (710–794) massive amounts of lumber were taken from the range to support the relocations of the Japanese capital to Nara, Kyoto and elsewhere, and to build imperial palace, shrines, temples, etc. The excessive logging turned the mountain range into a desolate area known throughout Japan as "Bald Tanakami." Mt. Tanakami Range is consisted of granite,[157] which is weathered easily and made it difficult for trees to take root, causing sediment runoff every time it rained, and people were suffered by perpetual landslides.

The late Edo Period, NISHIKAWA Sakuhei (1842–1918), an exemplary local farmer, discovered that *hime-yashabushi* trees[158] would take root in the eroded soil of the mountains through trial and error. Later, ICHIKAWA Yoshikata (1826– ?) , a civil engineer of Kyoto Prefecture, developed the method of terracing with seeding[159] which was eventually used to revegetate Mt. Tanakami.

During the Edo Period, each feudal domain implemented soil conservation and flood control projects.. After the Meiji Restoration, the work was taken over by the national Government of Japan. The Meiji government invited European civil engineers to Japan in 1873. Dutch engineer Johannis de Rijke (1842–1913) was one of them. He was appalled at the sorry state of the Mt.Tanakami area

[156] Takata-Matsubara, a tidal barrier pine grove in Rikuzen-Takata, Iwate Prefecture, was also meant to decelerate tsunami waves, and did very well against the 1896 Great Meiji Sanriku Tsunami, the 1933 Showa Sanriku Tsunami and the 1960 tsunami from the 1960 Valvidia Earthquake. However, the massive 9.0-magnitude of the 2011 Great East Japan Earthquake caused tsunami waves over 10 meters in height, which destroyed the grove. Still, the Great East Japan Earthquake was an exceptionally major earthquake, and coastline tidal barrier groves are appropriately regarded for their ability to reduce the risk of disaster from tsunami waves.

[157] Granite is an igneous rock formed through the cooling of magma, and its crystals are large in diameter. It weathers easily and is a common cause of landslides.

[158] *Hime-yashabushi*, known scientifically as *Alnus pendula*, are short, deciduous trees in the birch family. They are still widely used today in the reforestation of devastated land and bare mountains.

[159] The most common method of planting trees to protect mountain slopes, stop falling earth and boost water retention.

and lamented the villagers' reckless overcutting of the forests. De Rijke proposed 16 methods of preventing soil erosion in the area and taught the next generation of Japanese civil engineers. Home ministry civil engineer INOUE Seitaro (1852–1936) participated in field surveys starting in 1894, and later implemented soil erosion control techniques that employed the best attributes of the techniques he learned from de Rijke and Ichikawa.

In 1897, the national Government launched the "Bare Mountain Restoration Project" with direct control. Home ministry civil engineer Tanabe Gizaburo (1858–1889) designed the Yoroi Dam, the Holland Dam and several other unique sediment control dams that are still in service today. He used stone walls and other implements to shape mountainside slopes into terraces, and planted *hime-yashabushi,* pines and other trees on the flat parts. The forests of the Mt. Tanakami Range were restored by the 1960s, and the project was completed in 1962. The success of the mountain forest restoration eliminated landslide disasters and provided the recreation space now known as the Omiko Lake Southern Alps Recreational Forest.

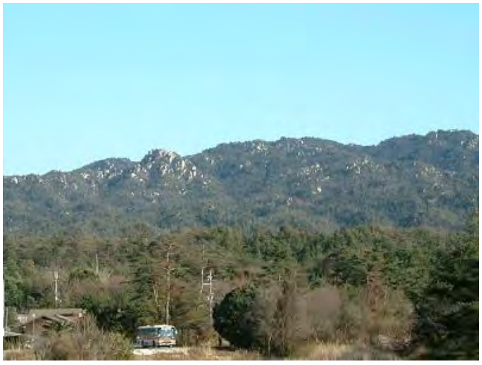


Fig. 6-57: Left: Mt. Tanakami Range forest recovery work, 1914; Right: Ichijoya Area, today(Source: Forestry Agency documents, Forestry Agency Kinki Chugoku Regional Forest Office homepage)

6.13.3. Tone River Flood Control Basins

As mentioned in "Chapter 6.3 Water Resources and DRR", disaster risk reduction assuming the flooding of the river have drawn the attention of the global community in recent years from the viewpoint of the natural environment conservation. It may be difficult to apply the flood control technology of Edo Period to modern Japan due to changes in the social environment, though it can demonstrate ways to control floods while preserving the natural environment to developing countries with modest civil engineering technology. Thus, we will see the Chujo-Tei Levee and Watarase-yusuichi (retarding basin), which was originally established to control mining pollution in the Tone River system.

Chujo-Tei Levee

Chujo-Tei Levee was a embankment for flood control of Tone River in Edo Period.[160] It was located just upstream of the confluence of the Tone River and Fukugawa Rivers near Kumagaya, Saitama Prefecture. As shown in the figure below, Chujo-Tei Levee was positioned nearly right angle to the levee on the Tone River (the main river) and ran nearly four kilometers along the south bank of an old channel of the Fukugawa River. Along the bank opposite the Chujo-Tei Levee, there was a Bunroku-Tei levee and the two levees formed a funnel shape as they approached each other and narrowed the width of the river. This shape caused the flood in present Kumagaya and Fukaya area when the Tone River was swelled and it reduced the flooding in the downstream region and protected Edo (present-day Tokyo) from serious flooding. The area was able to hold over 100 million cubic meters of floodwater, and floodwater was gradually returned to the Tone and Fukugawa Rivers through natural outflow.

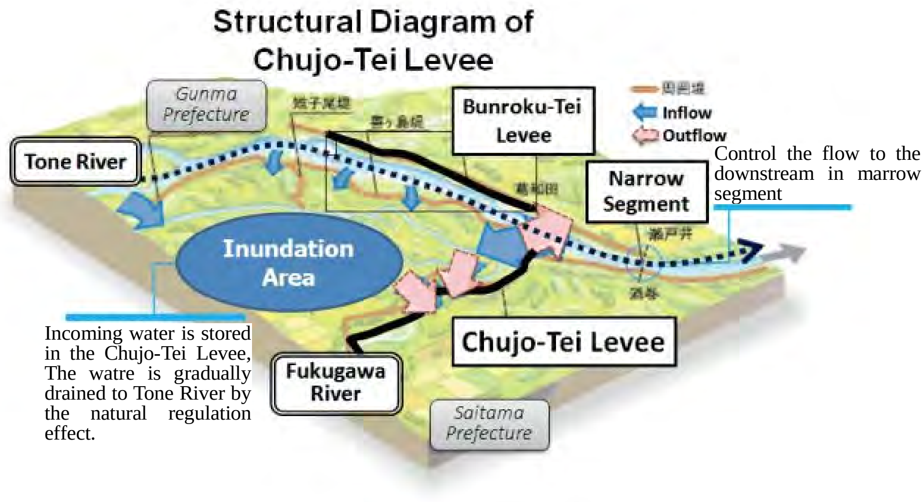


Fig. 6-58: Structural Diagram of Chujo-Tei Levee

(Source: Japan Institute of Country-ology and Engineering with modification) [161]

However, this style of flood control caused the interregional conflicts. People in the downstream area had got only benefits while people of the upstream areas suffered by the floods of Tone River .During the Edo Period, Oshi Feudal Domain, a branch of the Matsudaira clan (a shogun clan) ruled this area. Oshi Feudal Domain organized “Chujo-Tei Levee Association” that managed and operated the levee by its feudal authority. Although, after the Meiji Restoration, the conflict between the upper and lower reached worsened. After a major flood destroyed the levee in 1910, the conflict was brought in the administrative issues of Saitama Prefecture, causing widespread chaos. The government of Saitama Prefecture had involved in the conflict of this area, and riot and widespread confusion was resulted. Finally, the narrow part of the Tone River was widened, and a

[160] Many versions of the history of the Chujotei Levee exist, but leading theories suggest that the full-scale improvement was implemented by the feudal lord Ina Tadatsugu (1550–1610), who was in charge of the Edo shogunate’s plan to move the Tonegawa River eastward. (Miyamura (1981) and others)

[161] Original figure is in Japanese.

system of connected levees was established, bringing an end to over 300 years of flood control by the Chujo-Tei Levee.

Watarase-yusuichi (retarding basin)

Watarase-yusuichi is also located on the Tone River system, and it extends into four prefectures around Tochigi prefecture. Watarase-yusuichi was developed in 1912 as a countermeasure to pollution of Ashio Copper Mine. Now Watarase-yusuichi mainly serves to control flooding, and, it performs the same functions as the Chujo-Tei Levee except that water gates of Watarase-Yusuichi are purposefully controlled (see the figure). Its effective storage capacity is 170.68 million cubic meters, well over the 100 million provided by the Chujo-Tei Levee of Edo Period. A vibrant ecosystem has formed in the Watarase-yusuichi and has been managed appropriately such that it has become a habitat for rare plants and animals. Watarase-yusuichi was registered on the Ramsar List of Wetlands in July 2012. In actuality, Watarase-yusuichi serves to reduce disaster risk through its preservation of the natural environment.

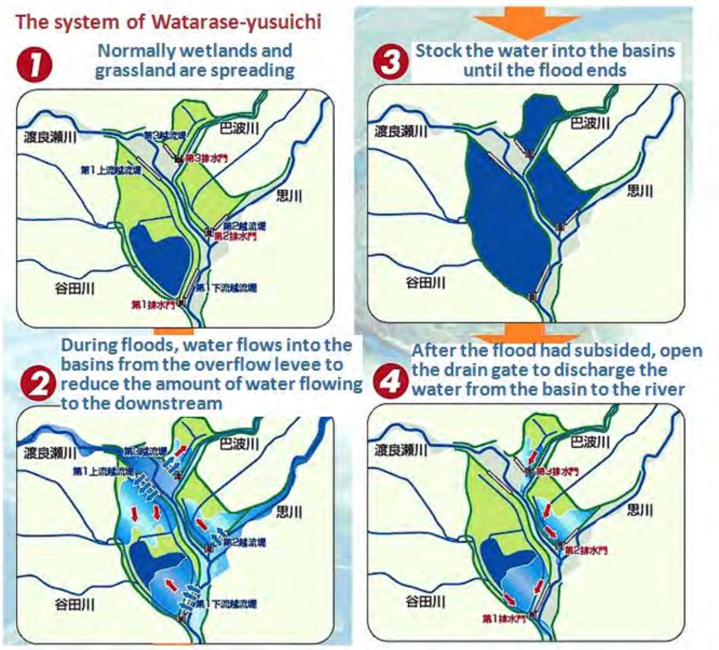


Fig. 6-59: Flood Control Function of Watarase-yusuichi (Source: MLIT) [162]

[162] Original figure is in Japanese.

Comparing Maintenance Systems of the Chujo-Tei Levee and Watarase-yusuichi

As described, the destruction of the Chujo-Tei Levee during the Meiji Period sparked conflict between people of the upper and lower reaches of the Tone River, and its flood-induced control system could not be maintained. The gap between the people of the upstream and downstream are was not apparent because the Edo shogunate did not collect land taxes on farmland in floodplains. Although the Meiji government started to collect taxes from all land of Japan and it prompted farmers who farmed in floodplains to demand the same safety and stability as people in other regions. It led to the riot after the destruction of the levee in 1910.

Conversely, in case of Watarase-yusuichi, land in Yanaka Village (Tochigi Prefecture) was forcibly acquired by the government in 1906 and is now under the jurisdiction of MLIT (as government-owned land), thus the flood control system is maintained through flooding. The lesson from this example of Japan is that it is important to strike an appropriate balance between the preservation of the environment and ecosystem and the interests of stakeholders when planning disaster risk reduction that makes use of the natural environment; it is important to give the same consideration to disaster risk reduction, the environment and affected communities.

6.14. Fisheries

In Japan, fisheries are affected by multiple natural disasters such as storm surge of typhoon or tsunami caused by earthquake. Thus, various structural and organizational disaster risk reduction countermeasures have been implemented. In March 2006, Fisheries Agency published "*Guidelines for the Construction of Disaster-Resilient Fisheries Areas*" and had worked on disaster risk reduction measures for fisheries. However, the damage of the tsunami by the 2011 Great East Japan Earthquake far exceeded expectations based on past damage, and in response the Fisheries Agency further strengthened the disaster risk reduction system and issued a revised version of this Guidelines in 2012. In this section we see the contents of this Guideline that can be applied to development outside of Japan.

6.14.1. Social Risk Reduction: Disaster Compensation Scheme

The support system for disaster affected fisheries is established for the Japanese fisheries which is similar to the agricultural sector. The following is a description of a common disaster compensation scheme.

(1) Fisheries Mutual Aid System

This is a mutual aid system for fishery operators, which is backed by the national and prefectural governments similar to the mutual aid system of agricultural sector. The system comprises four types of mutual aid: mutual aid for fishing, mutual aid for aquaculture, mutual aid for special aquaculture and mutual aid for fishing facilities. The figure below shows the framework for fisheries mutual aid system. Generally it is the same as the mutual aid system for farmers.

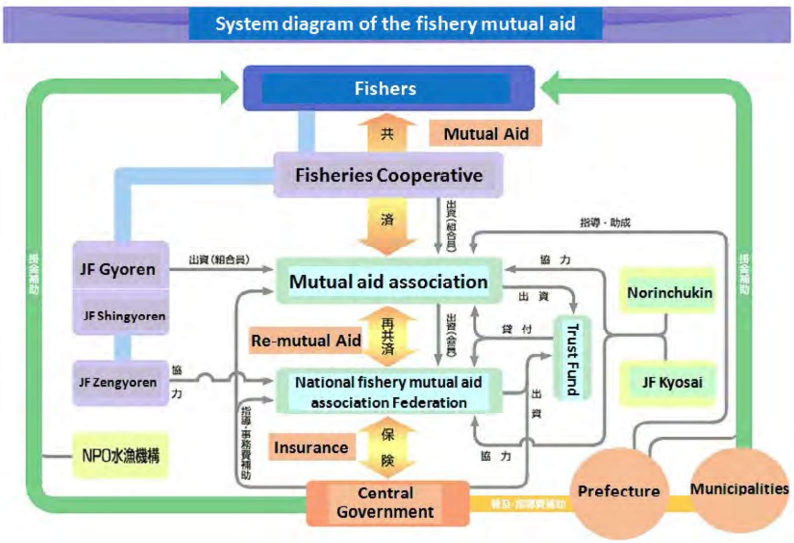
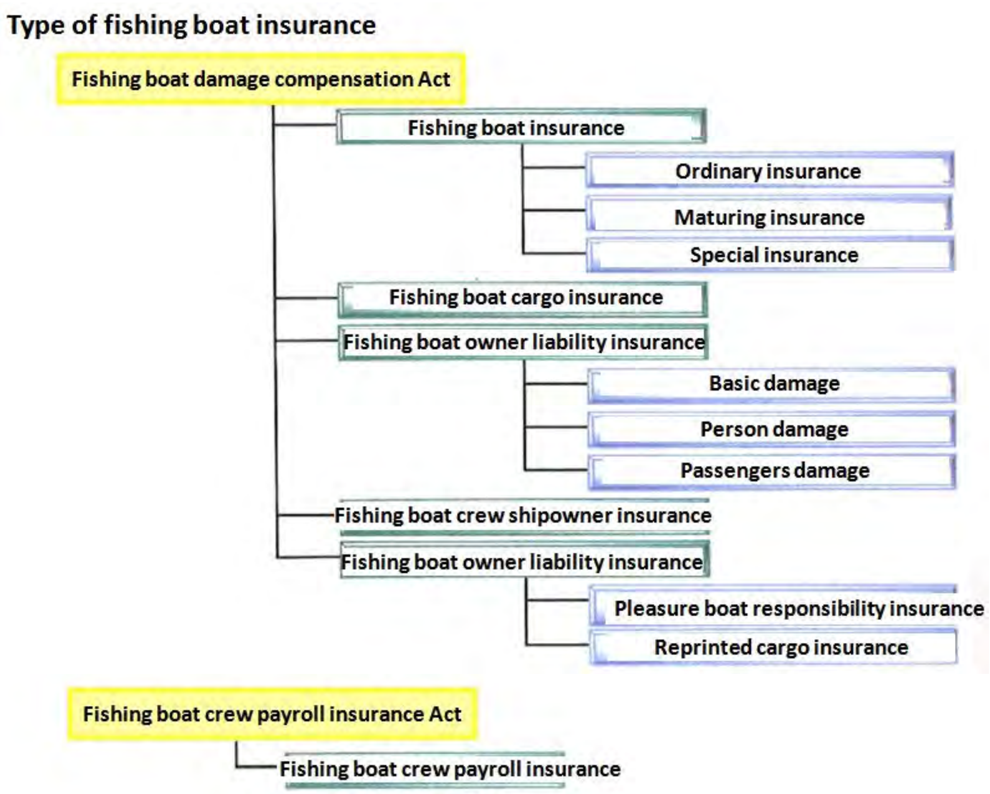


Fig. 6-60: Overview of the Fisheries Mutual Aid System (Source: JF and JF Gyosai) [163]

[163] Original figure is in Japanese.

(2) Fishing Boat Insurance System

Fishing boats are essential tools of production and valuable assets to fishermen. This insurance compensates them by payment for damage of unexpected accidents or disasters and urgent expenses. This system also has reinsurance through the national government.



General insurance	Insurance that pays benefits for damage caused to a fishing vessel's hull, engine, facilities and the like by submersion, running aground, fire or other accidents, and for expenses required to assist the vessel.
Matured insurance	Insurance that pays the exact same benefits as general insurance, and that upon expiration of the coverage period pays a matured benefit equivalent to the insurance benefit amount at the time the insurance was purchased.
Fishing vessel cargo insurance	Insurance that pays benefits for damage caused to catches of fish and stock items aboard a fishing vessel by an accident suffered by the vessel.
Fishing vessel owner's liability insurance	Insurance that pays benefits for damages for boats struck by a fishing vessel, and expenses and damages to third parties caused by the operation of the vessel.
Fishing vessel crew/owner's insurance	Insurance that pays a fixed benefit when a fishing vessel's crew/owner (a person who is both the owner of the vessel and a crewmember) dies, becomes missing or suffers a residual disability due to an unforeseen accident aboard the vessel.

Fig. 6-61: Overview of the Fishing Boat Insurance System[164]

[164] Original figure is in Japanese.

6.14.2. Seismic Reinforcement of Seawalls

Since 1995, Fisheries Agency has implemented "The Project for Construction of Disaster-Resilient Fishing Ports and Communities" to help fishing ports and communities susceptible to earthquakes, tsunami and other disasters. Since 1996, the agency has been developing "Disaster Risk Reduction Center Fishing Ports" to serve as local emergency transportation hubs. The two initiatives were integrated in 2006 and are being implemented as the "Project for Construction of Disaster-Resilient Fishing Areas".

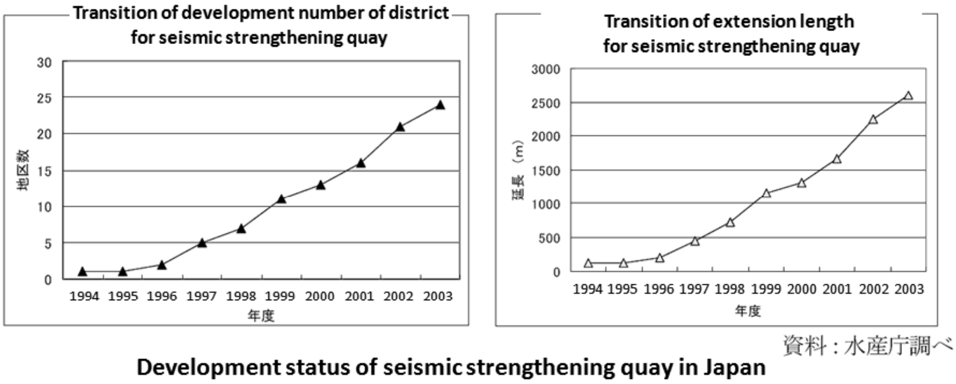


Fig. 6-62 Trends in Seismic Reinforcement of quays at Fishing Ports Controlled by the Fisheries Agency (Source: Fisheries Agency) [165]

6.14.3. New DRR Countermeasures after the 2011 Great East Japan Earthquake

The Fisheries Agency had implemented various disaster risk reduction measures, but the huge tsunami waves caused by the 9.0-magnitude of the 2011 Great East Japan Earthquake caused extensive damage in the marine product sector along the Pacific coast from the region of Tohoku to Kanto. Fisheries Agency revised the "*Guidelines for the Construction of Disaster-Resilient Fishing Areas*" in 2012 according to the results of field surveys of this disaster. A disaster risk reduction system for fishermen already exists and new organization "Disaster Management Council for Fishing Communities" are established to work closely with stakeholders in seaside area.

Fig. 6-63: Diagram of Disaster Risk Reduction Council for Fishing Communities (Source: FA) [166]

165 Original figure is in Japanese.
166 Original figure is in Japanese.

This guideline clearly explains the countermeasures from the lessons of the 2011 Great East Japan Earthquake. Also, it includes tsunami countermeasures and alternative measures to take in disaster situations. In this way, these guidelines serve as a plan to enable marine industries to continue business even in the major disaster.

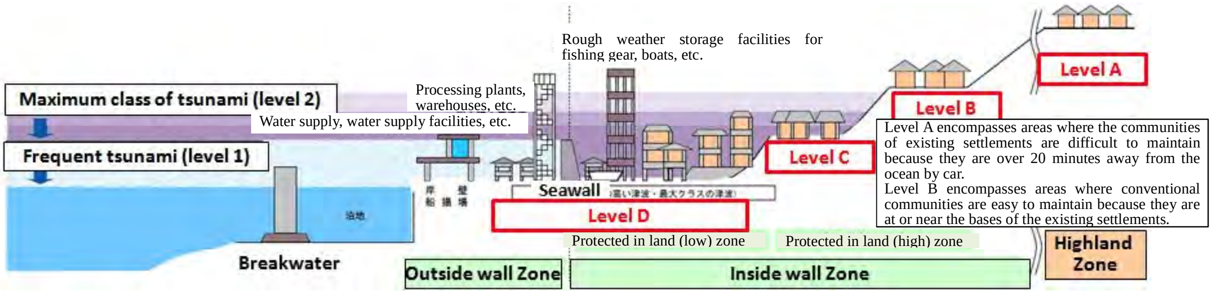


Fig. 6-64: Tsunami Countermeasures in Fishing Communities (Source: FA) [167]

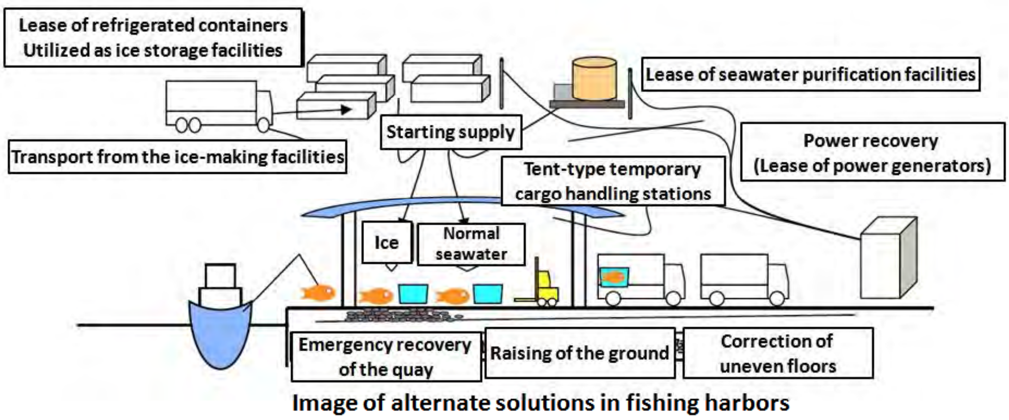


Fig. 6-65: Alternative Plans for Disaster Situations (Source: FA) [168]

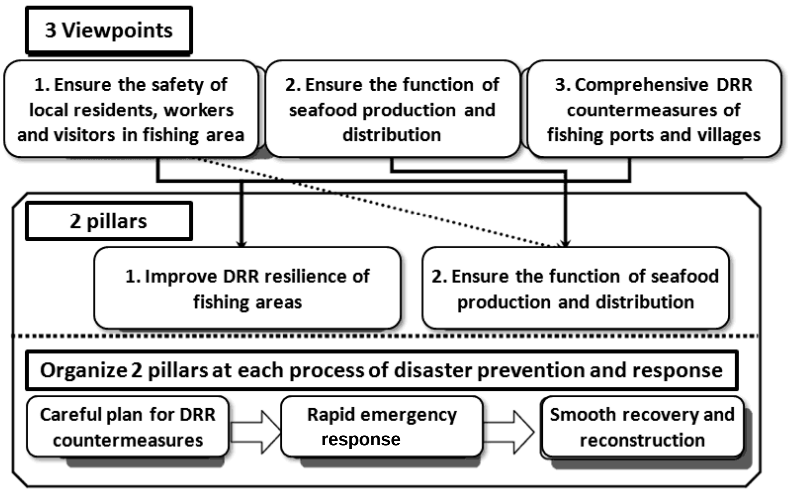


Fig. 6-66: Disaster Risk Reduction System for the Fisheries (Source: FA) [169]

[167] Original figure is in Japanese.
[168] Original figure is in Japanese.
[169] Original figure is in Japanese.

6.15. Gender

Globally, there are various researches and practical actions about the relationship between gender and disaster risk reduction. In the 1970s, researchers in the anthropology and geography fields started to research the relationship between ethnic group, hierarchy and disaster damage.[170] Since the 1990s up to present, these researches are expanded to include considerations for gender, age and disabilities. These researches are based mainly on vulnerability theories and famine researches. In the field of aid for developing countries, various NGOs are striving for coexistance of gender aid and assistance for disaster risk reduction. In particular, sexual violence is extremely critical after the occurrence of disaster, thus it must be considered for development aid. JICA has implemented projects considered with gender viewpoint in developing countries, and this section we see an example of JICA using viewpoint of gender in its domestic disaster aid activities after the 2011 Great East Japan Earthquake. It demonstrates the importance of understanding the relationship between gender and disasters, to incorporate with the viewpoint of gender for disaster risk reduction.

JICA's consideration for viewporint of gender in the 2011 Great East Japan Earthquake Aid Activities

After the 2011 Great East Japan Earthquake, JICA accepted stranded commuters at the JICA Research Institute and JICA Global Plaza (both in Shinjuku-ku, Tokyo), and JICA Tokyo (in Shibuya-ku, Tokyo). JICA also started receiving in residents who evacuated their homes due to the Fukushima Daiichi nuclear disaster on 14th March at JICA Nihonmatsu (Japan Overseas Cooperation Volunteer Training Center) located in Nihonmatsu, Fukushima Prefecture. JICA utilized its experience in overseas cooperation projects related to gender to undertake the following initiatives at JICA Nihonmatsu.

JICA staffs facilitated participatory workshops attended by evacuees and personnel of Fukushima Prefecture and Nihonmatsu City. The JICA staffs took steps to ensure that both men and women had a chance to express and discuss in the workshops and attempted for a gender balance in the selection of group representatives. The facilitators also used participant analysis and came to understand the backgrounds and conditions of the evacuees. Then JICA identified the special needs, such as for young mothers, and extended targeted care. They held several meetings of group representatives (which, as explained above, included women), listened to their concerns and needs, and provided various services for women, children, elderly peoples. Also, they set up men's and women's changing rooms separately to help evacuees who were living in auditoriums.

[170] It is given as famous references for disaster research from the point of human cultural studies.
・B. Wisner et al (2004) "*At Risk: Natural Hazards, People's Vulnerability and Disasters*". London: Routledge. http://www.preventionweb.net/files/670_72351.pdf
・R. Chambers (1989) "*Vulnerability: How the Poor Cope*" IDS Bulletin Vol.20(2)
You can download revised version of R. Chambers (2006) "*Vulnerability, Coping and Policy*" IDS Bulletin Vol.37(4) , from http://ipcc-wg2.gov/njlite_download.php?id=5783

This table shows important themes for advanced and developing countries in global research on gender and disasters. The table should serve as a reference for implementing international disaster risk reduction with the viewpoint of gender.

Table 6-9: Important theme of the between developed and developing countries in the international study of gender and disaster (Source: Enerson & Meyreles(2004))

TABLE 2. REGIONAL THEMES IN INTERNATIONAL GENDER AND DISASTER ANALYSIS

MAJOR THEME OR ATTRIBUTE	Highly Developed Nations	Less Developed Nations
Disasters Analyzed As		
• Social events triggered by natural hazards in risky environments	Frequent	Rare
• Socially constructed process rooted in unsustainable patterns of development	Rare	Frequent
Gender Analyzed As		
• Individual trait (e.g. coded male/female in survey research)	Rare	Very rare
• Gender relations (patterned social relationships based on sex/gender)	Occasional	Occasional
• Intersectional (gender relations integrally related to culture, race, class, sexuality, age, etc.)	Rare	Occasional
• Development concern (gender relations integrally related to development processes)	Rare	Frequent
Level Of Analysis In Disaster Events		
• Individual	Frequent	Rare
• Household	Frequent	Occasional
• Groups/Organizations (women's groups; community groups; NGOs)	Rare	Frequent
• National/International (GOs; IGOs; national disaster agencies)	Rare	Rare
Disaster Phase Emphasized		
• Risk perception/preparedness/early warnings	Occasional	Occasional
• Emergency response/relief	Frequent	Frequent
• Recovery	Rare	Occasional
• Mitigation/vulnerability reduction	Rare	Frequent
• Construction of social vulnerabilities to hazards	Rare	Frequent
Key Research Questions		
• Gender in men's lives in disaster contexts	Rare	Very rare
• Post-disaster 'window of opportunity' for gender power shifts	Rare	Occasional
• Women's coping strategies/capacities	Rare	Frequent
• Women's vulnerabilities	Frequent	Frequent
• Women's economic activities/gendered divisions of labor	Rare	Frequent
• Women in emergency management/relief agencies	Frequent	Occasional
• Women as environmental resource managers/users	Very rare	Frequent
• Women in the family/household	Frequent	Frequent
• Women's physical health and well-being (maternal; nutrition needs)	Rare	Frequent
• Women's social-psychological health	Frequent	Rare
• Violence against women in disaster context	Occasional	Rare
Note: We adopt regional categories utilized by the UN Development Program to make very large generalizations based on small numbers of publications from nations within these regions (see Table 1). Coding based on English and Spanish publications (1990-2003).		

6.16. Urban and Regional Development

6.16.1. MLIT Guideline for development of urban city design planning with DRR

MLIT developed the “Guideline for development of urban city design planning with Disaster Risk Reduction” after the 2011 Great East Japan Earthquake. The guideline reconsiders past approaches to disaster risk reduction in urban area and aim to guide the creation of urban cities that can survive various disasters. In this section we review this guideline for use in the international cooperation field.

In the past, Disaster Risk Reduction in Japanese cities focused mainly on fire control in the city and district level with lessons learned from the 1923 Great Kanto Earthquake and the 1995 Great Hanshin-Awaji Earthquake. However, the increased frequency of extreme weather in recent years, tsunami damage and the Nankai Trough and other major earthquakes prompt concern over new threats from natural disasters. Thus, it is important to thoroughly consider how to reduce disasters risks in all areas of disaster risk reduction planning, and for urban development plans to include an explicit emphasis on the goal of controlling and reducing damage from all types of natural disasters to create land and communities that are resilient in the face of disaster, both structurally and organizationally. In this guideline, urban development includes the tsunami and flood control measures, and vision of disaster-resilient cities as cities of the future given the lessons from the 2011 Great East Japan Earthquake. According to this new guideline, departments and agencies in each municipality should draft “Urban Development Plans with Disaster Risk Reduction”. This plan links the short-term “Local Disaster Management Plan”[171] and the “Urban Development Master Plans” that signify long-term visions for each city. In the course of drafting these plans, the department in charge of urban development cooperates with relevant authorities for disaster risk reduction, civil engineering, medical care and welfare, education and other fields as well as with national and prefectural governments. They will also draft urban development plans based on risk assessment of various disasters, in collaboration with local residents, in order to improve the local disaster risk reduction capacity.

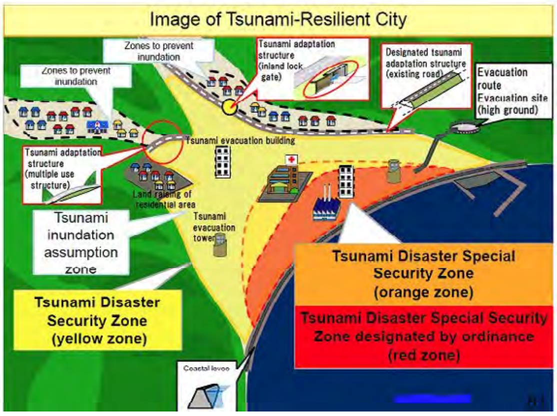


Fig. 6-67: Image of Regional Development with Tsunami Disaster Risk Reduction (Source: MLIT)

[171] Local Disaster Management Plan in Japan set forth short-term disaster risk reduction measures and did not sufficiently connect to Urban Development Master Plans, which signify long-term visions for each city.

6.16.2. Disaster Risk Reduction countermeasures by Mori Trust Co., Ltd.

Mori Trust Co., Ltd.[172] is a major private urban developer in Japan that implements advanced disaster risk reduction measures for its properties. These countermeasures proved to be very effective for its Sendai properties after the 2011 Great East Japan Earthquake. This section describes the disaster risk reduction measures of a private developer.

Mori Trust has implemented a “Gridded Business Continuity Plan (BCP)” at its offices in Tokyo, Sendai and Osaka. The company manages 114 facilities in Japan in groups centered on core facilities in each area, and the facilities are also arranged into a network on a grid. This enables the company to clarify and control information about various types of disasters while giving the company flexibility to increase its response speed or take alternative actions in emergency situations.

The “Gridded BCP” expects disasters at any time, and promotes physical preparation to support operation, Human preparation to enhance effectiveness, and system preparation to get operations started appropriately. “Physical preparation” includes introducing the latest earthquake resistant technologies and installing backup infrastructure in main buildings (installation of emergency generators capable of operating facilities for one week, full preparation of emergency food and beverages, emergency facilities as toilets, wells, etc.). “Human preparation” is improving the skills of company employees with implementation of practical Gridded BCP training, requiring all employees to become certified in life-saving skills, carry out emergency measures such as night watches, and development of disaster management manuals. “System preparation” means establishing an organization, communication network and operating system for emergency situations, and includes installing disaster portals to serve as emergency information sharing systems and speeding up initial disaster response by operating "Earthquake Response Headquarters" efficiently.

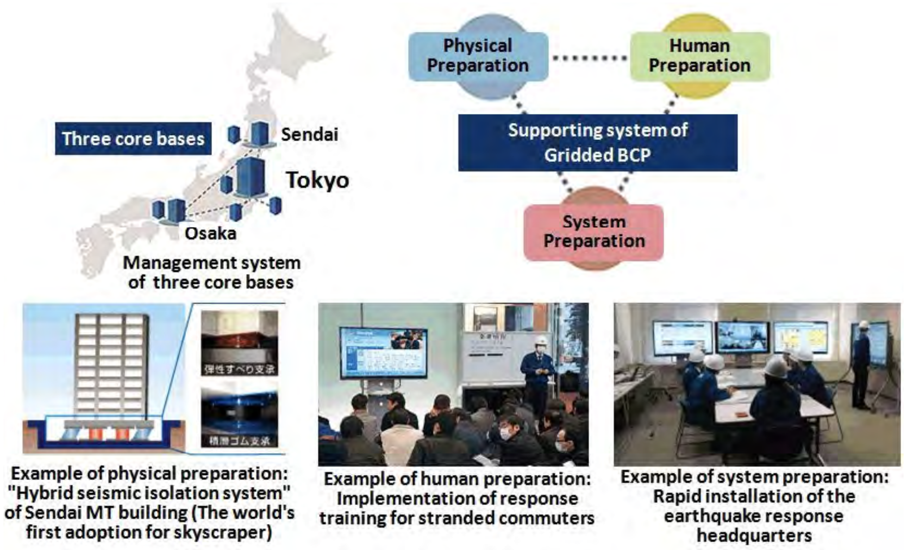


Fig. 6-68: Scheme of Mori Trust’s Gridded BCP and Disaster Risk Reduction (Source: Mori Trust) [173]

[172] Mori Trust became independent company from Mori Building Group in 1999.
[173] Original figure is in Japanese.

This chapter includes how Mori Trust carried out its disaster response at Sendai Trust City and the Sendai MT Building in the aftermath of the 2011 Great East Japan Earthquake.

"*Sendai Trust City*"[174] is a community reinvestment project implemented by Mori Trust. Main buildings of Sendai Trust City are "*Sendai Trust Tower*", 180 meter tall skyscraper with 37 above-ground floors and two underground floors, and "*The Residence Ichibancho*", 100 meter tall super-high-rise condominium building with 29 above-ground floors and one underground floor. In 1999, Mori Trust built the Sendai MT Building[175] which is the first high-rise seismic isolated building in Japan,[176], with 18 above-ground floors and two underground floors. Mori Trust applied this experience and the seismic isolation building method[177] on *The Residence Ichibancho*. *Sendai Trust Tower* is a hybrid structure with damping systems[178] designed to continuously maintain building function without repairs in earthquakes up to strong 6 on the Japanese seismic intensity scale. The tenants of *Sendai Trust Tower* are the Westin Sendai, a luxury hotel, stores, restaurants, medical clinics, etc. *Sendai Trust Tower* contains an emergency generators with three-circuit spot network power receiving system, which is designed to keep a constant power supply to a building even if one of the circuits fails during an accident or a power outage.

The Great East Japan Earthquake struck on 11th March, 2011. The seismic resistant design of *Sendai Trust City* had endured under the gigantic earthquake. The office floors of *Sendai Trust City* resumed its operations from the next day after the safety of facilities was confirmed. The medical clinics in the tower resumed the medical care on 15th March, and commercial facilities except the hotel[179] reopened on 24th March. 90% residents of *The Residence Ichibancho* reported that their homes suffered no damage despite the 9.0 magnitude earthquake with its seismic isolation structure.

[174] Located at Ichibancho, Aoba Ward of Sendai City.
[175] Located at Tsutsujigaoka, Miyagino Ward of Sendai City.
[176] The building used to be known as the *Sendai Mori Building* before 1999. Previous to the completion of the *Sendai MT Building*, the seismic isolation method was thought to be incompatible with high-rise buildings. Taisei Corporation's Hybrid TASS Method, which uses sliding shoes and laminated rubber to lengthen the periods of building vibrations. It enabled the Sendai MT Building to be built as a high-rise seismic isolation building.
[177] *The Residence Ichibancho* was built by Toda Corporation's TO-HIS Method to lengthen the periods of building vibrations by vibration-deadening hydraulic dampers, sliding shoes and laminated rubber
[178] Taisei Corporation built Sendai Trust Tower, and according to its documents (which Mori Trust posted on the Internet), it is composed by "CFT pillars", steel beams with ultra-high strength concrete to form and combined hysteretic and viscous structural materials. Vibration control devices on the rooftop minimize the swaying of the building in strong winds or minor earthquakes.
[179] *The Westin Sendai* suffered minor damage, but its reopening was delayed by its acceptance of disaster victims and other circumstances explained previously. It finally reopened on 29th April 2011, after all lifelines were completely restored.

The Tokyo headquarters and Sendai branch office of Mori Trust worked together with *the Westin Sendai* to establish a “Sendai Earthquake Response Headquarter” which investigated the extent of personal and physical damage at each facility at *Sendai Trust City* and the *Sendai MT Building/* Then, they established emergency information centers inside each of *Sendai Trust Tower*, *The Westin Sendai* and the *Sendai MT Building*. Further, they took in a total of 11,000 disaster affected people and stranded commuters. The Headquarter set up a mobile telephone charging station outside the *Sendai Trust City* to help the communication of disaster affected people. Tenant Stores and restaurants that are tenant of *Sendai Trust City* also assisted disaster affected people.[180] Mori Trust’s preparedness for disaster at any time helped reduce disaster impacts in the catastrophe of the 2011 Great East Japan Earthquake.

Fig. 6-69: Taking in disaster affected people at Sendai Trust City (Source: Mori Trust) [181]

[180] During this time, the Mori Trust Group donated and raised funds for supporting disaster victims.
[181] Original figure is in Japanese.

6.17. Poverty Reduction

As it has been described in previous sections, extreme weather and other factors have caused many natural disasters in recent years. In developing countries, the human, physical and economic loss from disasters has been increased. These loss prevents the eradication of poverty.

In this section, we review the efforts to reduce disaster risk and poverty through the concurrently implemented "*Integrated Approach to the Vulnerable People to Cope with Natural Disasters in Central Vietnam*", a JICA grassroots technical cooperation (partnership) project (conducted between 2008 and 2011) and "*Mechanisms and Enhancement of Community Resilience in Disaster Prone Area in Central Vietnam*", a project subsidized by Grants-in Aid for Scientific Research (operated by Japan Society for the Promotion of Science).

Thừa Thiên-Huế Province[182] in central Vietnam, an area prone to typhoons was the target area of the grassroots technical cooperation project. Natural disasters which suffer this area occur each year or once every few years, and they are frequently overlooked because the damages are smaller than that of major catastrophes. However, these types of disasters persistently affect the lives and livelihood of people in the area. And these damages obstruct the eradication of poverty, stagnate the local economy and deteriorate the natural environment. The poorest people also suffered by flooding in their homes as a result of increased river flow. Swollen rivers are not of much concern to people who are not poor, but constitute natural disasters for the poorest people. The goals of this project were to build a system for educating people living in areas prone to natural disasters about the environment and disaster risk reduction and for taking comprehensive action to reduce disaster risk in those areas, and to strive to ensure better living conditions and greater safety through practical action. This project was proposed by the Kyoto University Graduate School of Global Environmental Studies. Also, this project was the first grassroots technical cooperation project implemented by graduate schools.

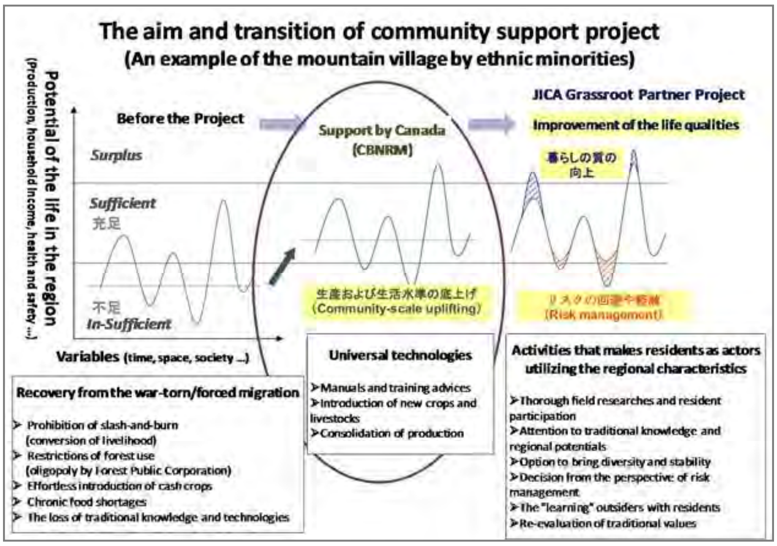


Fig. 6-70: Image of Grassroots Technical Cooperation[183] (Source: Tanaka (2007))

[182] The province had suffered catastrophic damage due to the Tet Offensive in 1968 during the Vietnam War.
[183] Original figure is in Japanese.

Initially, this technical cooperation focused on disaster risk reduction activities at community level. However, it became clear that what residents truly wanted was an improved living situation based on the field surveys and other information of the target area,

The Vietnamese government relocated people who lived on the water to land areas in the city of Huế as a way to reduce disaster risk, but this relocation separated the people's living spaces and their workplaces, and they lived in perpetual poverty as a result. Studies confirmed that these people were living in the "chains of poverty" which makes it difficult to educate their children and find work. On the other hand, it revealed by field interviews of people who had experienced disasters in their villages near lagoons that their vulnerability to flood was mitigated due to the improvement of social infrastructure to soil erosion and flood control dams after the implementation by economic liberalization policy of Vietnam.[184] Economic growth has also led to the raising of ground for individual homes and the construction of two-story buildings. It has become clear that there is a spirit of mutual aid in the local communities of Central Vietnam, and that they are prepared for seasonal flooding and natural disasters. Thus, this technical cooperation shifted the target to "simultaneously improving living situations and the capacity development of disaster management". Specifically, the cooperation now aims to involve the household of poverty, widows, elder people in creating alternative livelihoods (One Village Many Products).

They are examples of approach for regional disaster management by village people. Two facilities had been installed; the water level pole to measure the extent of the flood and bulletin board for and information sharing.

This is a scene of the disaster reduction education for junior high school students of the village in plain. It is an experiment for occurrence mechanism of flood.

Traditional textile classroom held by the requests of the women. The traditional techniques were not be inherited in the Vietnam war.

People who learn the vanilla cultivation.
This is the first introduction of vanilla cultivation in Vietnam.

Fig. 6-71: Implementation of this project (Source: JICA photo gallery) [185]

[184] A policy known as "Đổi mới", implemented by the Vietnamese government since 1986.
[185] Original captions are in Japanese.

6.18. Environment Management

Environment management sector of JICA is classified into three sub-sectors as i) environment management (air and water), ii) solid waste management and iii) global warming countermeasures. From the viewpoint of disaster risk reduction, air pollution is not so closely related. For global warming, JICA has already conducted the consideration process of climate change in all projects. Thus, this section includes the examples of DRR in "waste management" and "water environment (sewerage)".

6.18.1. Waste management after earthquakes

The Ministry of the Environment developed the "Guidelines for earthquake waste management" in 1998 to deal with the aftermath of the 1995 Great Hanshin-Awaji Earthquake and to support the development of the plans of disaster waste treatment for each municipality. However, enormous disaster waste was broken out in the extensive areas by earthquakes and massive tsunamis of the 2011 Great East Japan Earthquake. Disaster waste of this catastrophe was about 11.21 million ton in Miyagi Prefecture, equivalent to about 14 ordinary years; about 4.14 million ton in Iwate Prefecture, equivalent to about 9 ordinary years.

Fig. 6-72: Disaster wastes in Miyagi in 2012~2013
(L) Temporary waste storage in Ishinomaki
(R) Wastes from Miyagi to Tokyo by "Cross-jurisdictional waste treatment"[186]

[186] Onagawa nuclear power plant (Miyagi Prefecture) has stopped working correctly after the 2011 Great East Japan Earthquake and radioactivity did not leak to the outside. Although, disaster wastes from Miyagi had been transported to other areas by "Cross-jurisdictional waste treatment" with strict measurement of radioactivity.

Fig. 6-73: Disaster wastes in Iwate in 2011~2013

(L) Waste separation using heavy equipment in temporary storage

(R) Waste (fishing nets) from Iwate to Tokyo by "Cross-jurisdictional waste treatment"

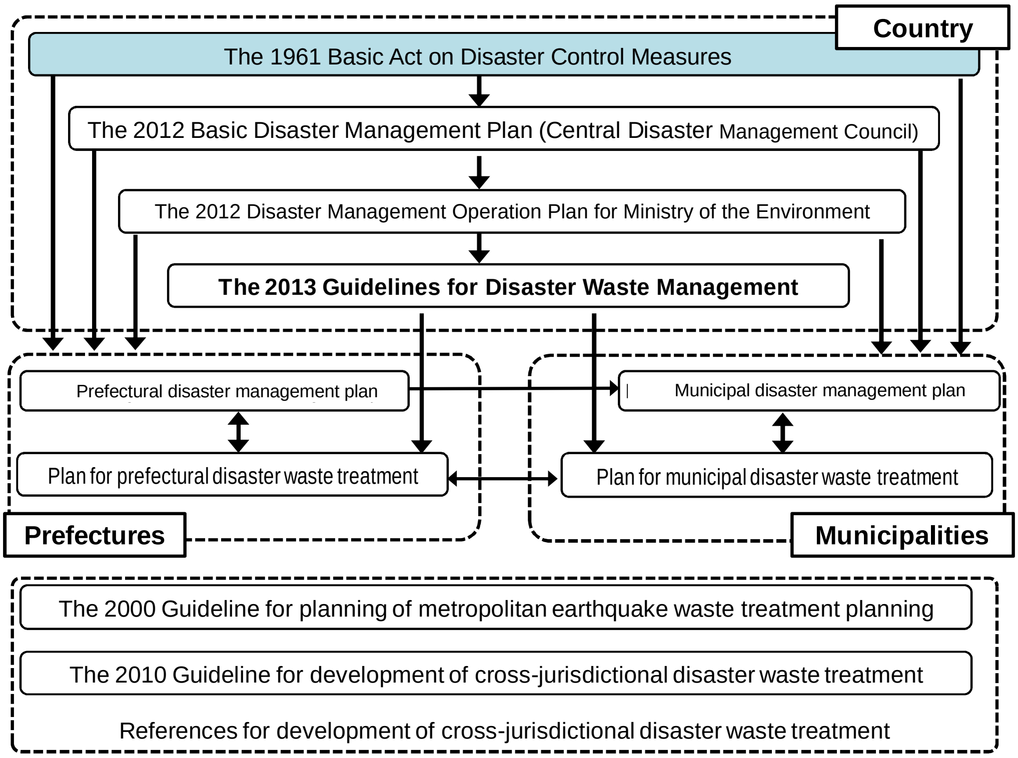


Fig. 6-74: The positioning of the Guidelines for Disaster Waste Management[187]

The treatment of massive disaster waste had difficulties for local municipalities, even with disaster waste treatment plans prepared in advance. Therefore, a new implementation of the "Cross-jurisdictional waste treatment"[188] had been carried out to solve this problem. The disaster waste treatment of the 2011 Great East Japan Earthquake was completed in March 2014 with the implementation of "Cross-jurisdictional waste treatment" (Figure 6-74).

[187] Original figure is in Japanese.
[188] For disaster waste of "Cross-jurisdictional waste treatment", the radioactivity of waste was limited to the no or very small amount detection.

From 2012 to 2013, Ministry of the Environment revised the “Guidelines for earthquake waste management” on the basis of opinions from local municipalities. The name of the new guideline had become as the “Guidelines for disaster waste management” which summarizes the fundamental issues for local municipalities to perform appropriate and quick waste management of disaster. This guideline works in association with the 1961 Basic Act on Disaster Control Measures, Basic Disaster Management Plan and the Disaster Management Operational Plan for Ministry of the Environment.

Local municipalities settle the “Plan for disaster waste treatment” according to the “Guidelines for disaster waste management” with the consistency of prefectural disaster management plans and municipal disaster management plans. Moreover, municipalities check the contents of this plan through the disaster management training and conduct a review as required continuously (Figure 6-75).

Plan for disaster waste treatment		Before Disaster (Normal time)	Disaster Emergency Response	Disaster Recovery/ Reconstruction
Plans of Prefecture	As affected position	• Plan including for liaison and coordination, gathering information, joint action, request for supports, substitute actions for affected municipalities	• Emergency response (system, finance, implementation etc.) • Gathering information and requesting supports of the affected municipalities	• Supporting examination of the execution plan, gathering information in the affected municipalities and supporting execution request • The recovery and reconstruction by prefecture
	As supporting position	• Plan including support measures from cross-jurisdictional perspective (organization, personnel, equipments etc.)	• Information gathering and implementation of support • Dispatching of disaster response experienced personnel	• Gathering information and implementation of support • Considering the implementation of long-term support
Unification of assumption of the affection scale / Consideration of broad-based perspective Adjustment of communication systems / Consistency with the plans of municipalities				
Plans of Municipalities	As affected position	• Plan with specificity as treatment forefront	• Initial response system, condition ascertainment, disaster response, financial management etc. • Requesting supports to prefectures, neighboring municipalities, other local governments, private company organizations, etc.	• Supporting examination of the execution plan / Treatment and recycling wastes consistent with the recovery and reconstruction plan • Requesting supports to other local governments, private company organizations, etc.
	As supporting position	• Plan for support measures (organization, personnel, equipments etc.)	• Information gathering and implementation of supporting • Dispatching of disaster response experienced personnel	• Gathering information and implementation of supporting • Considering the implementation of long-term support

Fig. 6-75: The contents of the Guidelines for disaster waste treatment[189]

Each municipality should, at the normal time, make a plan of necessary actions in disaster prevention, emergency response and recovery/reconstruction in case it is affected by disaster. Also, municipalities summarize requirements as a support provider for other disaster-stricken municipalities in this plan. Both plans are defined as the “Plan for municipal disaster waste treatment”. In the same way, each prefecture assumes the case in which the municipalities within

[189] Original figure is in Japanese.

the jurisdiction became affected by disaster, and the case of supporting municipalities outside of its jurisdiction. And each prefecture formulates the requirements as the "Plan for prefectural disaster waste treatment". When each prefecture formulates this plan, adjustment of assumed conditions such as scale of disaster is needed between the municipalities and prefecture.

When a disaster occurs, each prefecture and municipality will assess the damage status to estimate the amount of disaster waste to be treated. They should consider the schedule of waste treatment with setting the termination day of treatment under the confirmation of human resources, capacity of treatment facilities, and financial resources[190]. When it is decided that treatment of disaster waste is possible with existing facilities in a configured period, treatment will be carried out within each jurisdictions. On the other hand, when it is decided that treatment of disaster waste is impossible with existing facilities in a configured period, treatment will be carried out with "Cross-jurisdictional waste treatment" or new temporary incinerators.

6.18.2. Waste Treatment Facilities as the Disaster Management Bases

Among the types of waste treatment facilities, garbage treatment plants (garbage incineration plants) are regarded as large-scale facilities for the supply of electric power and heat or for the storage of fuel (fuel oil and waste materials) owned by local governments. Except for those hit by tsunami, waste treatment facilities stood unscathed during the Great East Japan Earthquake. They, therefore, can serve as disaster management bases during a disaster. In addition, they can also hold stocks of emergency provisions, emergency beverage, and other relief supplies and serve as refuges.

However, the Great East Japan Earthquake rendered many plants inoperative due to the disruption of external electric power or a lack of fuel for starting up. Therefore it is possible to ensure the ability to fulfill this purpose by the addition of new facilities to existing plants.

Aiming to strengthen disaster management measures at these plants, the Waste Treatment Facility Development Plan (Cabinet Decision in 2013) stipulates, "Waste treatment plants that serve as local core facilities should be improved through earthquake-proofing of facilities, soil improvement, measures against floods, etc. so that they would not be made inoperative by an earthquake or a flood and have the robustness needed for waste treatment systems. This enables the plants to serve as the bases for local disaster management. In particular, an incineration plant with the ability to operate during large-scale disasters is expected to play a role in ensuring the supply of electric power and heat. A conceptual drawing according to this vision of a waste treatment plant and related facilities serving as a disaster management base is shown in Figure 6-76.

[190] In the 1995 Great Hanshin-Awaji Earthquake and the 2011 Great East Japan Earthquake, the waste processing had carried out with schedule for about 2 years of dismantling buildings and about 3 years of processing of disaster wastes.

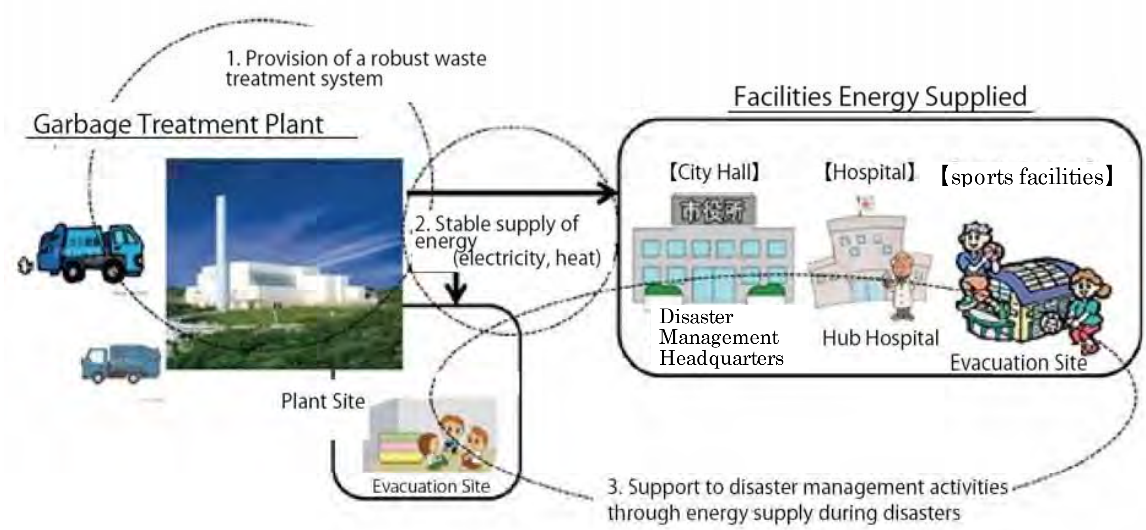


Fig. 6-76: Concept of Waste Treatment Plant and Related Facilities Serving as Bases for Local Disaster Management

(Source: Japan Waste Management & 3R Research Foundation)

6.18.3. A Case of Disaster Risk Reduction Forethought in the Sewer System

Disruption of the sewer system, or disruption of drainage, means a wide range of problems from inconvenience for citizens unable to use toilets and bath, to public health hazards due to the causation of public health hazards due to the accumulation of pollutants. Many efforts have, therefore, been made to prevent the damage to facilities during a disaster.

The experience during the Great Hanshin-Awaji Earthquake showed that the damage to the sewer system is the most likely to occur near the connection between the manhole and the sewer pipeline and that the floating of manholes may hinder traffic in the areas prone to soil liquefaction. The following summarizes the actions taken by the Metropolitan Government of Tokyo against this problem.

Tokyo has been conducting earthquake-proofing since fiscal year 2000 using no-excavation method to install flexible (pliable) connections between the manhole and the sewer pipeline. At the present, earthquake-proofing work has been conducted aiming to ensure the function of toilets at about 2,500 places such as refuges and disaster base hospitals designated in the local disaster management plan.

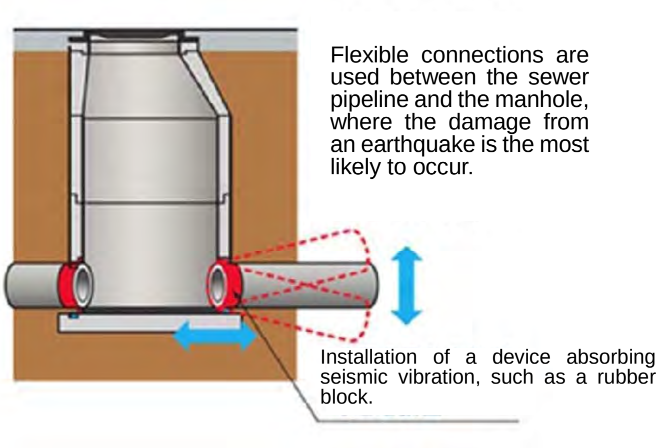


Fig. 6-77: Concept of Flexible Connection between Sewer Pipe and Manhole (Source: Yoshikazu Horii)

As for the floating of manholes, “no-excavation method to prevent manhole floating” was developed as a means to protect existing manholes against soil liquefaction without requiring excavation. This method adds a device called a dissipation valve to the side wall of the manhole. This valve reduces the buoyant force acting on the manhole by releasing the excessive interstitial water pressure resulting from the liquefaction of the soil around the manhole. Targeting at the emergency transportation roads totaling to about 500 km in the areas with a high risk of soil liquefaction, the improvement work was started in fiscal year 2008 and completed by the end of fiscal year 2010.

Fig. 6-78: Manhole floating due to soil liquefaction during the Great East Japan Earthquake (March 11, 2011 in Urayasu City, Chiba Prefecture) (Source:Miwa Horii)

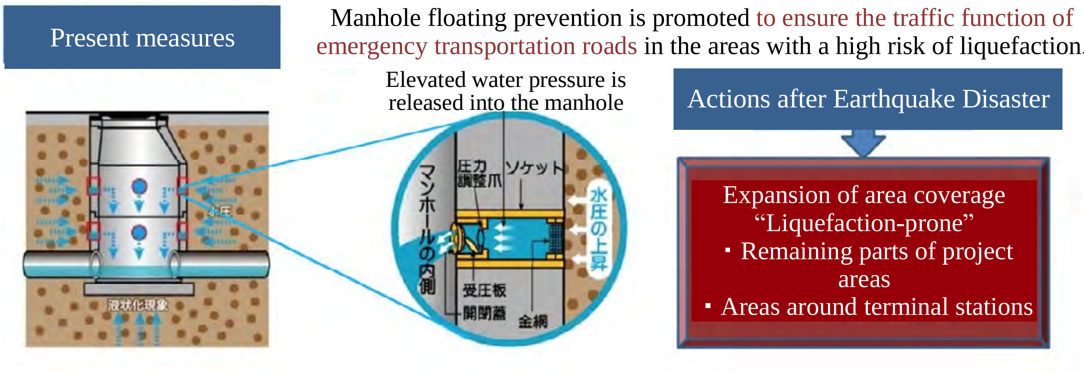


Fig. 6-79: Concept of Manhole Floating Prevention (Source: Miwa Horii)

With the recent increase in the sewer coverage and the installment of water closets, the provision of toilet facilities during a disaster has become a major problem. Generally speaking, temporary toilets (dry toilets) are installed at refuges and other places during a disaster. The excreta from temporary toilets are collected by local government and carried to sewage works for treatment. Depending on road conditions, there may be the cases where the vehicle carrying excreta have difficulty in operation and cannot reach the treatment plant. For this reason, it is a common practice to designate in advance the manholes that can accept excreta. In addition, the use of a type of temporary toilet called a manhole toilet, which makes it possible to use a manhole as a toilet during a disaster, is on the increase. Although a manhole toilet does not require water for flushing, the manhole on which the toilet is placed must be located on an earthquake-proof sewer near a refuge, have a water flow sufficient to carry away the excreta, and be situated so that the toilet would not hinder traffic.

Fig. 6-80: Example of Manhole toilets (Source: Website of Nagaokakyo City)