Hyogo Framework for Action 2005-2015:Building the Resilience of Nations and Communities to Disasters HFA IRIDeS Review Report Focusing on 2011 Great East Japan Earthquake

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International Research Institute of Disaster Science
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Preface

Having experienced the catastrophic disaster in 2011, Tohoku University has founded the International Research Institute of Disaster Science (IRIDeS). Together with collaborating organizations from many countries and staff with a broad array of specializations, the IRIDeS conducts world-leading research on natural disaster science and disaster mitigation. Based on the lessons from the 2011 Great East Japan (Tohoku) Earthquake and Tsunami disaster, the IRIDeS aims to become a world center for the research/study of disasters and disaster mitigation, learning from and building upon past lessons in disaster management from Japan and others around the world. Throughout, the IRIDeS should contribute to on-going recovery/reconstruction efforts in areas affected by the 2011 tsunami, conducting action-oriented research and pursuing effective disaster management to build a sustainable and resilient society.

The 3rd United Nations World Conference on Disaster Risk Reduction 2015 will be held on 14-18 March 2015 in Sendai City, one of the areas seriously damaged due to the 2011 Earthquake and Tsunami. The IRIDeS shall play an important role at the conference as an academic organization located in the hosting city. Drafting of this report, focusing on the 2011 Earthquake and Tsunami in terms of the core indicators of the Hyogo Framework for Action 2005-2015, is one of the contributory activities to the forthcoming event.
This publication is the final issue after the preliminary published in October 2013, for encouraging the discussion, making agreement, and achieving consensus. We hope that the Japanese experience of past disasters including the 2011 Earthquake and Tsunami will be shared among national/local governments, the private sector, NGO, NPO and citizens all over the world.

Fumihiko Imamura

Director
International Research Institute of Disaster Science
Tohoku University

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6. 2011 Great East Japan Earthquake Review

1. Introduction

Japan has one of the highest levels of urban risk of natural disaster in the world because all the three values determining the risk—hazard, vulnerability, and exposed value—are very high. Thus, Japanese society has struggled against natural disasters throughout history.

In this context, the UN World Conference on Natural Disaster Reduction was held in Yokohama in May 1994 as a part of a mid-term review of the International Decade for Natural Disaster Reduction (IDNDR). However, the most tragically disastrous event in Japanese history since World War II, the 1995 Great Kobe Earthquake, occurred the next year.

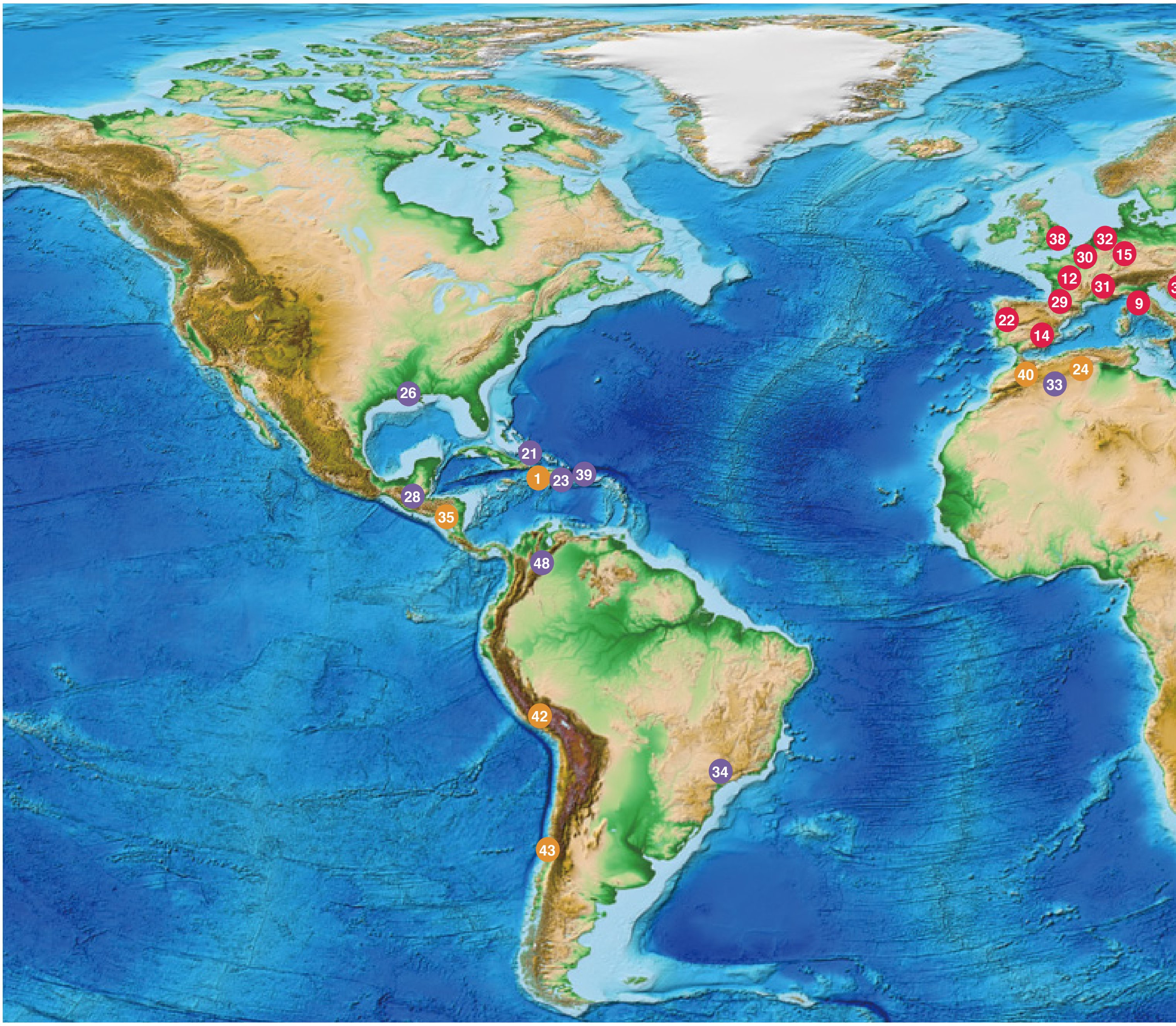
The earthquake led the 2005 World Conference on Disaster Reduction (WCDR) to select Kobe City, Hyogo Prefecture, as its location for demonstrating the city's remarkable recovery from the earthquake. The Hyogo Declaration was adopted at the conference, and the Hyogo Framework for Action 2005–2015 (HFA) was built as a 10-year plan to safeguard the world from natural hazards. The HFA consists of the following five priorities for action, which would serve as guidelines to reduce future disaster damage for every country or region.

Priorities for action 2005–2015:
1. Ensure that disaster risk reduction is a national and local priority with a strong institutional basis for implementation;
2. Identify, assess, and monitor disaster risks and enhance early warning;
3. Use knowledge, innovation, and education to build a culture of safety and resilience at all levels;
4. Reduce the underlying risk factors;
5. Strengthen disaster preparedness for effective response at all levels.

During that decade, the Great East Japan Earthquake with Mw 9.0 occurred on March 11, 2011. We must learn from such devastating experiences for the sake of future societies. To this end, International Research Institute of Disaster Science (IRIDeS), Tohoku University issued *"HFA IRIDeS Review Preliminary Report Focusing on 2011 Great East Japan Earthquake"* in October 2013 in terms of HFA guidelines from the academic viewpoints of professors at IRIDeS to disseminate the event's lessons learned. IRIDeS faculties had enriched the report with more cases learnt from the disaster since then. This revised report adds more topics to the previous one with additional information of post-disaster urban recovery plan announced by municipalities affected by the 2011 Tsunami.

As well as the preliminary report, each topic deals with a specific case, contains ***context***, the situation ***before*** and ***after*** the event, ***good practices***, and ***problems***, followed by ***future recommendations*** summarized at the end of the 6th chapter: ***2011 Great East Japan Earthquake Review***.

2. World's 21st Century Natural Disasters

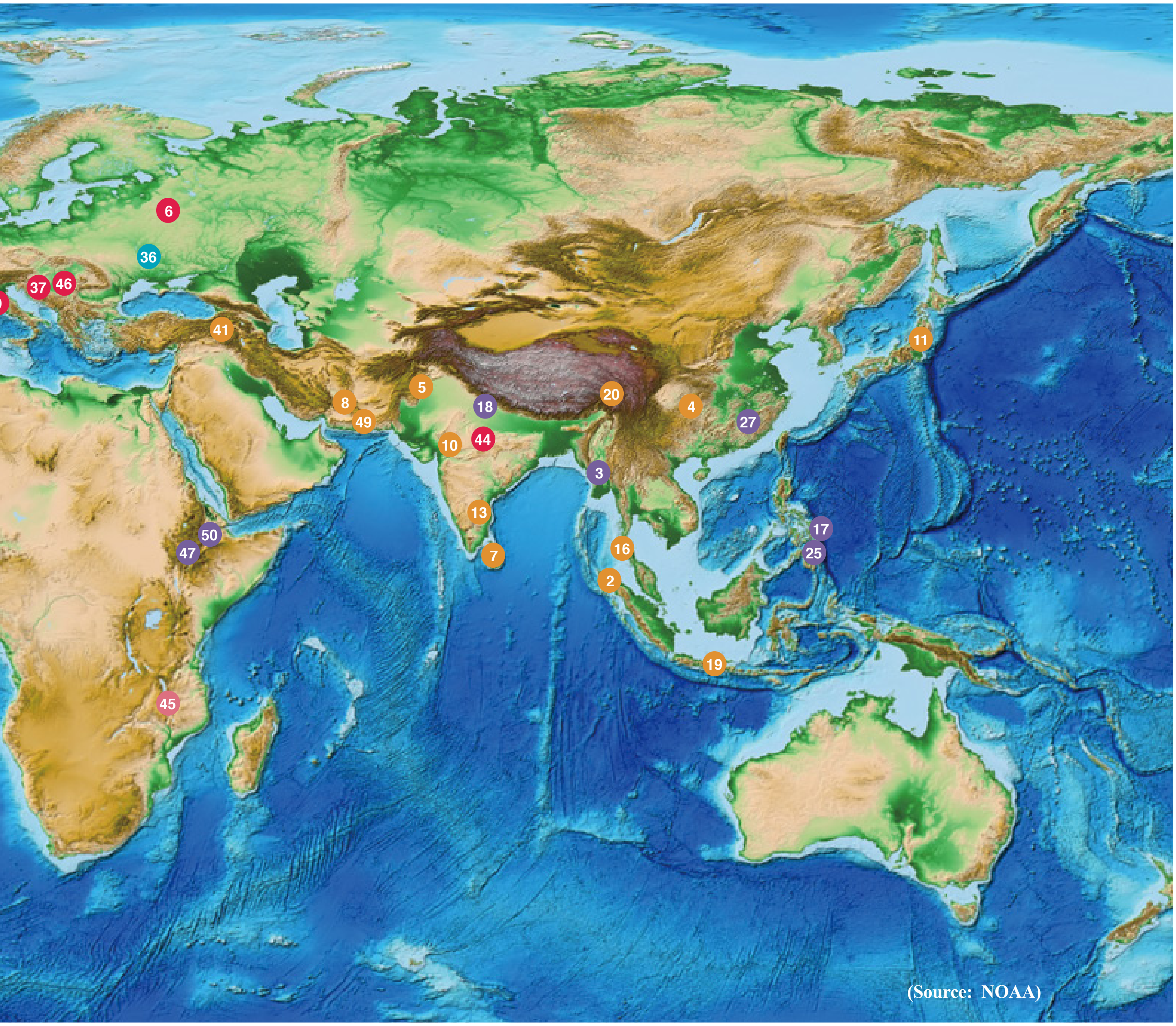


No.	Month/Year	Disaster Type	Country	Killed	Total Affected	Estimated Damage (US$ Million)
1	January 2010	Earthquake	Haiti	222,570	3,700,000	8,000
2	December 2004	Earthquake	Indonesia	165,708	532,898	4,452
3	May 2008	Storm	Myanmar	138,366	2,420,000	4,000
4	May 2008	Earthquake	China	87,476	45,976,596	85,000
5	October 2005	Earthquake	Pakistan	73,338	5,128,309	5,200
6	June-August 2010	Heat wave	Russia	55,736		400
7	December 2004	Earthquake	Sri Lanka	35,399	1,019,306	1,317
8	December 2003	Earthquake	Iran	26,796	267,628	500
9	July-August 2003	Heat wave	Italy	20,089		4,400
10	January 2001	Earthquake	India	20,005	6,321,812	2,623
11	March 2011	Earthquake	Japan	19,846	368,820	210,000
12	August 2003	Heat wave	France	19,490		4,400
13	December 2004	Earthquake	India	16,389	654,512	1,023

No.	Month/Year	Disaster Type	Country	Killed	Total Affected	Estimated Damage (US$ Million)
14	August 2003	Heat wave	Spain	15,090		880
15	August 2003	Heat wave	Germany	9,355		1,650
16	December 2004	Earthquake	Thailand	8,345	67,007	1,000
17	November 2013	Storm	Philippines	7,986	16,106,807	10,000
18	June 2013	Flood	India	6,054	504,473	1,100
19	May 2006	Earthquake	Indonesia	5,778	3,177,923	3,100
20	April 2010	Earthquake	China	2,968	112,000	500
21	September 2004	Storm	Haiti	2,754	315,594	50
22	August 2003	Heat wave	Portugal	2,696		
23	May-June 2004	Flood	Haiti	2,665	31,283	
24	May 2003	Earthquake	Algeria	2,266	210,261	5,000
25	December 2012	Storm	Philippines	1,901	6,246,664	1,693
26	August-September 2005	Storm	United States	1,833	500,000	125,000

This map indicates the fifty worst disasters between 2001 and April 2014. These disasters are categorized into five types.

🟧 Earthquake
🟪 Windstorm, Flood
🟥 Drought
🟥 Heat wave
🟦 Extreme winter conditions



(Source: NOAA)

No.	Month/Year	Disaster Type	Country	Killed	Total Affected	Estimated Damage (US$ Million)
27	May-August 2010	Flood	China	1,691	134,000,000	18,000
28	October 2005	Storm	Guatemala	1,513	475,314	988
29	July 2006	Heat wave	France	1,388		
30	August 2003	Heat wave	Belgium	1,175		
31	July 2003	Heat wave	Switzerland	1,039		280
32	July 2006	Heat wave	Netherlands	1,000		
33	November 2001	Flood	Algeria	921	45,423	300
34	January 2011	Flood	Brazil	900	45,000	1,000
35	January 2001	Earthquake	El Salvador	844	1,334,529	1,500
36	January-February 2006	Extreme winter Conditions	Ukraine	801	59,600	
37	July 2003	Heat wave	Croatia	788		
38	July 2013	Heat Wave	United Kingdom	760		

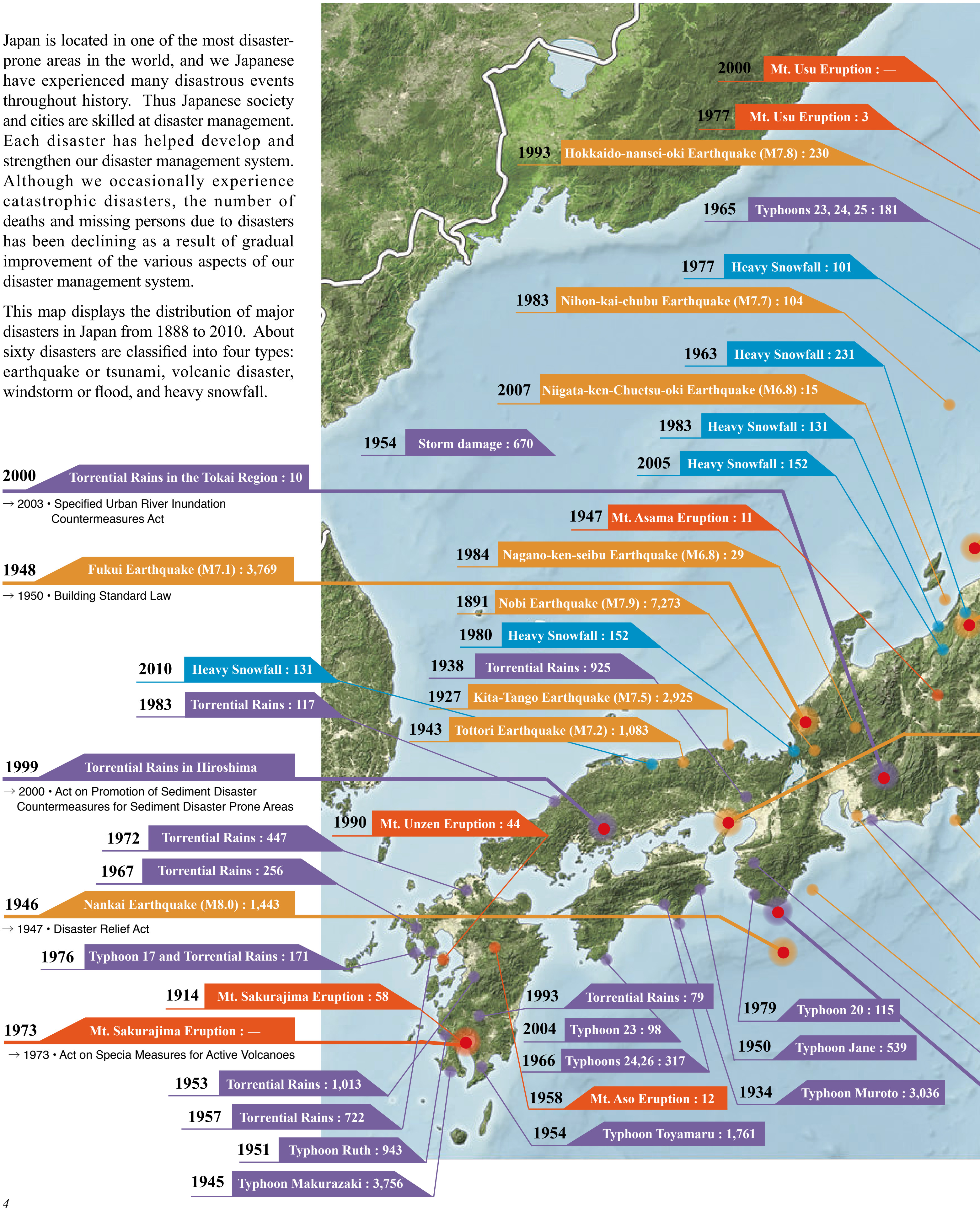
No.	Month/Year	Disaster Type	Country	Killed	Total Affected	Estimated Damage (US$ Million)
39	May-June 2004	Flood	Dominican Republic	688	10,002	
40	February 2004	Earthquake	Morocco	628	13,465	400
41	October 2011	Earthquake	Turkey	604	32,938	1,500
42	August 2007	Earthquake	Peru	593	658,331	600
43	February 2010	Earthquake	Chile	562	2,671,556	30,000
44	April-June 2013	Heat Wave	India	557		
45	February 2002	Drought	Malawi	500	2,829,435	
46	July 2007	Heat wave	Hungary	500		
47	August 2006	Flood	Ethiopia	498	10,096	3
48	April 2010-March 2011	Flood	Colombia	418	2,791,999	1,000
49	September 2013	Earthquake	Pakistan	399	185,749	100
50	August-September 2006	Flood	Ethiopia	364	8,000	

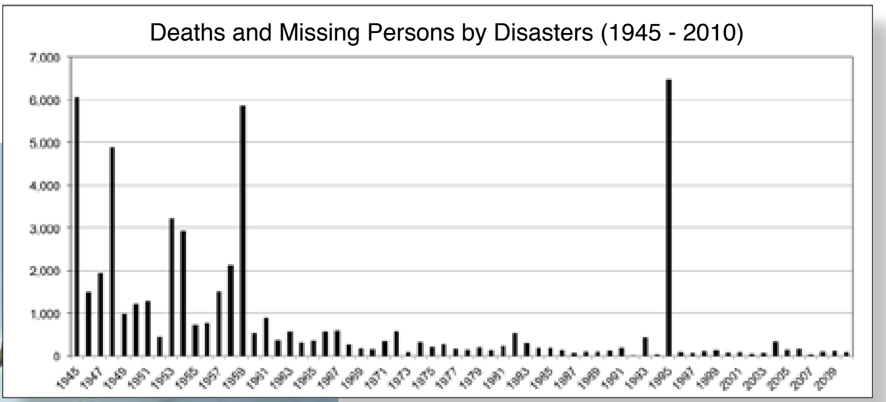
Data Source: EM-DAT: The OFDA/CRED International Disaster Database, Centre for Research on the Epidemiology of Disasters (CRED)

3. History of Natural Disasters in Japan (1888 - 2010)

Japan is located in one of the most disaster-prone areas in the world, and we Japanese have experienced many disastrous events throughout history. Thus Japanese society and cities are skilled at disaster management. Each disaster has helped develop and strengthen our disaster management system. Although we occasionally experience catastrophic disasters, the number of deaths and missing persons due to disasters has been declining as a result of gradual improvement of the various aspects of our disaster management system.

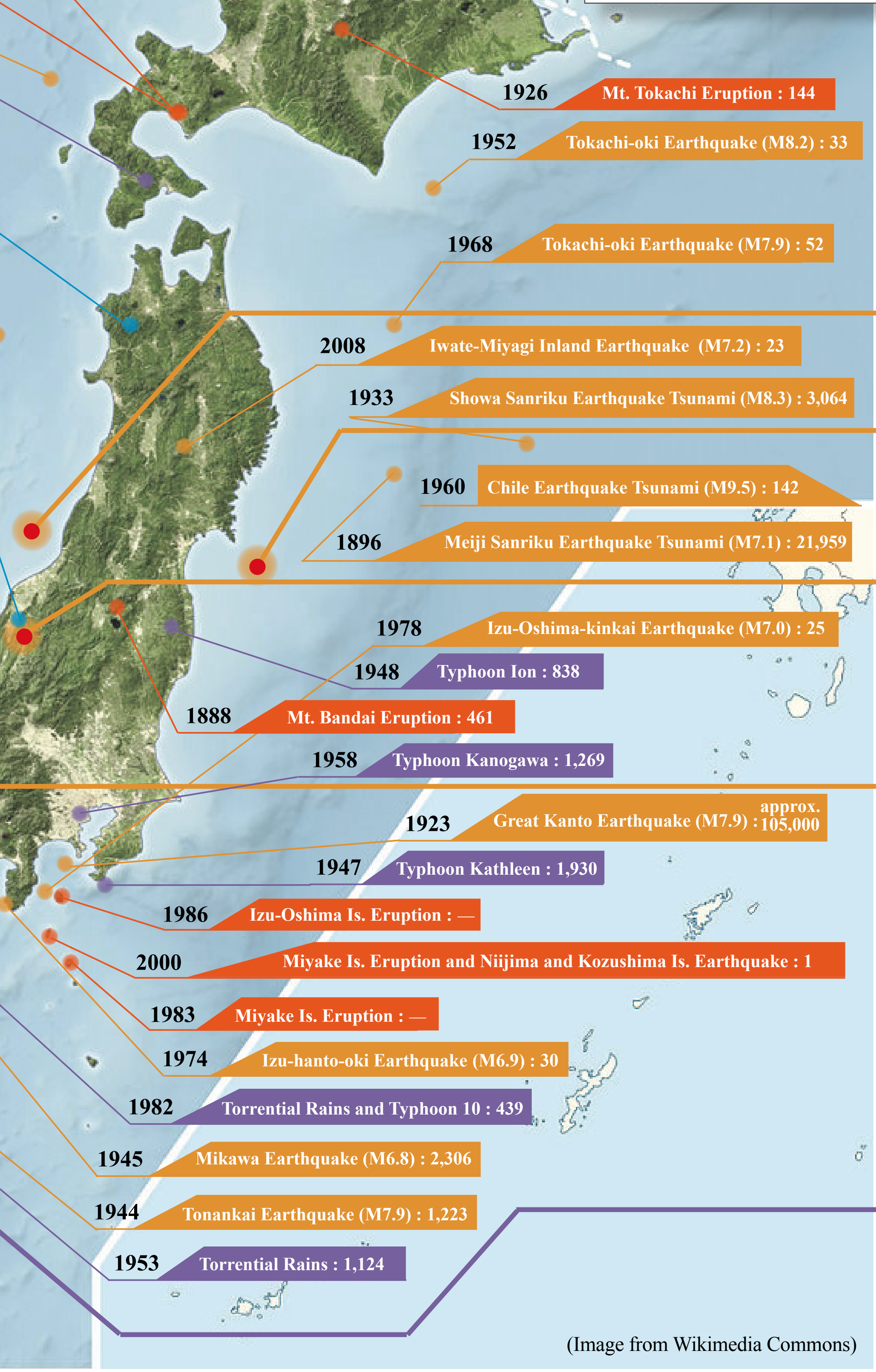
This map displays the distribution of major disasters in Japan from 1888 to 2010. About sixty disasters are classified into four types: earthquake or tsunami, volcanic disaster, windstorm or flood, and heavy snowfall.




Deaths and Missing Persons by Disasters (1945 - 2010)

Year	Disaster (Magnitude) :	Number of Deaths and Missing

🟧 Earthquake (epicenters marked), Tsunami
🟥 Volcanic disaster
🟪 Windstorm (landed places marked), Flood
🟦 Heavy snowfall
(places with highest seasonal total marked)



1926 Mt. Tokachi Eruption : 144

1952 Tokachi-oki Earthquake (M8.2) : 33

1968 Tokachi-oki Earthquake (M7.9) : 52

2008 Iwate-Miyagi Inland Earthquake (M7.2) : 23

1933 Showa Sanriku Earthquake Tsunami (M8.3) : 3,064

1960 Chile Earthquake Tsunami (M9.5) : 142

1896 Meiji Sanriku Earthquake Tsunami (M7.1) : 21,959

1978 Izu-Oshima-kinkai Earthquake (M7.0) : 25

1948 Typhoon Ion : 838

1888 Mt. Bandai Eruption : 461

1958 Typhoon Kanogawa : 1,269

1923 Great Kanto Earthquake (M7.9) : approx. 105,000

1947 Typhoon Kathleen : 1,930

1986 Izu-Oshima Is. Eruption : —

2000 Miyake Is. Eruption and Niijima and Kozushima Is. Earthquake : 1

1983 Miyake Is. Eruption : —

1974 Izu-hanto-oki Earthquake (M6.9) : 30

1982 Torrential Rains and Typhoon 10 : 439

1945 Mikawa Earthquake (M6.8) : 2,306

1944 Tonankai Earthquake (M7.9) : 1,223

1953 Torrential Rains : 1,124

1964 Niigata Earthquake (M7.5) : 26

→ 1966 • Act on Earthquake Insurance Insurance

1978 Miyagi-ken-oki Earthquake (M7.4) : 28

→ 1981 • Amendment of Building Standard LawInsurance

2004 Niigata-ken-Chuetsu Earthquake (M6.8) : 67

→ 2005 • Amendment of Act on Promotion of the Earthquake-proof Retrofit of Buildings

• Amendment of Flood Control Act

• Amendment of Act on Promotion of Sediment Disaster Countermeasures for Sediment Disaster Prone Areas

1995 Great Hanshin-Awaji Earthquake (M7.3) : 6,437

→ 1995 • Act on Special Measures for Earthquake Disaster Countermeasures

• Act on Promotion of the Earthwuake-proof Retrofit of Buildings

• Amendment of Disaster Countermeasures Basic Act

• Amendment of Act on Special Measures for Large-scale Earthquakes

→ 1996 • Act on Special Measures for Preservation of Rights and Profits of the Victims of Specified Disasters

→ 1997 • Act on Promotion of Disaster Resilience Improvement in Densely Inhabited Areas

→ 1998 • Act on Support for Livelihood Recovery of Disaster Victims

1959 Typhoon Ise-wan : 5,098

→ 1960 • Soil Conservation and Flood Control Urgent Measures Act

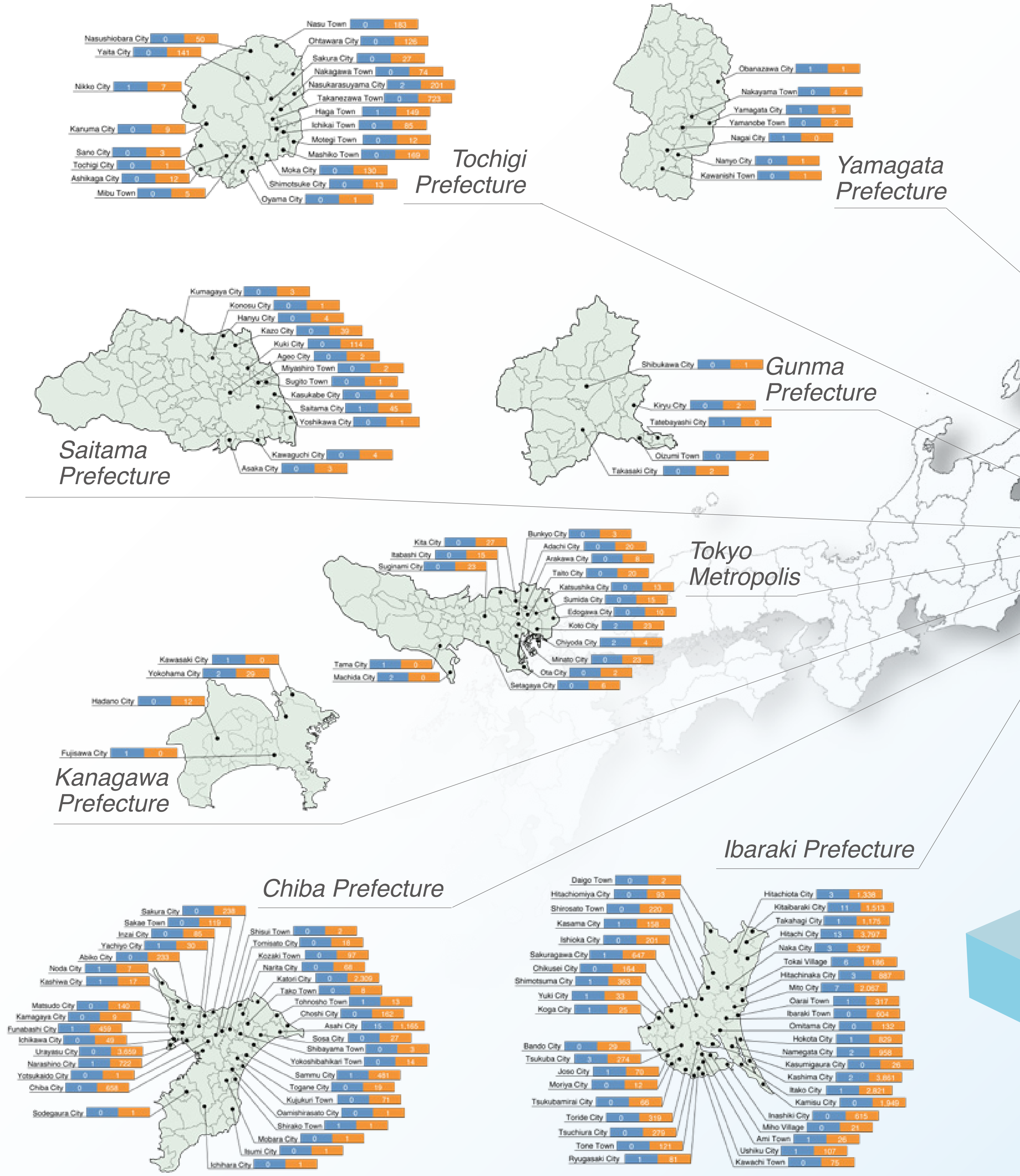
→ 1961 • Disaster Countermeasures Basic Act

→ 1962 • Act on Special Financial Support to Deal with Extremely Severe Disasters

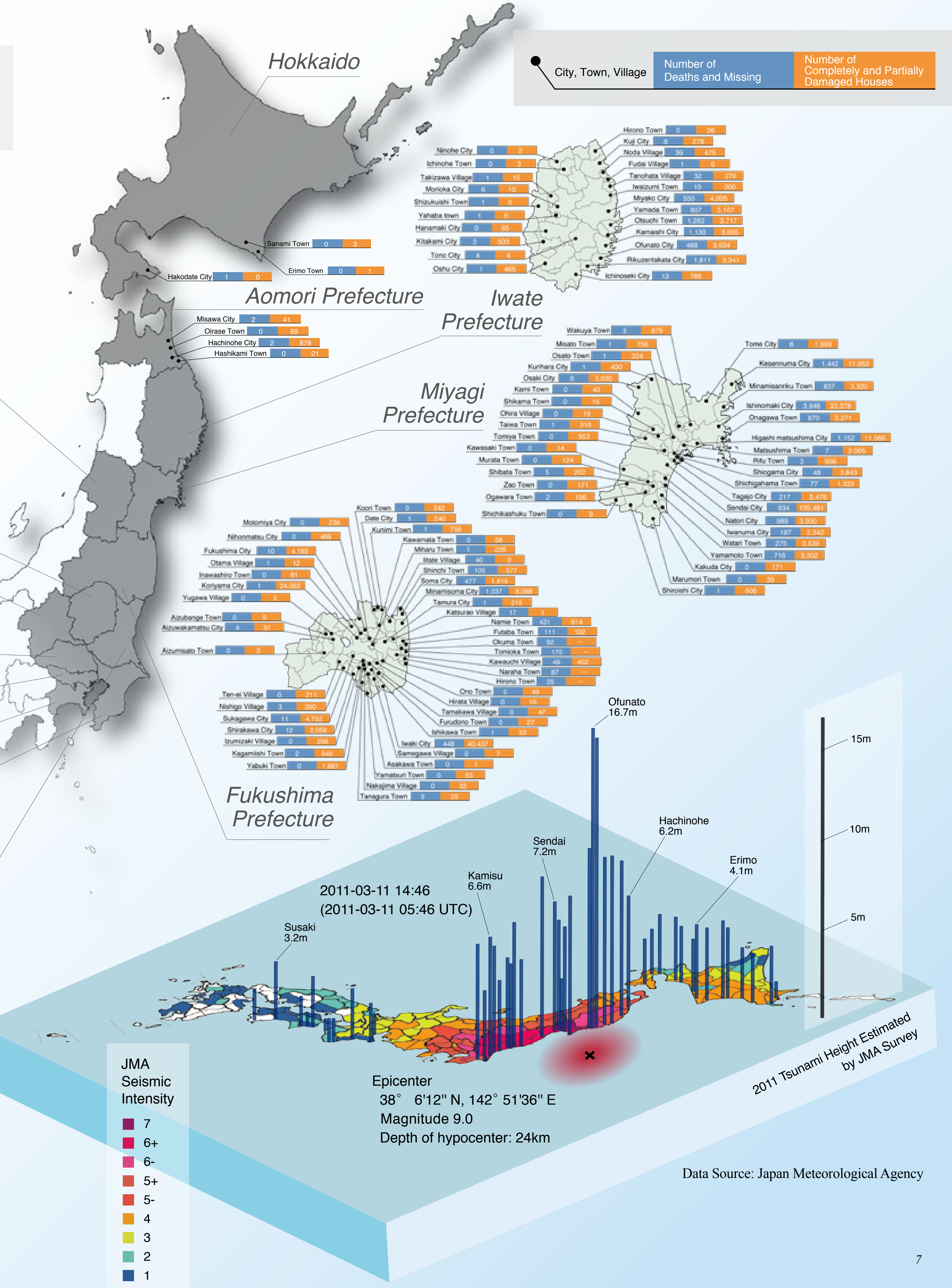
(Image from Wikimedia Commons)

Data Source: “*Disaster Management in Japan*” (Cabinet Office, Government of Japan, 2011)

4. Damage due to
2011 Great East Japan Earthquake and Tsunami



Data Source: Fire and Disaster Management Agency, (as of March 26, 2013)



Hokkaido

City, Town, Village	Number of Deaths and Missing	Number of Completely and Partially Damaged Houses
Sanami Town	0	3
Erimo Town	0	1
Hakodate City	1	0

Aomori Prefecture

City, Town, Village	Number of Deaths and Missing	Number of Completely and Partially Damaged Houses
Misawa City	2	41
Oirase Town	0	69
Hachinohe City	2	878
Hashikami Town	0	21

Iwate Prefecture

City, Town, Village	Number of Deaths and Missing	Number of Completely and Partially Damaged Houses
Ninohe City	0	2
Ichinohe Town	0	3
Takizawa Village	1	15
Morioka City	6	10
Shizukuishi Town	1	0
Yahaba town	1	0
Hanamaki City	0	65
Kitakami City	2	503
Tono City	4	4
Oshu City	1	465
Hirono Town	0	26
Kuji City	6	278
Noda Village	39	479
Fudai Village	1	0
Tanohata Village	32	270
Iwaizumi Town	10	200
Miyako City	550	4,005
Yamada Town	807	3,167
Otsuchi Town	1,282	3,717
Kamaishi City	1,130	3,655
Ofunato City	488	3,934
Rikuzentakata City	1,811	3,341
Ichinoseki City	13	789

Miyagi Prefecture

City, Town, Village	Number of Deaths and Missing	Number of Completely and Partially Damaged Houses
Wakuya Town	3	878
Misato Town	1	756
Osato Town	1	324
Kurihara City	1	430
Osaki City	6	3,030
Kami Town	0	43
Shikama Town	0	15
Ohira Village	0	19
Taiwa Town	1	310
Tomiya Town	0	553
Kawasaki Town	0	14
Murata Town	0	124
Shibata Town	5	202
Zao Town	0	171
Ogawara Town	2	156
Shichikashuku Town	0	9
Tome City	8	1,999
Kesennuma City	1,442	11,053
Minamisanriku Town	837	3,320
Ishinomaki City	3,946	33,378
Onagawa Town	870	3,271
Higashi matsushima City	1,152	11,066
Matsushima Town	7	2,005
Rifu Town	3	956
Shiogama City	48	3,843
Shichigahama Town	77	1,323
Tagajo City	217	5,476
Sendai City	934	139,481
Natori City	989	3,930
Iwanuma City	187	2,342
Watari Town	275	3,539
Yamamoto Town	716	3,302
Kakuda City	0	171
Marumori Town	0	39
Shiroishi City	1	606

Fukushima Prefecture

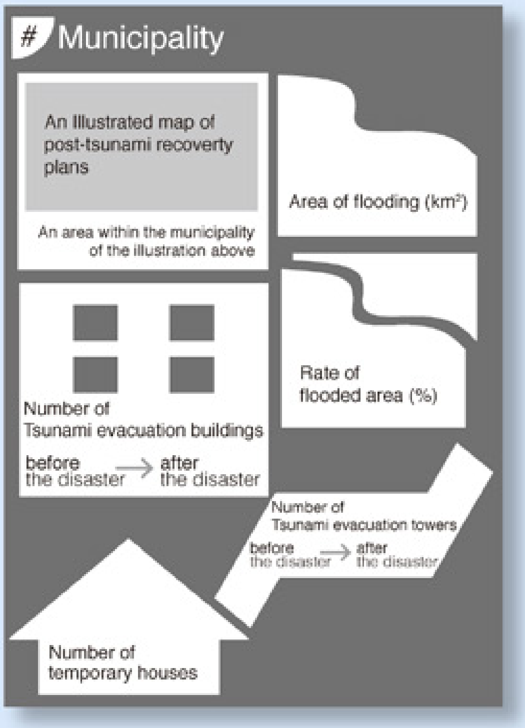
City, Town, Village	Number of Deaths and Missing	Number of Completely and Partially Damaged Houses
Motomiya City	0	236
Nihonmatsu City	0	469
Fukushima City	10	4,185
Otama Village	1	12
Inawashiro Town	0	81
Koriyama City	1	24,062
Yugawa Village	0	3
Aizubange Town	0	9
Aizuwakamatsu City	4	91
Aizumisato Town	0	2
Ten-ei Village	0	211
Nishigo Village	3	390
Sukagawa City	11	4,752
Shirakawa City	12	2,058
Izumizaki Village	0	298
Kagamiishi Town	2	940
Yabuki Town	0	1,881
Koori Town	0	242
Date City	1	240
Kunimi Town	1	756
Kawamata Town	0	58
Miharu Town	1	226
Iitate Village	40	0
Shinchi Town	105	577
Soma City	477	1,819
Minamisoma City	1,037	8,088
Tamura City	1	215
Katsurao Village	17	1
Namie Town	431	614
Futaba Town	111	102
Okuma Town	92	–
Tomioka Town	170	–
Kawauchi Village	49	402
Naraha Town	87	–
Hirono Town	35	–
Ono Town	0	49
Hirata Village	0	16
Tamakawa Village	0	47
Furudono Town	0	27
Ishikawa Town	1	33
Iwaki City	448	40,437
Samegawa Village	0	7
Asakawa Town	0	1
Yamatsuri Town	0	63
Nakajima Village	0	32
Tanagura Town	0	25

Data Source: Japan Meteorological Agency

5. Various Post-tsunami Recovery Plans for the Coastal Areas affected by 2011 Great East Japan Earthquake and Tsunami

The 2011 Great East Japan Earthquake and Tsunami affected not only seriously damaged Iwate, Miyagi, and Fukushima prefectures but also Aomori, Ibaraki, and Chiba prefectures. The total inundated areas by the tsunami covered about 561km² in the six prefectures (Geospatial Information Authority of Japan, 2011). Each municipality devised post-tsunami recovery plans for the damaged areas in 2011 or 2012 according to its damage situation and regional context.

This map shows the coastline of the six affected prefectures from Aomori in the north to Chiba in the south, focusing on seventy municipalities. It illustrates the inundated areas by the tsunami, which help us understand the differences of regional characteristics. In addition, the illustrations of each municipality contain visual and numerical data of inundated areas and some basic information on their recovery situation: a illustrated map of post-tsunami recovery plan showing a section of future vision of the damaged areas, the number of temporary houses constructed as of April 2013, and the number of tsunami evacuation buildings and towers as of March 2011 and August 2013.



Municipality

An Illustrated map of post-tsunami recovery plans

An area within the municipality of the illustration above

Area of flooding (km²)

Rate of flooded area (%)

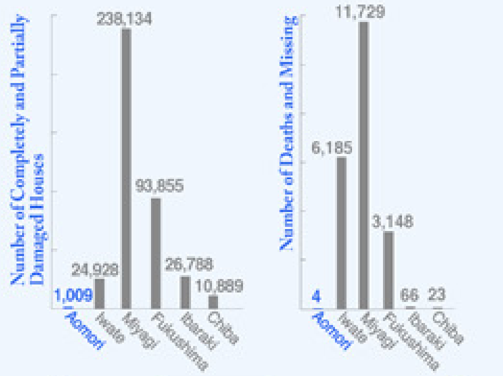
Number of Tsunami evacuation buildings

before the disaster → after the disaster

Number of Tsunami evacuation towers

before the disaster → after the disaster

Number of temporary houses



0
Total Number of Temporary Houses

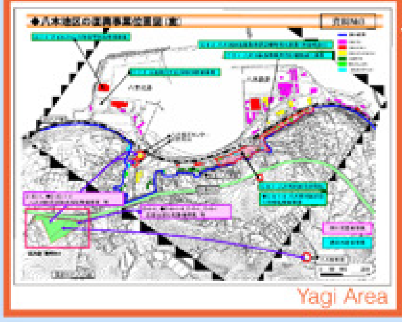
2→20
Total Number of Tsunami Evacuation Buildings

0→0
Total Number of Tsunami Evacuation Towers

The death toll in Aomori by the disaster was the least among out of the six prefectures. The damage to buildings by the tsunami occurred mostly in four municipalities —Misawa, Oirase, Hachinohe, and Hashikami. The main purpose of those recovery plans is not only to restore to the previous conditions but also to trigger formulating better local communities.

Aomori Prefecture

7 Hirono Town



Yagi Area

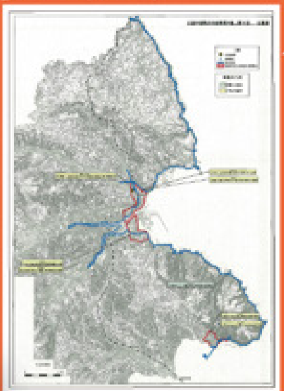
5

0→1

1 km²

0.3 %

8 Kuji City



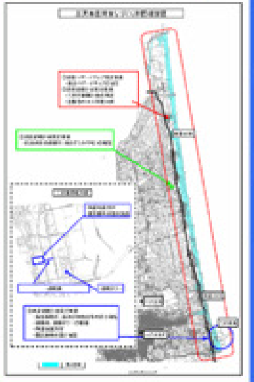
15

0→0

4 km²

0.6 %

3 Misawa City



0→0

6 km²

5.0 %

4 Oirase Town

0→0

3 km²

4.2 %

5 Hachinohe City

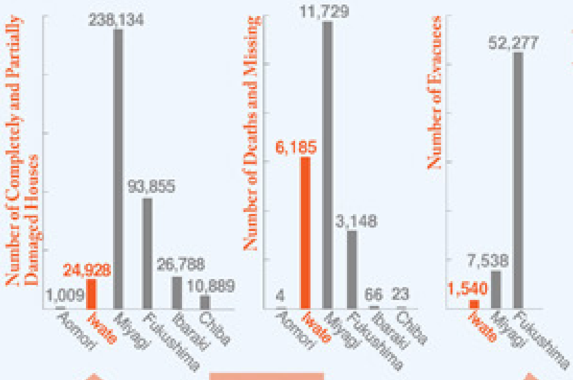
2→20

9 km²

3.0 %

Iwate Prefecture

Iwate, having three tsunami experiences in 1896, 1933, and 1960 before the 2011 Tsunami, was the second worst damaged prefecture following Miyagi. Its coastal areas are characterized by ria coast as well as the northern part of Miyagi. Some municipalities had built tsunami mitigation constructions since the mid-twentieth century; Taro town in Miyako had very famous X-shaped huge seawall, and Kamaishi City had the deepest breakwater in the world.

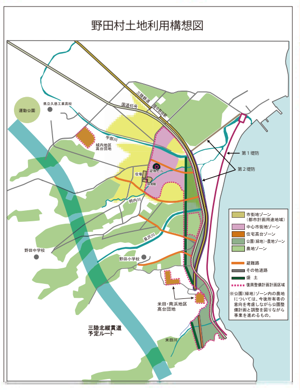


13,984
Total Number of Temporary Houses

2→1
Total Number of Tsunami Evacuation Buildings

0→0
Total Number of Tsunami Evacuation Towers

9 Noda Village



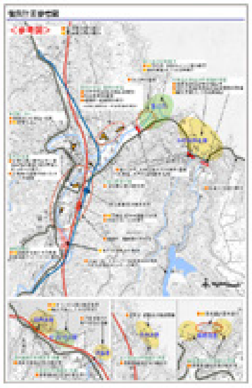
213

0→0

2 km²

2.5 %

10 Fudai Village

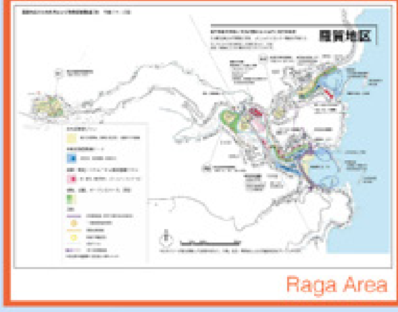


0→0

1 km²

1.4 %

12 Tanohata Village



Raga Area

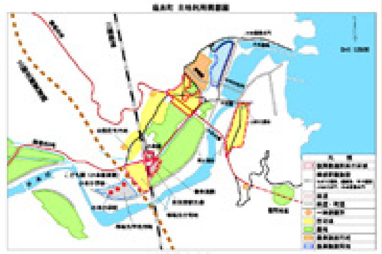
186

0→0

1 km²

0.6 %

11 Iwaizumi Town



143

0→0

1 km²

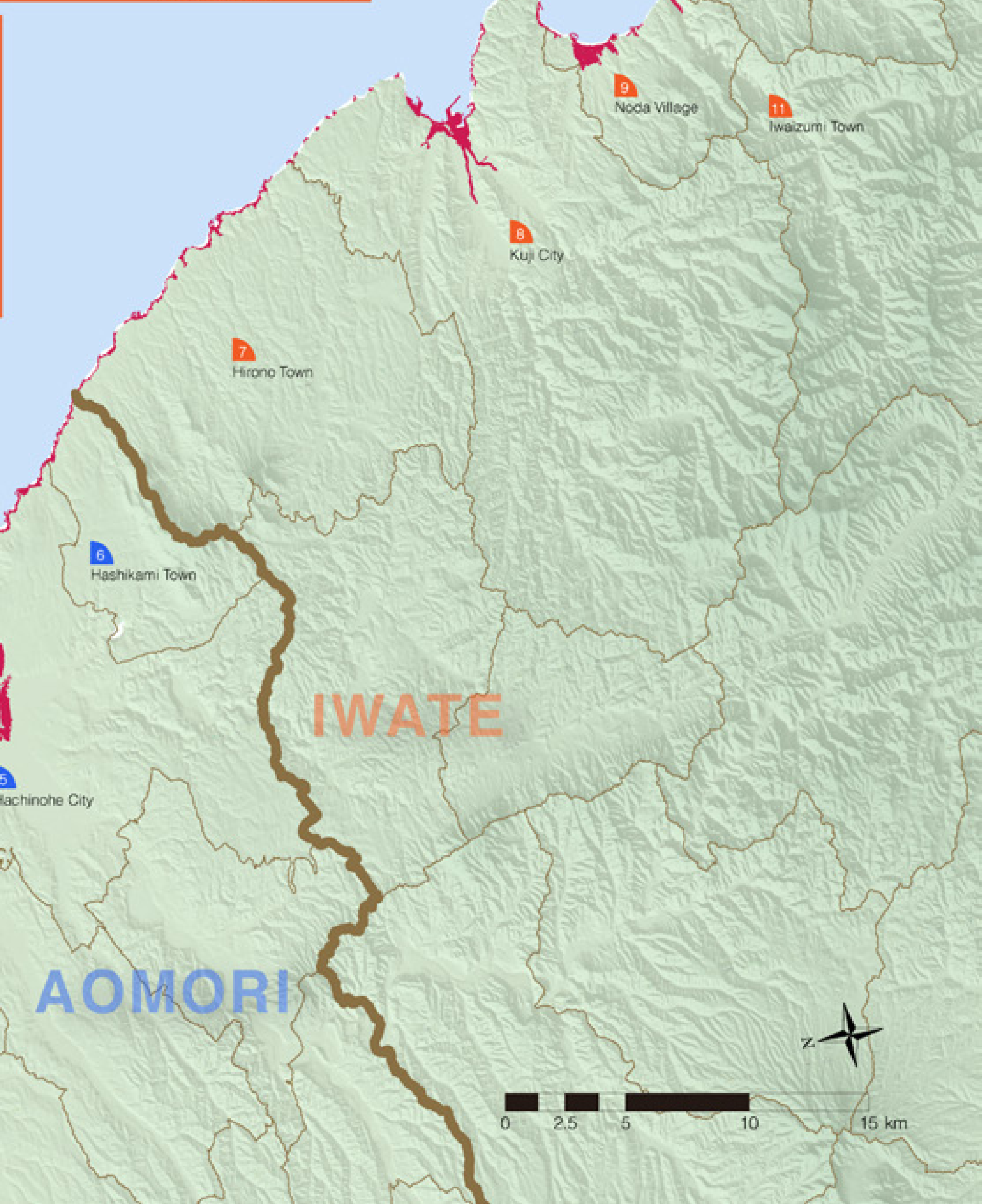
0.1 %

6 Hashikami Town

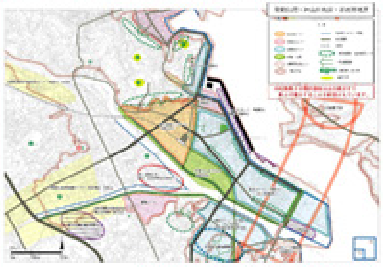
0→0

0.5 km²

0.5 %



19 Kesennuma City



Minami-kesennuma Area

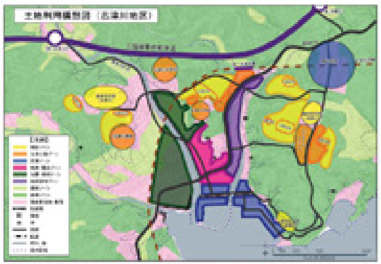
3,504

15→2

18 km²

5.4 %

20 Minamimsanriku Town



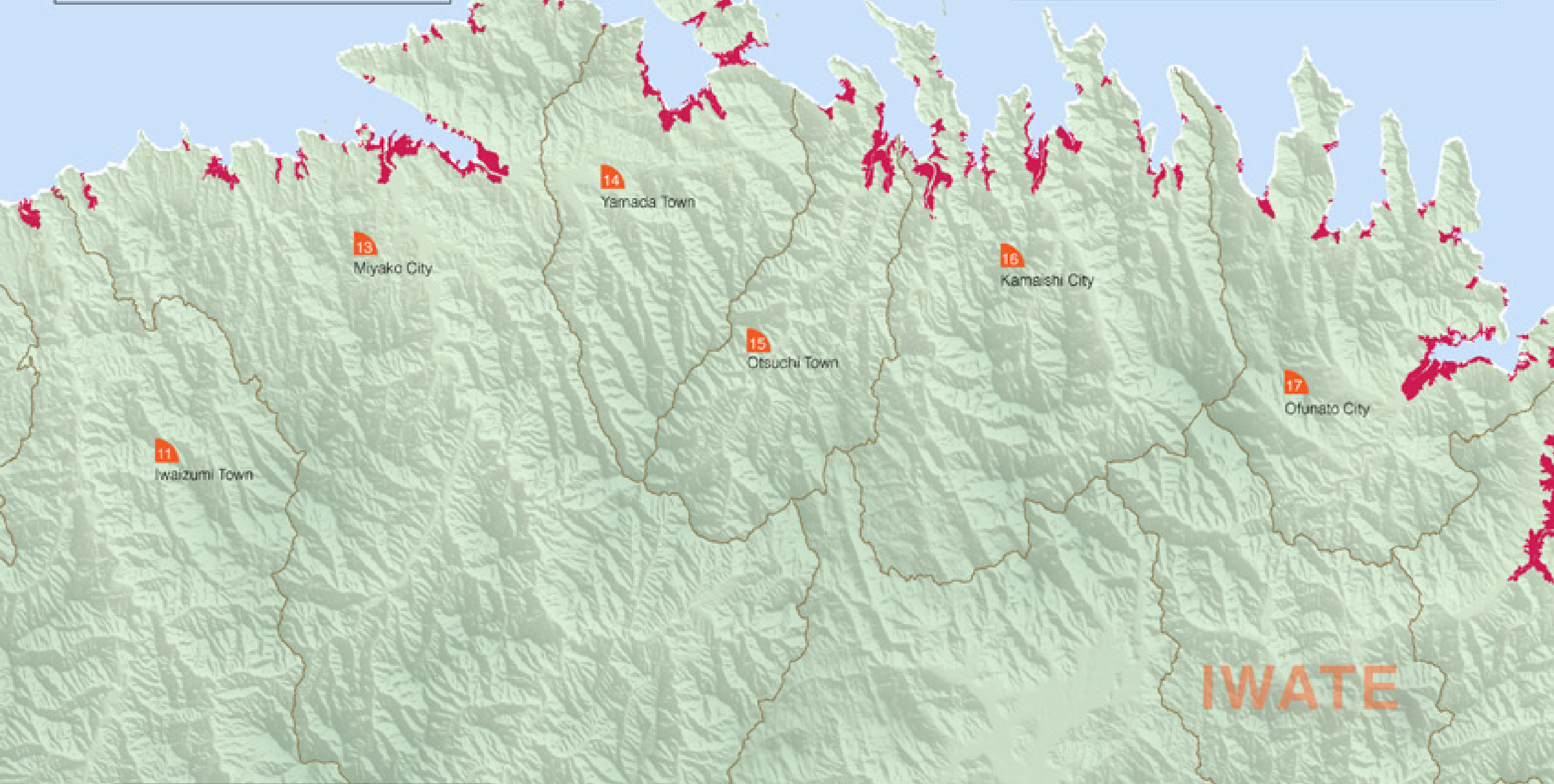
Shizugawa Area

2,195

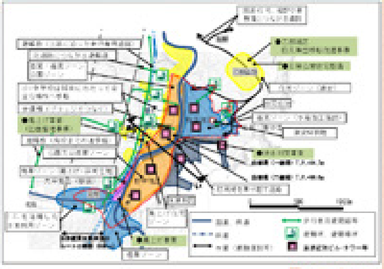
4→0

10 km²

6.1 %



13 Miyako City



Taro Area

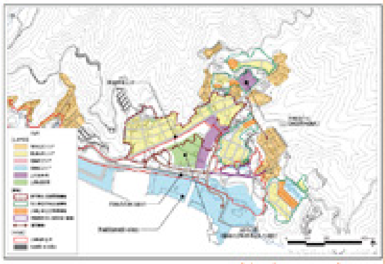
2,010

0→0

10 km²

0.8 %

15 Otsuchi Town



Akahama Area

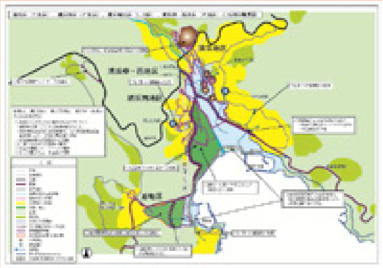
2,146

0→0

4 km²

2.0 %

17 Ofunato City



Urahama Area

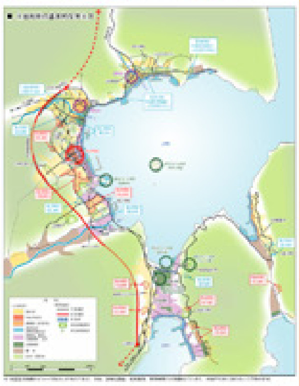
1,811

0→0

8 km²

2.5 %

14 Yamada Town



1,990

0→0

5 km²

1.9 %

16 Kamaishi City

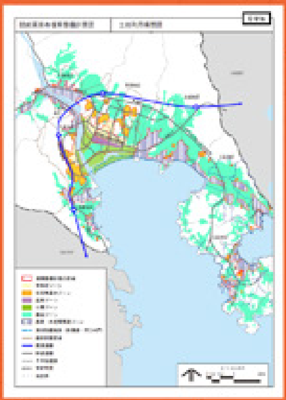
3,164

2→0

7 km²

1.6 %

18 Rikuzentakata City



2,168

0→0

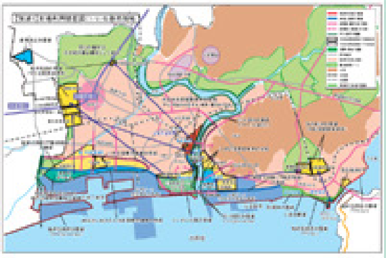
13 km²

5.6 %

Miyagi Prefecture

Miyagi was the worst damaged prefecture by the earthquake and tsunami in terms of death toll and missing people. While most districts in the northern part are surrounded by mountains because of the geographical feature of ria coast, coastal areas in the south are wide-open in Sendai Plain. Recovery activities are in progress respectively.

21 Ishinomaki City



Urban Area of Ishinoomaki

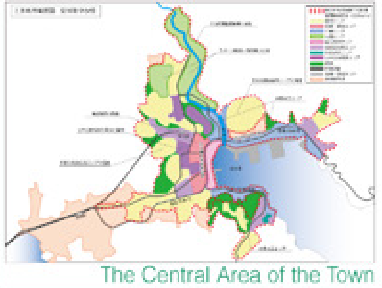
7,297

3→4

73 km²

13.1 %

22 Onagawa Town



The Central Area of the Town

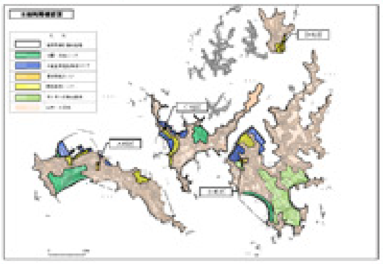
1,294

0→0

3 km²

4.5 %

25 Shiogama City



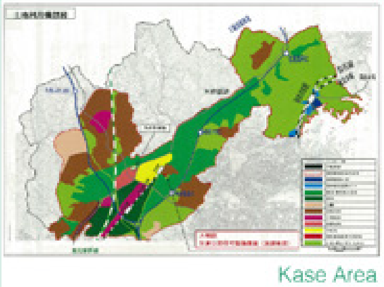
206

4→4

6 km²

33.3 %

26 Rifu Town



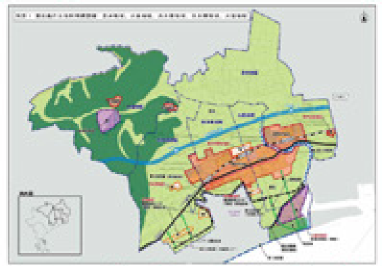
Kase Area

0→0

0.5 km²

1.1 %

23 Higashi matsushima City



The Central Area of the City

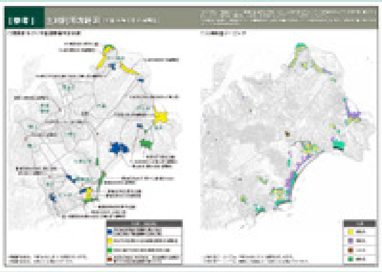
1,753

2→0

37 km²

36.3 %

27 Town of Shichigahama



421

0→0

5 km²

38.5 %

24 Matsushima Town

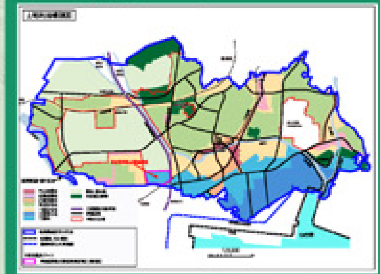
Tetaru Area

0→0

2 km²

3.7 %

28 Tagajo City

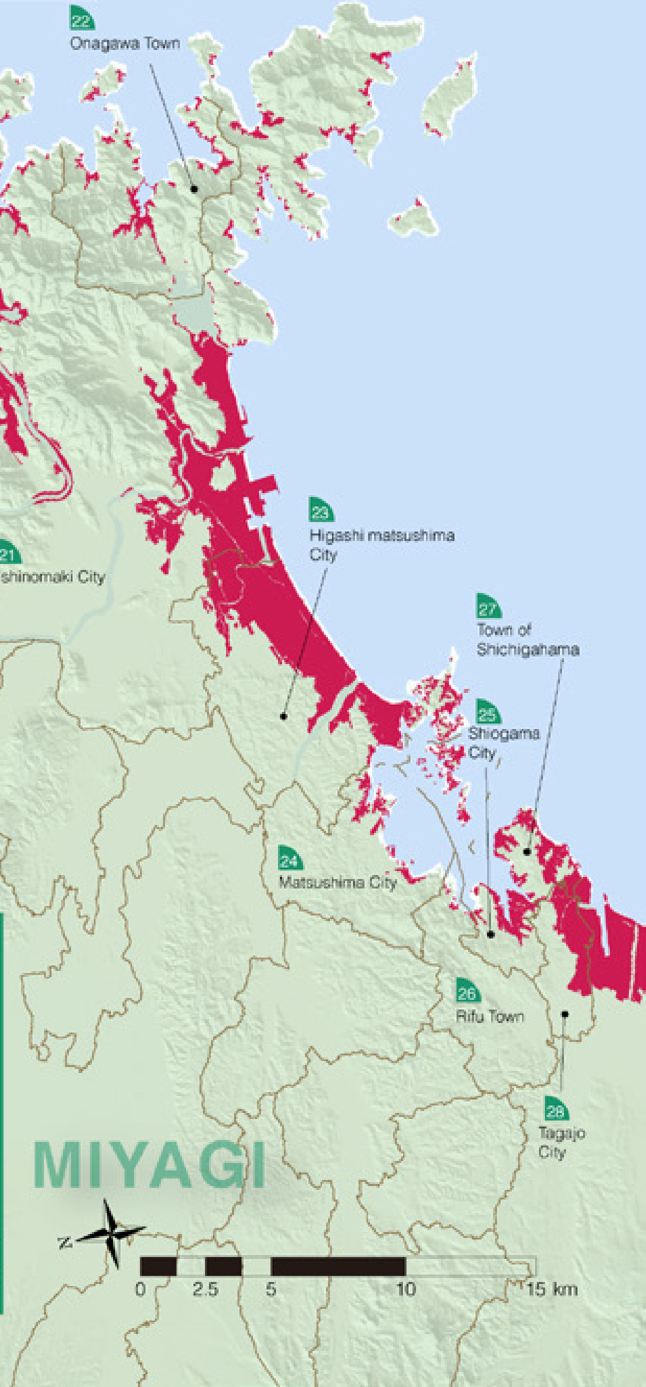


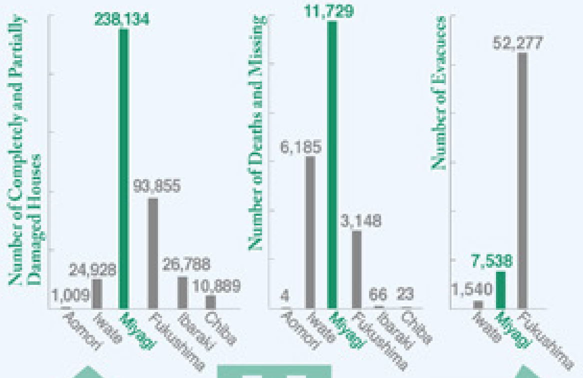
373

12→16

6 km²

30.0 %



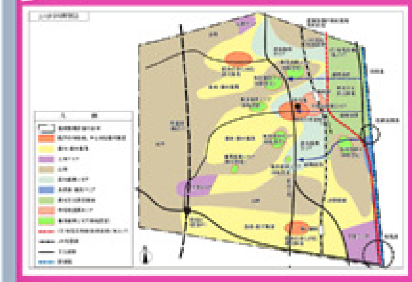


22,095
Total Number of Temporary Houses

45→29
Total Number of Tsunami Evacuation Buildings

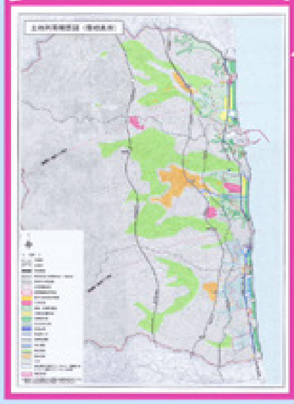
0→1
Total Number of Tsunami Evacuation Towers

34 Shinchi Town



573
0→0
11 km²
23.9 %

36 Minamisoma City



2,853
0→0
39 km²
9.8 %

35 Soma City

1,500
0→0
29 km²
14.6 %

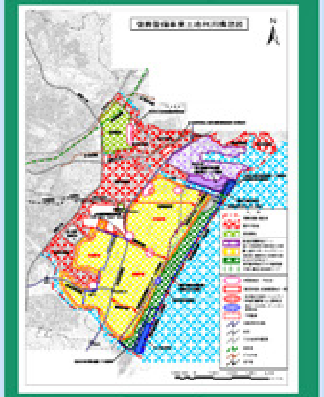
37 Namie Town

0→0
6 km²
2.7 %

38 Futaba Town

0→0
3 km²
5.9 %

29 Sendai City

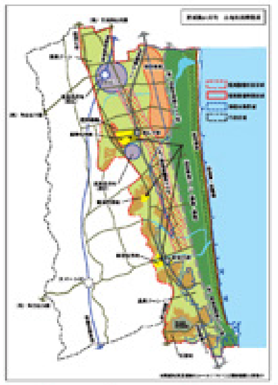


1,523
2→1
0→1
52 km²
15.6 %

31 Iwanuma City

384
0→0
29 km²
47.5 %

33 Yamamoto Town

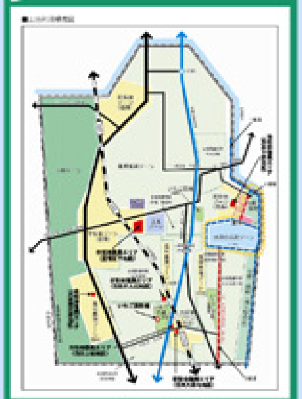


1,030
0→0
24 km²
37.5 %

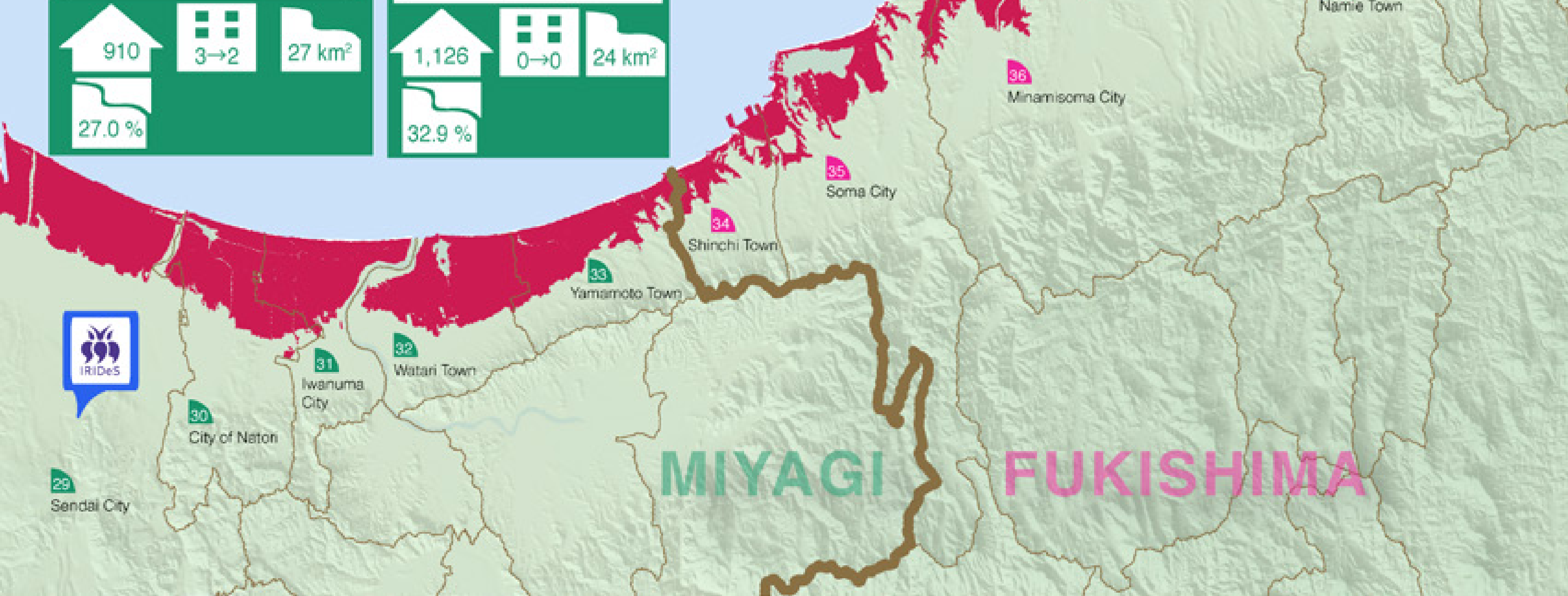
30 City of Natori

910
3→2
27 km²
27.0 %

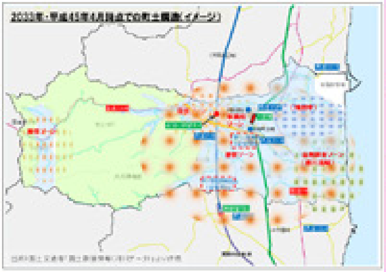
32 Watari Town



1,126
0→0
24 km²
32.9 %



39 Okuma Town

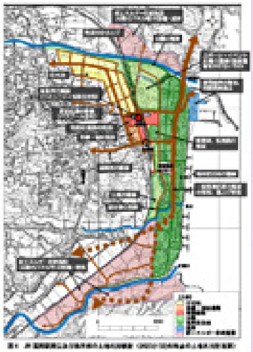


0→0

2 km²

2.5 %

40 Tomioka Town

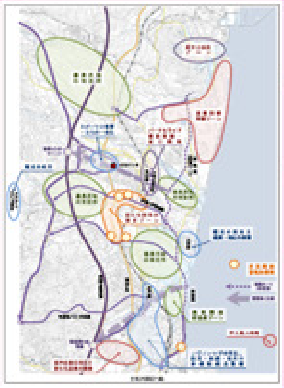


0→0

1 km²

1.5 %

41 Naraha Town



0→0

3 km²

2.9 %

43 Iwaki City

Kanegasawa • Hisanohama Area

3,512

0→0

15 km²

1.2 %

Fukushima Prefecture

17,143

Total Number of Temporary Houses

0→0

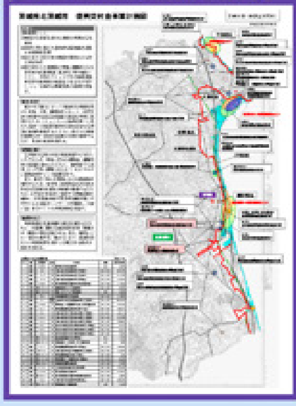
Total Number of Tsunami Evacuation Buildings

0→0

Total Number of Tsunami Evacuation Towers

The death toll in Fukushima by the earthquake and tsunami was the third. However, the prefecture has faced another very serious problem since March 2011: Fukushima Daiichi nuclear disaster. The nuclear disaster forced residents in the area to evacuate from the emergency evacuation preparation zone surrounding the Fukushima Daiichi nuclear power plant. This complicated situation delayed the construction of temporary housings and recovery activities in some municipalities within the prefecture.

44 Kitaibaraki City



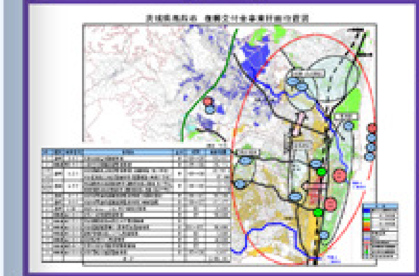
10

0→0

3 km²

1.6 %

45 Takahagi City

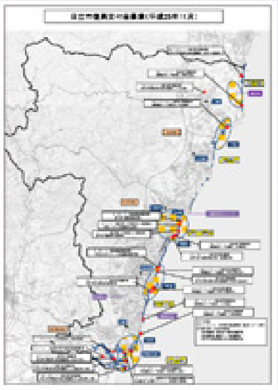


0→0

1 km²

0.5 %

46 Hitachi City

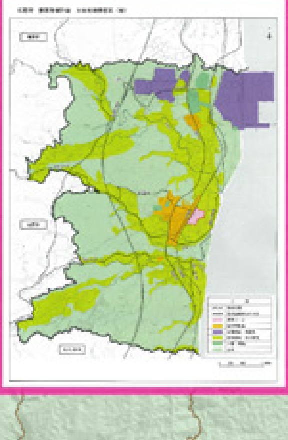


0→0

4 km²

1.8 %

42 Hirono Town



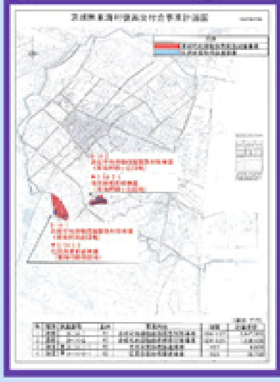
46

0→0

2 km²

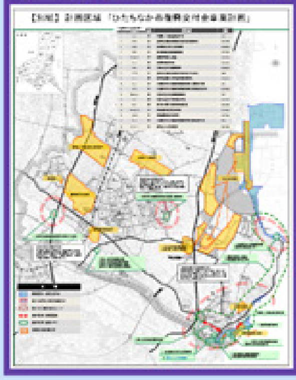
3.4 %

47 Tokai Village



0→0

48 City of Hitachiinaka

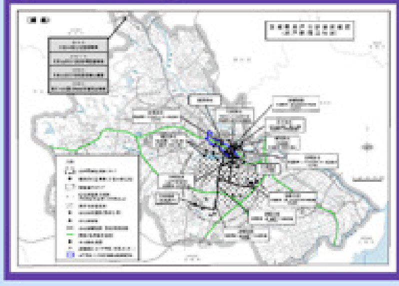


0→0

3 km²

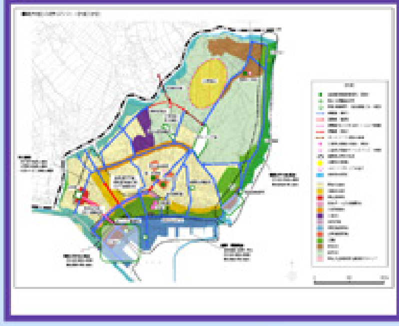
3.0 %

49 Mito City



0→0

50 Oarai Town

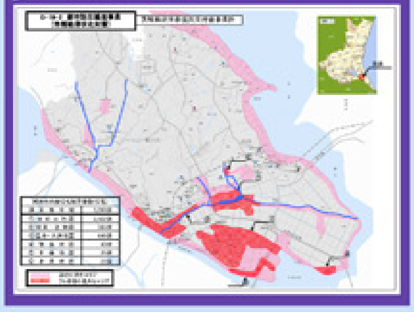


0→0

2 km²

8.7 %

53 Itako City



0→0

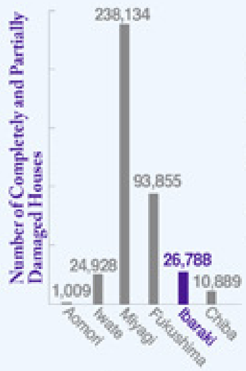
54 Kamisu City

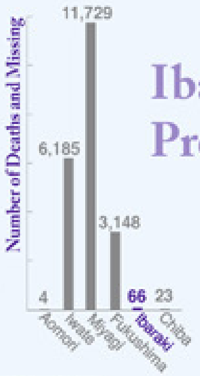
0→28

3 km²

2.0 %

People in Ibaraki experienced very strong ground motion as well as in Miyagi and Fukushima. The earthquake damaged a lot of buildings in the prefecture. Inundated areas were less than those in the northern prefectures. Therefore, post-disaster urban planning means not to create new districts but to improve existing towns in Ibaraki. The number of tsunami evacuation facilities rapidly increased in the coastal industrial area in Kamisu City.





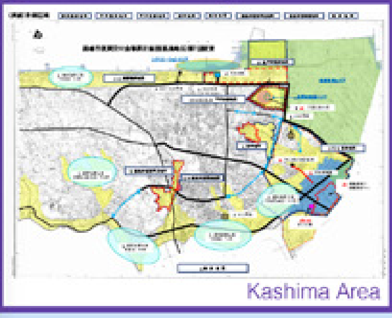
Ibaraki Prefecture

10
Total Number of Temporary Houses

0→28
Total Number of Tsunami Evacuation Buildings

0→0
Total Number of Tsunami Evacuation Towers

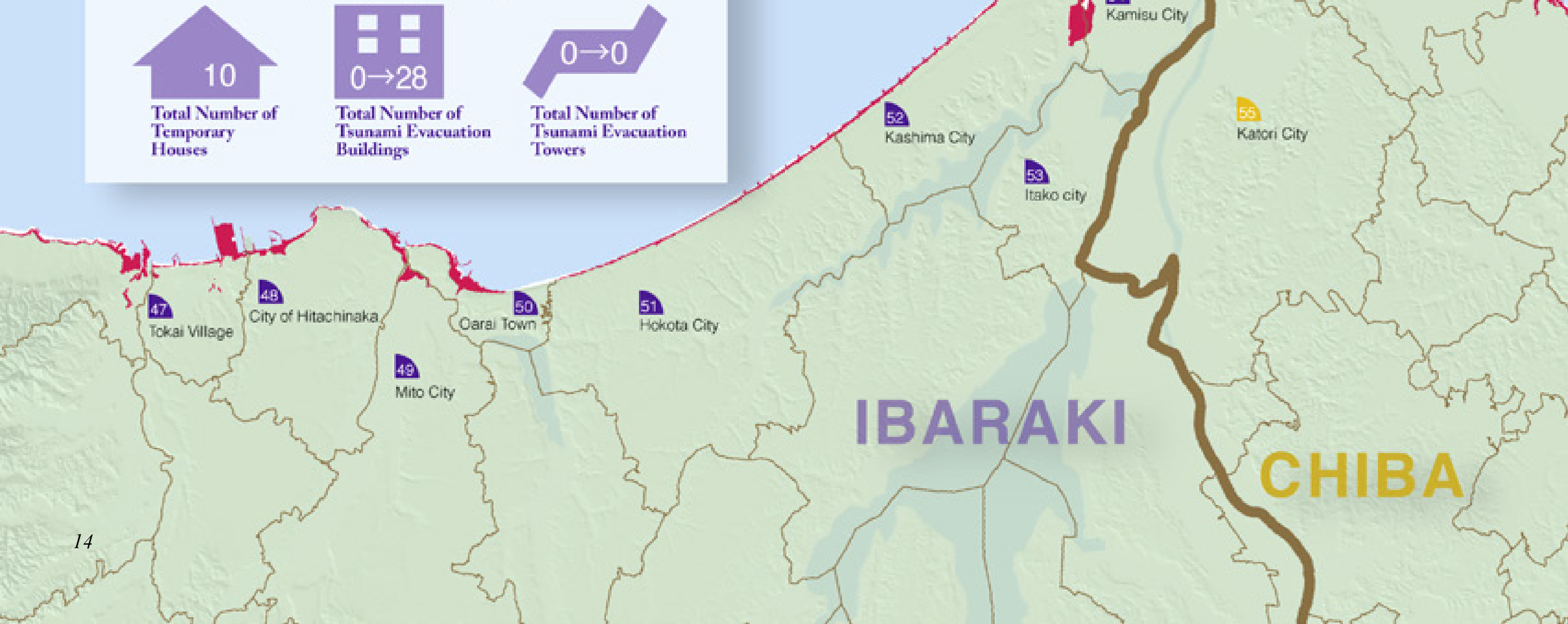
52 Kashima City



0→0

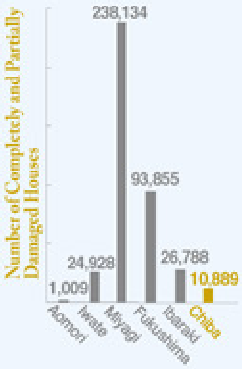
3 km²

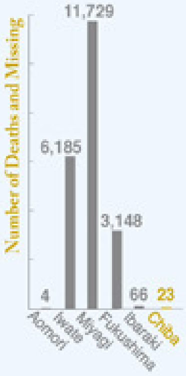
2.8 %



Chiba Prefecture

Although Chiba Prefecture is located far away from the epicenter, inundation area was 17 km² and some people died by the tsunami in Asahi City. Remarkable damage was caused by liquefaction in Urawa City, facing Tokyo Bay. Each municipality has made an effort to increase tsunami evacuation facilities in coastal areas.



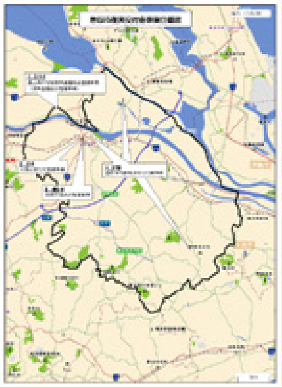


230
Total Number of Temporary Houses

62→178
Total Number of Tsunami Evacuation Buildings

0→3
Total Number of Tsunami Evacuation Towers

55 Katori City



30

57 Choshi City

Shiomi Area

0→8

58 Asahi City

200

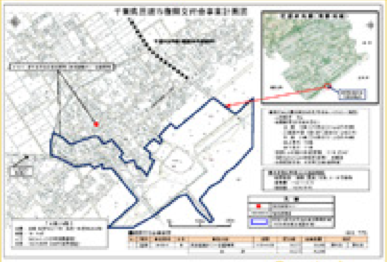
3 km²

1→8

2.3 %

0→2

59 Sosa City



South Area

0→0

60 Yokoshibahikari Town

4→5

61 Sammu City

1→5

6 km²

4.1 %

62 Kujukuri Town

0→5

0→1

63 OamishirasatoTown

0→4

64 Shirako Town

22→29

66 Ichinomiya City

5→9

67 Isumi City

1→4

68 Onjuku Town

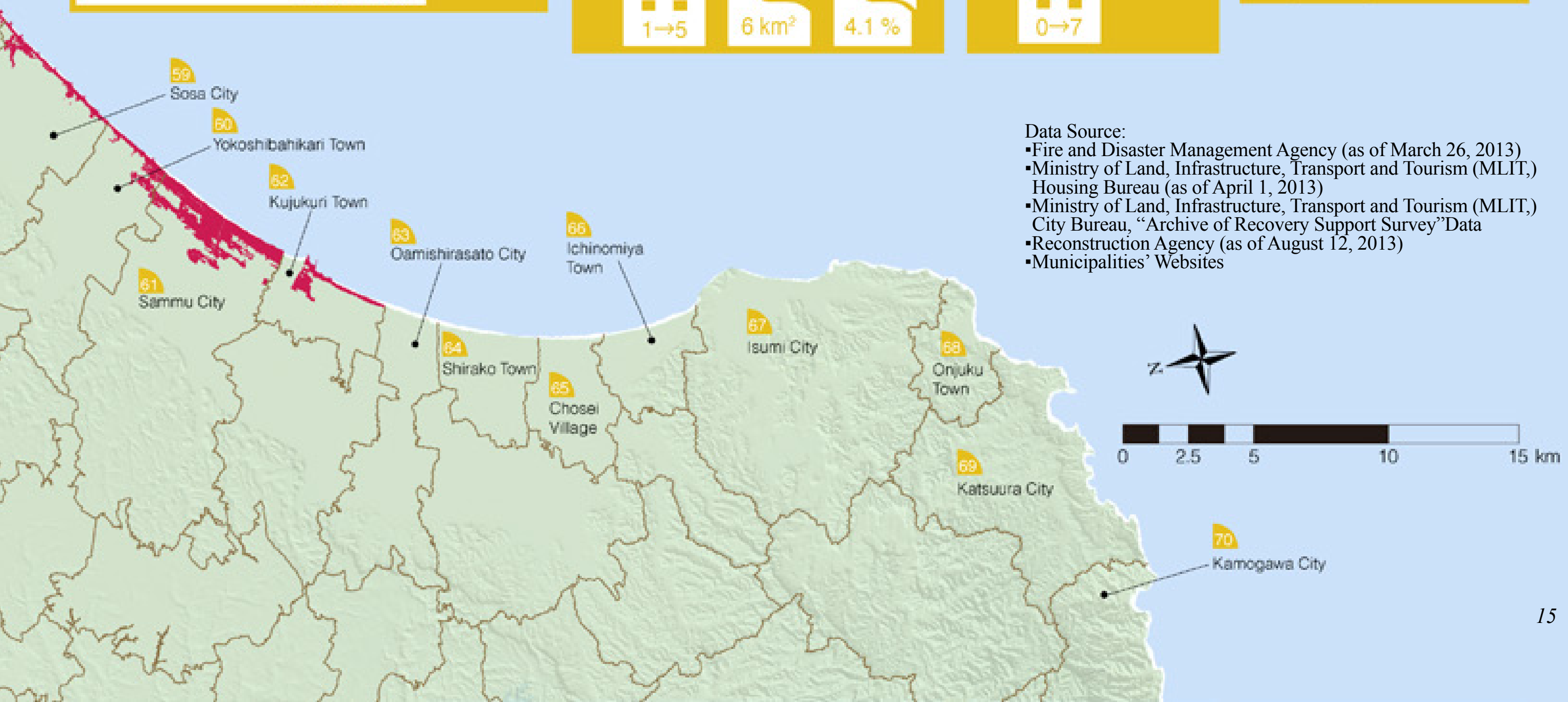
0→7

69 Katsuura City

0→10

70 Kamogawa City

1→44



Data Source:
- Fire and Disaster Management Agency (as of March 26, 2013)
- Ministry of Land, Infrastructure, Transport and Tourism (MLIT,) Housing Bureau (as of April 1, 2013)
- Ministry of Land, Infrastructure, Transport and Tourism (MLIT,) City Bureau, "Archive of Recovery Support Survey"Data
- Reconstruction Agency (as of August 12, 2013)
- Municipalities' Websites

6. 2011 Great East Japan Earthquake Review

HFA Priority for Action 1: *Ensure that disaster risk reduction is a national and a local priority with a strong institutional basis for implementation.*

1 *National Policy and Legal Framework for Disaster Risk Reduction*

HFA Core Indicator 1.1:
National policy and legal frameworks for disaster risk reduction exist and include decentralized responsibilities and capacities at all levels.

Keywords:
institutional structure, disaster management acts, disaster management plans

Context:
Japan's national institutional and legislative frameworks for disaster management, originating in the 1880s, are well developed and have been refined after each large-scale disaster, in order to function at all national, regional, and local levels. The current disaster management framework is specified by the Disaster Countermeasures Basic Act of 1961, enacted after Typhoon Isewan in 1951, which caused severe damage. In the wake of the Great East Japan Earthquake (hereinafter GEJE) in 2011, new laws and amend laws have been enacted to introduce a new countermeasure framework against major earthquakes and other serious incidents to ensure the resiliency of Japan.

Institutional structure 1: Key national players for disaster management: Central Disaster Management Council, Cabinet Office and national ministries

Before:
A basic disaster management system was introduced at the national level in 1961, and several national key players have taken central roles since then. The Central Disaster Management Council (established in 1962) discusses, evaluates and decides upon crucial disaster management policy. The Prime Minister chairs the council, and its members include all cabinet ministers (representing all ministries and agencies), four heads of important public organizations and four disaster management experts. This council has Committees for Technical Investigation, which investigate topics that require further research and assessment for scientific and administrative inputs (Table 1.1)

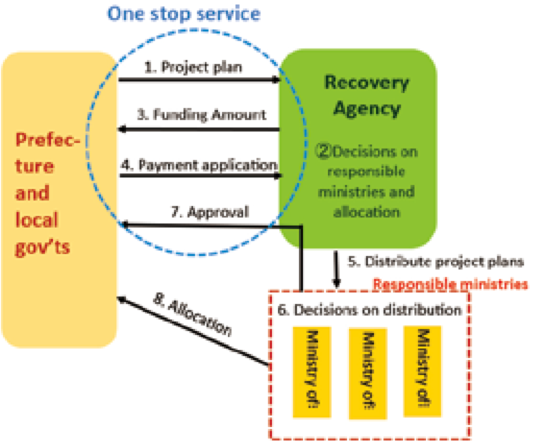
The Disaster Management Section of the Cabinet Office centrally manages coordination and collaboration among ministries and other relevant national organizations, and is in charge of the secretariat of the Central Disaster Management Council. A cabinet minister, deputy ministers and vice ministers are responsible for the section, and the Director-General and the staff of this section draw up basic disaster management policies in response to large-scale disasters by coordinating with ministries relevant to disaster management.[1]

National ministries in charge of disaster management have prepared countermeasures for disasters based on various acts that they hold jurisdiction over.

Table 1.1 Organization of the Central Disaster Management Council

Central Disaster management Council			
Chair	Prime Minister		
Member (upper 25)	Minister of State for Disaster Management, and all other ministers	Heads of Designated Public Corporations (Appointed by the PM) (4)	Experts of disaster manage-ment (4)
Secretariat	Disaster Management Section of Cabinet Office		
Committees for Technical Investigation			

After:
The devastation wrought by the GEJE in the Tohoku region on March 11, 2011, led to the creation of a new reconstruction agency (See Figure 1.1). The Reconstruction Agency officially debuted on February 10, 2012, following the previous Headquarters of Reconstruction, which was set up in June 2011. The Reconstruction Agency was created under the Act Establishing the Reconstruction Agency and is planned to operate for 10 years. This agency is primarily responsible for coordinating various ministries' budgetary and reconstruction procedures so that reconstruction efforts in all localities can proceed in a timely manner.



Source: recreated from the Prime Minister and the Cabinet, available at: http://www.kantei.go.jp/fukkou/organization/reconstructiongrant.html
Fig. 1.1 Role of the National Reconstruction Agency

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[1] Ministries of Internal Affairs and Communications; Justice; Foreign Affairs; Finance; Education, Culture, Sports, Science and Technology; Health, labor and Welfare; Agriculture, Forestry and Fisheries; Economy, Trade and Industry; Land, Infrastructure, Transport and Tourism; Environment; and Defense.

The Central Disaster Management Council created some committees for technical investigation following the GEJE. In April 2011, a committee on earthquake and tsunami countermeasures was set up to scientifically assess and integrate the lessons learned from the GEJE. Later in October of the same year, the Committee for Policy Planning on Disaster Management was established, followed by two new working groups for detailed analysis of countermeasures for the Nankai Trough Earthquake and Tokyo Inland Earthquakes. After the final reports by these committees were published, the Committee for Execution of Disaster Management Policy was established in March 2013.

Institutional structure 2: Managing disasters with plans

Before:

Disaster management plans are basic tools for disaster preparedness in Japan. There are three types of such plans based on the Disaster Countermeasures Basic Act: 1) Basic Disaster Management Plan of the central government, 2) Disaster Management Operation Plans of ministries and quasi-governmental agencies, and 3) Local Disaster Management Plans of prefectures and municipalities. Plan 1) was first adopted in 1963 and has since been guiding the country's disaster management. Plans 2) and 3) are drawn up based on the content of plan 1). These plans cover three disaster phases: i) mitigation and preparation, ii) response and iii) recovery and reconstruction, and are organized by disaster type, for example, earthquake, winds and floods, volcanoes, and snowstorms in the natural disaster category. Their content is revised as needed, and revisions have been more frequent in recent years.

After:

The first revision after the GEJE in the Basic Disaster Management Plan was the response to a large-scale tsunami. Previously, the response to tsunamis had not been emphasized enough and was included in the chapter on earthquakes in this plan. Furthermore, several fundamental revisions of the plan have been executed to reflect additional countermeasures, prescribe new acts and amend acts. Plans 2) and 3) have also been revised accordingly.

Legislative structure: Disaster Management Acts

Before:

Since the Disaster Relief Act of 1947, one of the oldest disaster-related acts in modern legislation, Japan has passed various laws and acts on the management of and response to disasters. The content of these laws varies depending on the targets. The Flood Control Act (1949) and the Building Standards Act (1950) were drawn up to reduce damage from floods and earthquakes and/or fires, respectively. The Disaster Countermeasures Basic Act (1961) established the present framework of Japanese disaster management. It was drastically revised based on the lessons learned from the 1995 Great Hanshin-Awaji Earthquake. More recently, the Act on Support for Reconstructing the Livelihoods of Disaster Victims (1998) was established to secure the basic livelihoods of families affected by disasters.

After:

After the GEJE, the Japanese government actively established the new acts and amended existing acts.

- Two new acts for tsunami disaster management (June and December 2011)
- A revision of the Act on Special Measures concerning Urban Regeneration (April 2012)
- A revision of the Disaster Countermeasures Basic Act (June 2012 and June 2013)
- A new act concerning the reconstruction from major disasters (June 2013)
- A new act of countermeasures for the Tokyo Inland Earthquake (November 2013)
- A fundamental revision of an act for promotion of countermeasures for the Nankai Trough Earthquake (November 2013)
- A new basic act of national resilience for disaster management and mitigation (December 2013)

All of these acts were drafted by utilizing the precious lessons learned from the GEJE, and enacted to prepare for major disasters predicted to affect Japan in the near future.

2 Evacuation System for "Persons with Special Needs*" in Nuclear Disasters

**Elderly, Infants, Expectant and Nursing Mothers, Injured or Sick Persons, Persons (Children) with Disabilities, and Foreign Nationals, etc.*

HFA Core Indicator 1.1:
National policy and legal frameworks for disaster risk reduction exist and include decentralized responsibilities and capacities at all levels.

Keywords:
nuclear disasters, person requiring support under disaster situation, evacuation, hospitalized patients, Fukushima Daiichi nuclear disaster

Context:

The current Emergency Preparedness Guide was established in 1980 after the Three Mile Island nuclear accident in the US. Revisions were made after the Tokaimura nuclear accident. However, a drastic review of the Emergency Preparedness Guide was not carried out after the Chernobyl nuclear disaster because of the belief that a Chernobyl-type nuclear accident could not occur in Japan. After the occurrence of the Niigata-ken Chuetsu-oki Earthquake in 2007, many local governments hosting nuclear power plants requested that the national government prepare for complex disasters (including situations where a nuclear power plant could be affected by a large-scale natural disaster). However, the Guide was not revised drastically after the Niigata-ken Chuetsu-oki Earthquake on the assumption that severe nuclear accidents could never occur in principle since extremely stringent safety examinations were conducted during the design phase of nuclear power plant construction, and because local residents should not be misled or confused [2].

Before:

The Prefecture Regional Disaster Prevention Plan stipulates that the evacuation of hospitalized patients shall basically be implemented by the hospitals on their own. Evacuations of entire hospitals were not expected before the Fukushima Daiichi nuclear disaster.

Fig. 1.2 Surface contamination measurements at the Sousou Healthcare Center on March 14, 2011

After:

After the Fukushima Daiichi nuclear accident, hospitalized patients who could not be evacuated easily were left behind in an area within a 20 km radius of the nuclear plant. On March 13, 2011, the Cabinet Office ordered the local government to assist with the evacuation of the hospitals inside the Restricted Area. In a situation where communication was limited and sufficient information could not be obtained, the evacuation of hospitalized patients was extremely difficult, resulting in at least 60 deaths by the end of March 2011 [2].

Good practices:

There are seven hospitals within the 20 km radius around the Fukushima Daiichi Nuclear Power Plant. At the time of the accident, approximately 850 patients were hospitalized at these seven hospitals. Among these patients, about 400 were seriously ill. Futaba Hospital was one of these hospitals, and is located within a 5 km radius of the nuclear plant. In the case of Futaba Hospital, slightly ill hospitalized patients were transported out of the hospital on March 12, 2011. Seriously ill patients were left in the hospital, and there was no assistance for the seriously ill patients from the town office. Japan Self-Defense Forces and the local police arrived at the Futaba Hospital on March 14 and 15, and they transported the patients to the Sousou Healthcare Center, which was where surface contamination measurements of the evacuees were conducted at that time [2] (Fig. 1.2).

Problems:

Before the Fukushima Daiichi nuclear disaster, it was assumed that the possibility of a severe accident was extremely low and that complex disasters were highly unlikely. The Nuclear Regulation Authority (NRA) was established in 2012 to learn lessons from the Fukushima Daiichi nuclear disaster. The NRA postulates tremendous natural disasters, intentional airplane crashes and terrorist attacks. In order for regulations to reflect the lessons learned from the Fukushima Daiichi nuclear disaster and other international nuclear accidents, organizational independence of the NRA is important.

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[2] Main report. The National Diet of Japan Fukushima Nuclear Accident Independent Investigation Commission. 2012.

3 Dedicated and Adequate Resources for Disaster Management in Japan

HFA Core Indicator 1.2:
Dedicated and adequate resources are available to implement disaster risk reduction activities at all administrative levels.

Keywords:
budgetary resources, human resources, informational resources

Context:

Japan is a unique country in that it invests ample resources in disaster management. The budget for disaster management is annually secured, and abundant supplemental budgets have been provided for rebuilding in the aftermath of the GEJE disaster. Additionally, given that Japan is aging and losing population, new forms of collaboration have been emerging to secure adequate human resources from the decreasing pool to fill the gap. Such collaboration efforts have accelerated further after the GEJE. Disaster white papers since 1963 are another form of useful resource for the national, regional, and local administrations, as well as private citizens.

Budgetary resources

Before:

Although the proportion of the budget allocated for disaster management in the general account budget was decreasing prior to the GEJE, from 8% in 1997 to 3.5% in 2010, 1.24 trillion yen were appropriated for disaster management in 2010[3]. In addition, abundant supplemental budgets have often been provided for rebuilding public infrastructures after significant disasters.

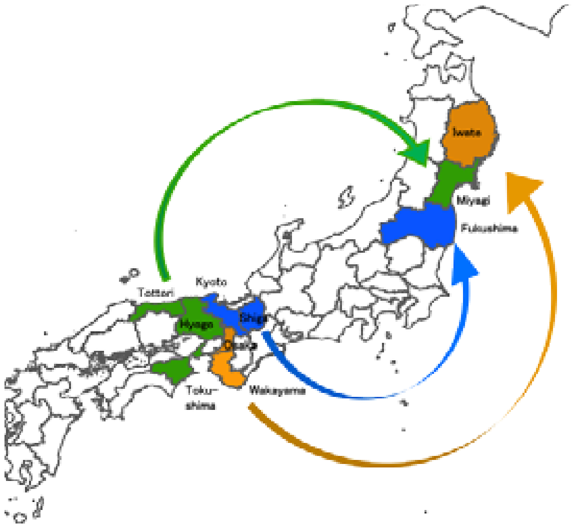
After:

The GEJE's direct economic damage is calculated as 16.9 trillion yen. As of July 2013, budgets for rebuilding post-GEJE are calculated to cover around 23.5 trillion yen for total direct losses[4].

Human resources

Before:

Inter-prefecture and -locality partnerships for mutual help, including objectives to share human resources, have been encouraged since 1995. Such partnerships have largely involved exchanging agreements. More recently, as a goal of decentralized governance, the Kansai Large-Area Coalition (Kansai Koiki Rengo) was formed on October 27, 2010, the first such organization in modern government administrations. This coalition comprises seven participating prefectures of the Kansai region. One of the seven administrative goals of this coalition is to establish a large-area disaster management system so that participating prefectures can provide or receive support for emergencies resulting from disasters beyond their own control. This coalition also strives to secure sufficient human and other resources for potential disasters.



Source: http://blog.kahoku.co.jp/saisei/2012/03/post-33.html
Fig. 1.3: Counterpart Support by the Kansai Large-area Coalition

After:

For the first time in disaster management history, the large-area administrative coalition is supporting the affected large-area regions. As part of the "counterpart system approach," Osaka and Wakayama Prefectures partner with Iwate; Hyogo, Tottori, and Tokushima partner with Miyagi; and Shiga and Kyoto partner with Fukushima, each partnership including the dispatching of volunteers and specialists for short-term response and long-term rebuilding (Fig. 1.3). As of August 30, 2013, 136,000 man days in total have been dispatched. Additionally, the prefectures temporarily host evacuees from other prefectures[5].

Informational resources

Since 1963, the Cabinet has published an annual disaster white paper structured to report significant disaster data for damages, responses, and changes affecting disaster management. This paper is a useful resource for national, regional, and local administrations as it reports the relevant statistics on disasters and their management, budget, and related laws and institutions. Administrations refer this paper for updating disaster management plans that they need to review annually. Since the GEJE, statistics and revised laws and regulations have been updated annually.

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[3] Cabinet Office, Government of Japan, 2011. "Disaster Management in Japan."

[4] Reconstruction Agency, 2013. "Reconstruction progress and issues."

[5] Kansai Large-Area Coalition. "Response of Kansai Large-Area Coalition on the Great East Japan Earthquake of 2011. Retrieved September 3, 2013, from http://www.kouiki-kansai.jp/contents.php?id=219.

4 University Faculty as a Non-Governmental Resource to Support Disaster Risk Reduction in Recovery Planning with Local Government

HFA Core Indicator 1.2:
Dedicated and adequate resources are available to implement disaster risk reduction activities at all administrative levels.

Keywords:
planning aid, recovery planning, university teacher, community, local government

Context:

One of the characteristics of the Great East Japan Earthquake is that the damage caused by it and the following tsunami was overwhelmingly beyond the response capabilities of the affected local governments, which should be in charge of recovery planning, both quantitatively and qualitatively. Moreover, most of the local communities in the affected areas did not have sufficient experience in community planning for both hard and soft aspects. It was, therefore, expected that experts should support these planning activities.

Before:

Local governments were to formulate their own recovery plan by themselves because of the decentralization of power. However, it was very hard for them to do so by themselves because of a lack of experience. Local communities also faced a similar problem.

After:

National government supported the formulation of recovery plans for the affected municipalities in the first year after the disaster by organizing planning committees comprising prefectural and national government bureaucrats, consultants and individuals from the academic community. The Ishinomaki City government uniquely organized a recovery planning conference regularly from the second year; the chairman of which was a university professor. Four working groups, which were reorganized into three one year later, were organized under this council to change information, adjust each project and to share a common recognition of problems (Fig.1.4). Faculty members of the universities also support the reconstruction activities at the community level.

Good practices:

- Experts in architecture, civil engineering and urban planning working together as a team exceed the framework of their specialized field.
- Local governments and experts forge a long-term relationship with each other, which makes it possible to engage in a frank exchange of views.
- The experts contribute to consensus building in the local community through technical support.
- The experts function as an intermediary between the city administration and the local community.

Problems:

- Some of the advice was not accepted by the local government because it was impractical or because of limited administrative capacity.
- Similar cooperation between the local governments and faculty members is not widely observed in other regions.

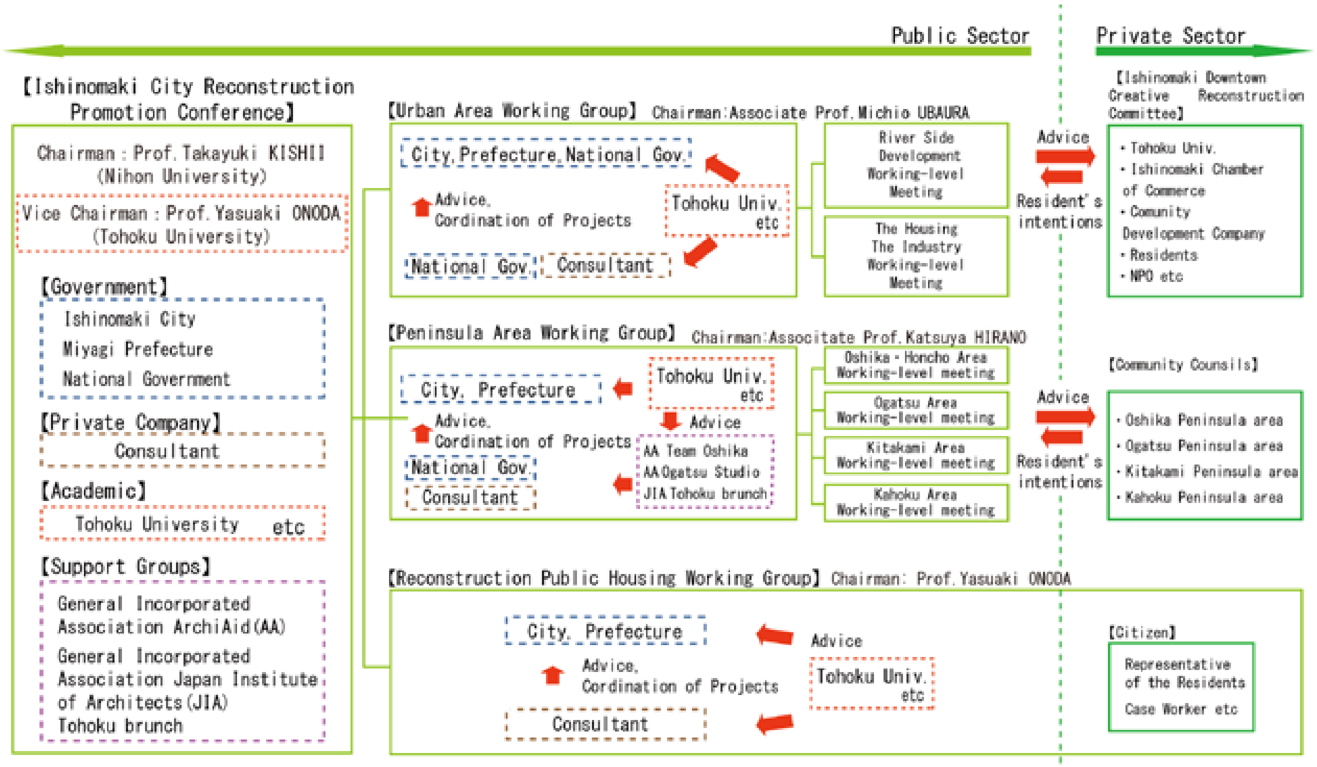

Fig. 1.4 Role of university teachers in the public and private sectors

5 *Community Participation in Japan*

HFA Core Indicator 1.3: Community participation and decentralization are ensured by delegating authority and resources to local levels.

Keywords:
voluntary community organization, business communities

Context:
Japan has a long history of community participation in disaster reduction activities. The notions of "self-help," "mutual-help," and "public-help" have been widely shared, especially after the 1995 Hyogoken-Nanbu Earthquake. The voluntary community organization for disaster management, represented by firefighting activities, is considered especially important for self-help and mutual help actions. Business communities have also begun preparing business continuity plans since 2005, when the Central Disaster Management Council prepared a guideline on this topic.

Voluntary community organization for disaster management

Before:
Voluntary community organizations for disaster management are regulated in the Disaster Countermeasures Basic Act of 1961, number 5, article 2. According to the statistics of the Fire and Disaster Management Agency, 139,000 voluntary community organizations existed in 1,658 localities in 2009, and their activities covered 73.5% of all households across the nation[6].

After:
Various communities that were significantly affected by the GEJE and had practiced their volunteer activities during normal periods in preparation for emergency response found their preparedness functional and effective. For example, creating a list of the population needing help (handicapped and elderly) was useful when evacuating them. Rules adopted prior to the GEJE to inform the community about individuals' safety during significant disasters have also helped community members to identify those who were missing. Nevertheless, various issues emerged: for example, in the relationship between local governments and voluntary community organizations, some were unofficial and inhibited direct work, such as when goods and supplies for temporary evacuees were available only to those in designated evacuation shelters, whereas, in reality, evacuation shelters existed in many other places as demand was high after the GEJE's unexpected size[7]. Currently, many activities led by voluntary community organizations are being reviewed and assessed for better operations in the future.

Business communities preparing for disaster

Before:
The Special Committee of the Central Disaster Management Council in 2005 developed and began promoting Business Continuity Plans (BCPs), which enable private corporations to prepare for disasters to mitigate damages and to continue operations during the response and recovery stage. Targeting large and medium enterprises in particular, this effort was expected to enable sustained business operations even in emergencies.

After:
The business community has researched the effectiveness of BCPs during and immediately after the GEJE. According to web-based research led by NTT data (the national telecom company)[8], 44.7% of corporations either had or were developing a BCP when the GEJE struck, among which 45% of large corporations already had BCPs. Regarding BCP operation, 65.7% of 263 corporations reported that the BCP either had problems in functioning, partially or completely, with the GEJE's impact to the global supply chain, which extended beyond the size of "expected" disasters. A complete review is currently on-going in business communities to revise the contents of BCPs to operate more efficiently in future disasters.

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[6] Fire and Disaster Management Agency, 2009. "Chapter 4 Disaster management activities by self-help and regional resilience creation to disasters." Firefighting White Paper, retrieved September 29, 2013, from http://www.fdma.go.jp/html/hakusho/h21/h21/index2.html#dai4.

[7] Fire and Disaster Management Agency, 2009. "Chapter 4 Disaster management activities by self-help and regional resilience to disasters." Firefighting White Paper. Retrieved September 29, 2013, from http://www.fdma.go.jp/html/hakusho/h21/h21/index2.html#dai4.

[8] Ohashi, K., 2011. "How do we reflect lessons learned from the earthquake? Findings from the survey results of business continuity by corporations affected by the GEJE." Retrieved September 29, 2013, from http://www.keieiken.co.jp/monthly/2011/1109-04/index.html.

6 Japan's Multi-sectoral Platform for Disaster Risk Reduction

HFA Core Indicator 1.4:
A national multi-sectoral platform for disaster risk reduction is functioning.

Keywords:

Disaster Countermeasures Basic Act, volunteer activities, wide-area response and mutual support between municipalities

Context:

Japan's multi-sector platform for disaster risk reduction is functioning under the 1961 Disaster Countermeasures Basic Act. However, the GEJE and Tsunami have proven that there is no perfect system resilient to all types and sizes of disaster, regardless of how well the platform is established and operated. The national government response was limited, incapable of quickly responding to the needs of the affected local government as it was difficult for them to investigate the overall damage. Meanwhile, having a multi-sector platform has also proven that support from non-structured segments, such as volunteer efforts, could be quite useful. The platform then incorporates these lessons via modification of the Disaster Countermeasures Basic Act, in order to improve response capacity against future mega-disasters.

Before:

Under the 1961 Disaster Countermeasures Basic Act, the national government, local governments, Japan Red Cross, other key semi-governmental and humanitarian organizations and communities were prepared to function under emergency conditions throughout the response stage. The Act was significantly revised to further strengthen functions of emergency response headquarters and traffic regulations for better emergency management after the 1995 earthquake. At this time, the word "volunteer" was first included in the Act and in national law. Since 2005, the Cabinet office has established the Committee for Disaster-related Volunteer Activities to encourage citizens' greater participation in disaster reduction activities. Various committees were established and meetings held in several cities nationwide, including topics related to wide-area response and networking on disaster management. Encouragement to reach agreements on mutual support during emergencies between neighboring local governments has increased during this period, and in 2010, 90% of local governments across Japan had reached such agreements[9].

Problems:

Although local governments are technically mandated to act centrally for disaster response and management, prefectural and national governments are also required to step in and take the lead in responding to mega-disasters like the GEJE by creating emergency headquarters in their administrations. Nevertheless, because of the size and complexity of the GEJE and Tsunami, national and prefectural government provision of the necessary support to local governments was delayed because local governments' help requests encountered complications resulting from the devastating damage to the usual means of reaching the national government.

Good practices:

Despite the initial difficulties in reaching the affected areas because of an insufficient volume of damage information and avoiding secondary disasters, numerous volunteers and organizations, including international and domestic NGOs, NPOs, and student groups, joined in to provide support in the affected areas (see Fig. 1.5 for volunteer participation six months later in Ishinomaki City). So far, 936,900 people in total have volunteered to support the affected region within the two years after the GEJE[10]. Furthermore, various inter-governmental agreements have effectively supported the affected region by, for example, hosting disaster-affected populations who lost their houses in disasters.

After:

In response to the GEJE disaster, the Disaster Countermeasures Basic Act was amended, effective April 12, 2013. Major revisions include i) strengthening response capacity for large-scale disasters; ii) providing residents with smooth and safe evacuation routes; iii) improving response capacity, and iv) enhancing learning of disaster management procedures in normal periods— all of which emphasize improvement in response to large-scale disasters. Another major focus for change has been public volunteer coalitions for better response capacity for mega-disasters. A unit called the "Coalition Group of Volunteers and Corporations for the Public Interest" was established in the Reconstruction Agency on February 10, 2012, replacing an existing volunteer management unit in the Cabinet office. In addition, the proportion of local governments' mutual support extending beyond prefectural boundaries is increasing. For instance, there were 46.9% extra-prefectural agreements but in 2012, it has increased to 55.1%[11].

Fig. 1.5 Volunteers Camping in a School Field, Six Months after the GEJE

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[9] Fire and Disaster Management Agency, 2007. "Enhancing mutual-supporting system between municipalities." Retrieved August 28, 2013,from http://www.fdma.go.jp/neuter/about/shingi_kento/h24/tikoutai/01/shiryo_02.pdf.

[10] National Institute for Educational Policy Research, 2012. Activities by NPOs and volunteers following the Great East Japan Earthquake. Retrieved on September 28, 2013, from http://www.nier.go.jp/jissen/chosa/rejime/2011/02_npo_vol/05_chapter3.pdf.

[11] Fukumoto, H., 2013. Supporting affected areas by municipalities during emergency – assessing effectiveness of inter-governmental mutual-support agreements –.

7 *Improvement in Risk Assessment and Early Warning Systems with Real-time Monitoring: Lessons from the 2011 Tohoku Earthquake and Tsunami*

HFA Core Indicator 2.1:
National policy and local risk assessments based on hazard data and vulnerability information are available and include risk assessments for key sectors.

HFA Core Indicator 2.2:
Systems are in place to monitor, archive and disseminate data on key hazards and vulnerabilities.

HFA Core Indicator 2.3:
Early warning systems are in place for all major hazards, with outreach to communities.

Keywords:
hazard map, tsunami early warning, real-time monitoring, earthquake early warning, long-term earthquake forecast

Before:

Tsunami inundation maps produced from the risk evaluation based on historical events over 400 years have been distributed among the residents in coastal communities for utilization in developing their evacuation plans and preparedness procedures. Nevertheless, previous inundations were much smaller than the 2011 Tohoku Earthquake and Tsunami, which caused more casualties without evacuation. Earthquakes followed by tsunamis recurred throughout history in each coastal area. Japan's Cabinet Office Central Disaster Mitigation Council evaluated the earthquakes and tsunamis for the target regions' safety levels, and the Ministry of Education, Culture, Sports, Science and Technology (MEXT) Headquarters for Earthquake Research Promotion (HERP) evaluated seismic activities, which are updated every year. Those results are available for creating hazard maps, conducting disaster response drills, and increasing awareness through the mitigation plan. However, the gap between the estimated and observed inundations was so large that it allowed people to take insufficient action.

Although the tsunami warning was issued roughly 3 min after the earthquake, about 19,000 people (90% of casualties) were killed by the 2011 Tohoku Tsunami within 20–30 min of its arrival at Sanriku and roughly 1 h of its arrival at Sendai bay; only two people were killed by the tsunami on the Pacific Ocean. The warning from the PTWC and Japanese media should have led to immediate Pacific coastal evacuation. Japan's tsunami warning system began in 1952, providing information on the estimated tsunami arrival time and height, which is divided into two categories, depending on the arrival time lesser or greater than 1 h, that is, near or far field, respectively. The first tsunami warning in the 2011 Tohoku Earthquake was underestimated because of the lower earthquake magnitude estimation, and the second was updated using the tsunami data observed by a GPS buoy in real time offshore from Sanriku, Tohoku. Reasons for the large number of casualties due to the tsunami remain under investigation and discussion. Not only the warning's accuracy but also its dissemination, traffic jams on the roads, and wrong directions to safe places have been reported by eyewitnesses.

HERP, a special governmental organization attached to the Prime Minister's office (now part of MEXT) and established in 1995, has been releasing probable seismic hazard maps annually since 2005, compiling thousands of instrumental, historical, and paleoseismological data and numerical models of plausible future earthquake sources. The map released in 2005 was the first publically available probabilistic seismic hazard map of major shaking for various purposes such as city planning and emergency local government response. In the map, the HERP expressed concern about frequent M7-8 earthquakes along the Japan trench (the Sanriku coast to the Boso Peninsula) and announced a 98% chance of an M7.4-8.0 earthquake offshore of Miyagi (Sendai) for the next 30 years, based on 37-year average inter-event time of large subduction earthquakes during the past 200–300 years. Such high probability has effectively stimulated seismic retrofits, better city planning, and disaster drills. However, the extent of the M9.0 2011 Tohoku Earthquake's large shaking areas was much wider than the map estimates, especially in Fukushima and Ibaraki, the southern region of the 2011 source.

Despite the size of the main Tohoku shock and areas of large seismic intensity, numerous buildings collapsed (~400,000), mostly from the tsunami; the number collapsing from shaking was rather limited. Less damage was observed in the newer buildings and houses. The ratio of the death toll associated with the collapses was less than several percent of the total, demonstrating that Japan's building code, regulated since 1981 and reflecting the 1978 Miyagi-oki earthquake, worked effectively.

After the 1995 Kobe Earthquake, the Japanese government funded an enormous budget to deploy thousands of seismometers and GPS stations to monitor seismic and crustal activity. The National Research Institute for Earth Science and Disaster Prevention (NIED) has built three seismic networks (Hi-net, F-net, and K-net) for various purposes, and the Geospatial Information Authority of Japan (GSI) has operated 1,240 permanent GPS stations to monitor near-real-time ground movement. Furthermore, the ALOS satellite launched in 2006 by the Japan Aerospace Exploration Agency (JAXA) has been providing synthetic aperture radar data associated with several devastating earthquakes, including the Tohoku Earthquake, which expanded understanding of the earthquake rupture process. Data circulation and data sharing have improved annually and now allow even foreign scientists and engineers to help us provide better models and warnings. Such dense networks and real-time monitoring systems enable the Japan Meteorological Agency (JMA) to publically announce seismic intensity distribution within 1.5 min and the activity's detailed hypocenter and magnitude information within several minutes, supporting urgent rescue responses and operations. However, the Tohoku Earthquake's size was so great that immediate estimate of magnitude was 7.9 because of magnitude saturation in the high-frequency domains, causing underestimates of the tsunami height.

Since 2007, the JMA has been operating the earthquake early warning system, which provides immediate estimates of strong shaking within seconds to people before the actual seismic wave arrives. People can be informed of the warning via TV, radio, and mobile phone, as well as special devices, when the estimated JMA intensity reaches 5 or higher. Seventeen cases of the early warning through 2010 have proven its validity and efficacy for disaster mitigation, for example, by suggesting that students hide themselves under their desks in school. In the Tohoku Earthquake, the system provided a warning eight seconds before the primary wave arrived at the city of Sendai, and successively stopped bullet trains in the Tohoku area. However, it underestimated ground acceleration in the Tokyo metropolitan area. Furthermore, the Tohoku Earthquake's numerous aftershocks revealed the weakness of the early warning system in that it released a number of false alarms resulting from unexpected remote simultaneous aftershocks and interruptions of data transmission.

The JMA has been announcing advisories about the probabilities of subsequent large shaking (intensities 5 or higher) due to aftershocks since the 2004 Niigata-ken-Chuetsu Earthquake (M6.8). Statistics of well-recorded early aftershocks enable us to extrapolate the subsequent three- or seven-day probability of large aftershocks. It is useful to promote public awareness of the continuing danger. The advisory worked after the Tohoku Earthquake. However, the widespread aftershocks and remotely triggered earthquakes were unprecedented because of its extent of crustal deformation. Several M6 class inland earthquakes have occurred and caused local damage in Akita, Fukushima, Nagano, and Shizuoka Prefectures, located 100 km to 300 km from the locus of high seismic slip.

After:

To overcome the problem of inadequate evacuation due to the map's underestimated inundation, the guideline for creating a tsunami hazard map is undergoing modification and revision. For example, the scenario should include the probable maximum as well as the previous maximum, and should be expanded to several scenarios to avoid a sense of certainty, especially of unjustified safety.

A new offshore network system in the Pacific Ocean, east of Japan, is going to be installed with more than 50 seismic and tsunami monitoring sensors, covering the trough in the deep sea where earthquakes and tsunamis have repeatedly originated. The system enables monitoring them in real time and providing more accurate estimations, even for a large-scale event.

The HERP confirmed the validity of the methodology for creating the probabilistic seismic hazard map by retrospective tests beginning in 1890. The map underestimated the strong ground motion in Tohoku because of the ~200–300-year relatively short period of reliable historical and instrumental data.

We may have to consider hypothetical M9 super-cycles by taking pre-historic and paleoseismic data into account. The magnitude of the anticipated large earthquakes along the Nankai trough for southwest Japan has now increased to M9.0, based on the tsunami sediment and paleo-geodesy along the coastal regions.

To overcome the magnitude saturation issue that emerged from the Tohoku Earthquake, the Geospatial Information Authority of Japan (GSI) and Tohoku University have been developing a real-time magnitude determination system using continuous GPS data and a data assimilation technique.

Problems:

Limitation in the deterministic evaluation for a low-frequency event such as the 2011 Tohoku disaster suggests a new approach, combining the statistical method with an inter-disciplinary approach including history, geology, sedimentrology, and physiography. A multi-scenario prediction would reduce the risk of governments and citizens having a false sense of certainty or safety.

Although the tsunami warning for a far field event is effective, the issues in a near field event remain because of having a short evacuation window. An early warning system should trigger the people to evacuate or take mitigating action. This system should be connected or cooperate with the planning of evacuations and systems/facilities in each area, which would require understanding people's reasons for not taking action to move to safe areas despite receiving the warning in the 2011 Tohoku disaster. At the beginning of the earthquake and tsunami generation, errors or indefinite remains can be reduced by monitoring data in real time, indicating a speed–accuracy trade-off. It is important to receive the updated information timely after the event. Then the dissemination system, by combining mass media, ICT, and public information, can ensure people's access to information at any time.

The recent destructive earthquakes including the Tohoku Earthquake raised several critical issues in the probabilistic seismic hazard map. However, the map, averaging probabilities of strong ground motion from various sources in a given place, remains useful for seismic damage mitigation. The larger issue is to avoid people's misunderstanding: the map does not indicate "earthquake probability."

In the Tohoku Earthquake, Japan's recent building code demonstrated its protection against strong seismic motion. However, the domain of seismic acceleration and local intensity at a subduction earthquake is frequently different from that caused by large, shallow, inland earthquakes. Reconstructions and seismic retrofits of the old buildings are strongly recommended.

The earthquake early warning system has been steadily improving since its 2007 initiation. Frequent drills in the immediate action necessary within seconds before a seismic wave arrives have become far more important for protecting human life. Thus, we need to educate people on the warning system's limitations, particularly for large inland earthquakes, and further promote seismic retrofits to prevent the collapse of old buildings.

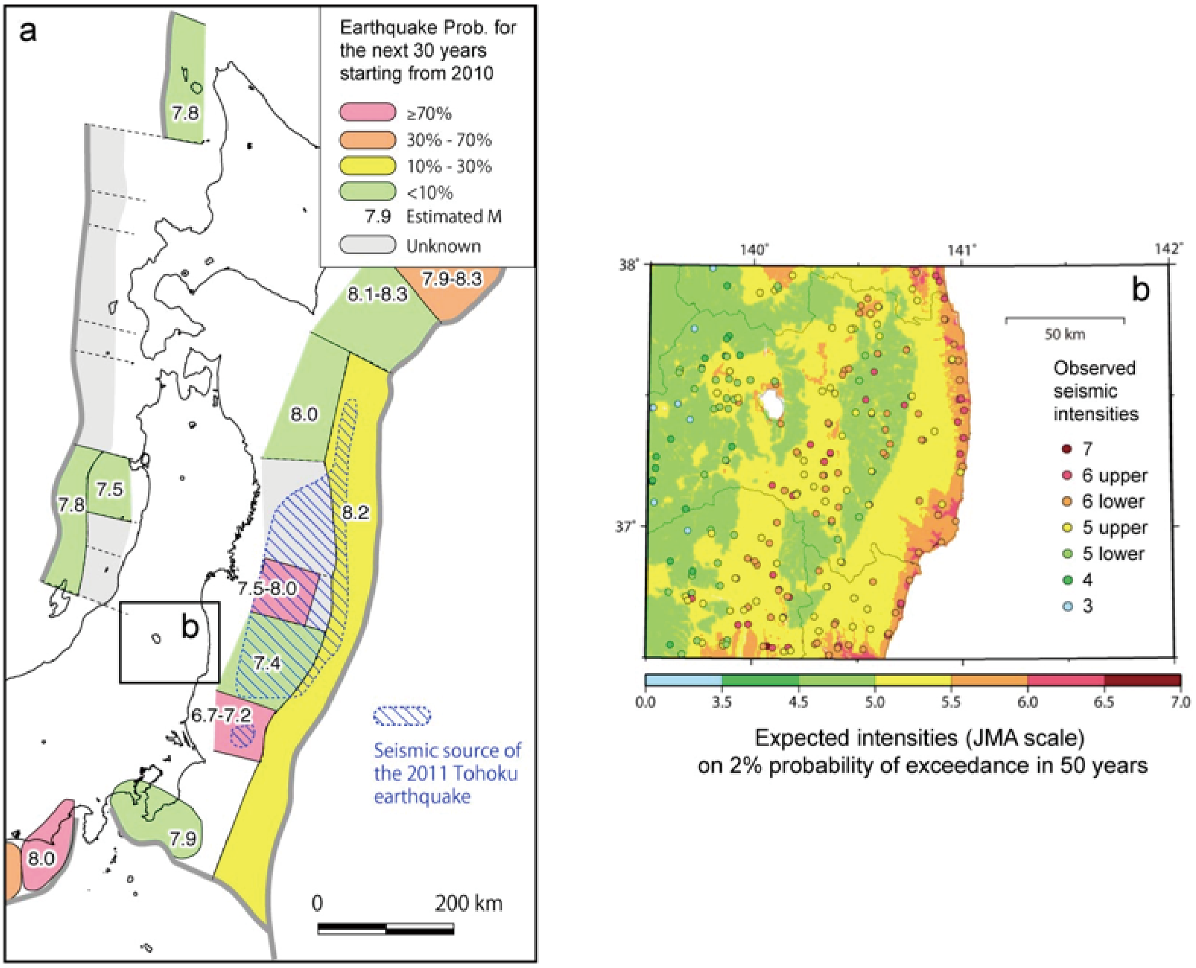
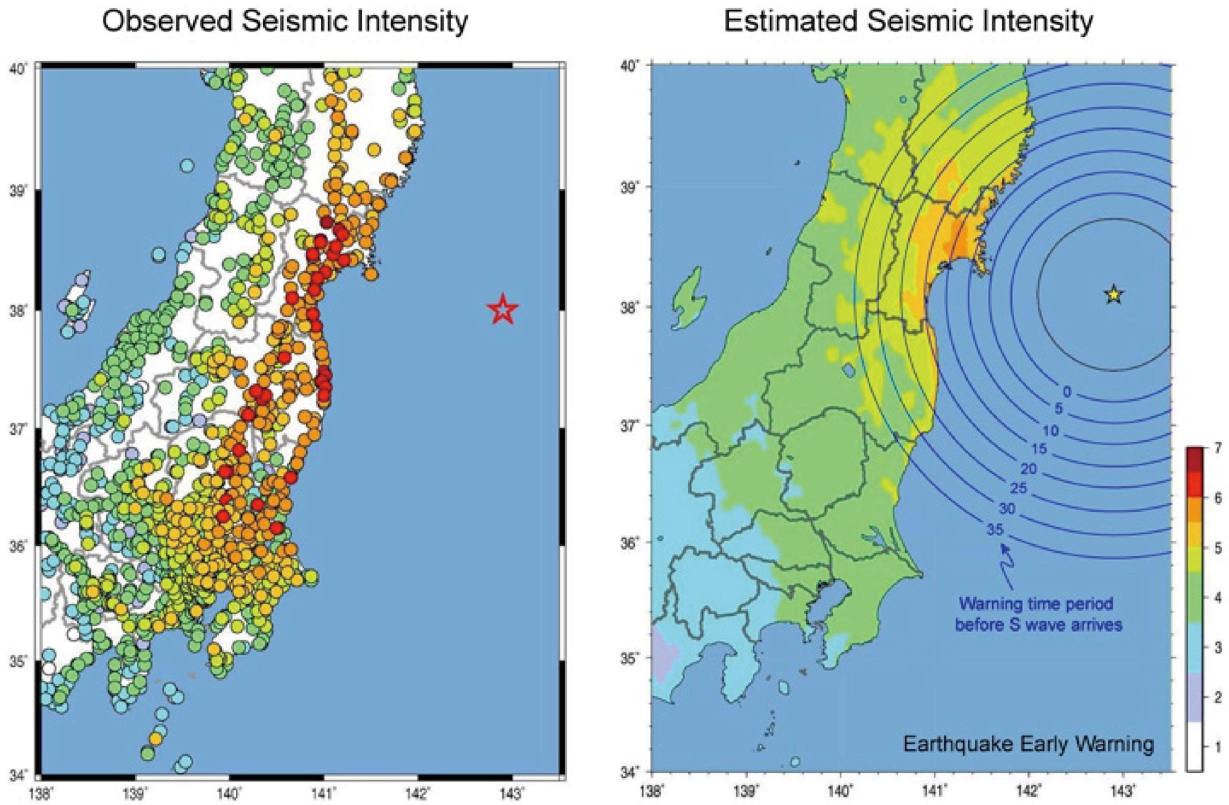


Fig. 2.1 a) Earthquake Probabilities of Subduction Earthquakes for the Next 30 Years (HERP, 2010).
b) A Comparison between the Expected Seismic Intensities Calculated from the Long-term Forecast and Observed Intensities Recorded for the 2011 Tohoku Earthquake.



Observed Seismic Intensity

Estimated Seismic Intensity

Fig. 2.2 Observed Seismic Intensities of the 2011 Tohoku Earthquake (left) and Intensities Estimated from the JMA Earthquake Early Warning System (right). (Yamada, 2011)

8 Importance of Quantitative Assessment of Uncertainties and their Visualization in Tsunami Hazard Assessment

HFA Core Indicator 2.1:
National policy and local risk assessments based on hazard data and vulnerability information are available and include risk assessments for key sectors.

Keywords:
tsunami hazard assessment, quantitative uncertainty assessment, visualization of uncertainty

Context:
A tsunami hazard map is an indispensable map that shows the possible tsunami inundation area in order to consider tsunami disaster prevention measures. The Japanese government and most of the local governments along coastal areas in Japan have published many tsunami hazard maps.

Before:
Before the GEJE, the Miyagi-oki earthquake and the Sanriku-oki earthquake were assumed in the tsunami hazard maps published by the Miyagi prefectural government. The tsunami hazard maps published by most of the local governments along coastal area have also adopted an earthquake scenario.

After:
In many coastal areas of the Tohoku region, the area inundated by the GEJE tsunami exceeded the area specified in the tsunami hazard maps. As a result, some residents did not evacuate because they believed the inundation hazard maps. Against this background, there is a recent proposal to categorize a tsunami hazard as one of two types: L1 tsunamis, which occur frequently and cause extensive damage even though they are not very high, and L2 tsunamis, which occur at an extremely low frequency but cause massive amounts of damage.

Good practices:
It is certain that tsunami hazard maps have facilitated tsunami evacuation for the residents to some degree following the GEJE and other past earthquakes.

Problems:
Many uncertainties in tsunami wave height are present in each phase of the tsunami hazard assessment: earthquake generation, tsunami propagation and tsunami inundation. A problem is that the uncertainties are not explicitly described in the tsunami hazard maps. Tsunami hazard maps that do not concretely show the uncertainties could generate a situation beyond the assumption again such as the GEJE and mislead residents about potential tsunami hazards.

In the future, we need to quantify the uncertainties and clarify how much we can assure the tsunami hazard assessments. Hazard maps based on the two types of tsunamis (L1 and L2) are still insufficient for understanding the potential tsunami hazard. Some examples of visualizing uncertainties are as follows. Fig. 2.3 shows an uncertainty in the coastal tsunami wave height. Here, we defined the uncertainty as a coefficient of variation of the possible tsunami wave height. The uncertainty increases as the points pinken. We can also see regional characteristics of the uncertainty. Fig. 2.4 shows the uncertainty of the tsunami inundation around Soma port. The green area is the tsunami inundation area for a 500-years return period. The red and blue areas are inundation areas when the uncertainties are considered. Although the return period for each of the three cases is 500 years, the inundation areas factoring in the uncertainties differ. If the tsunami hazard map explicitly indicates the uncertainties of the tsunami hazard assessment as indicated above, residents who use the map can properly understand the uncertainties of the tsunami inundation area.

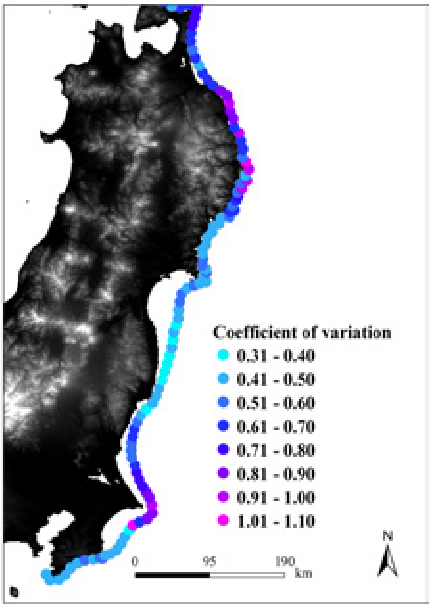


Fig. 2.3 Coefficient of variation of tsunami height along Tohoku coastal area[1]

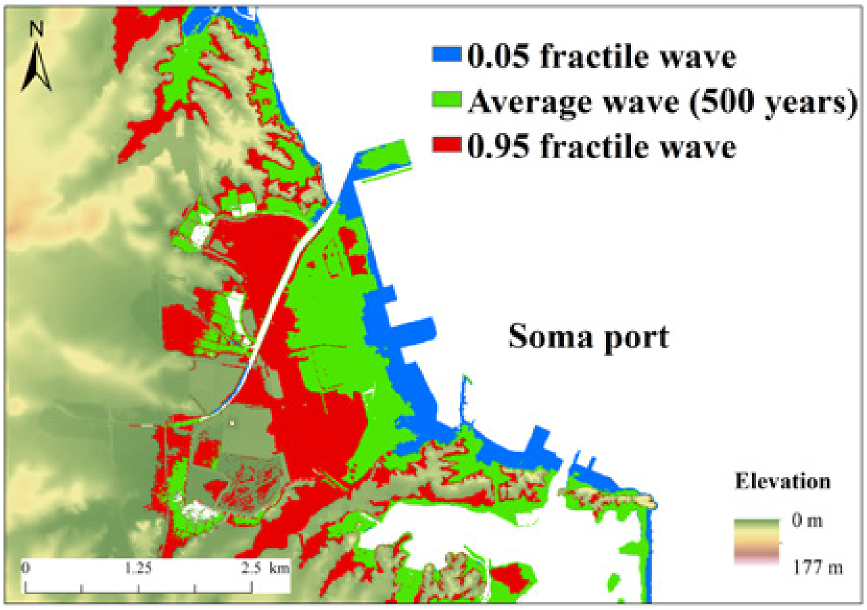


Fig. 2.4 Example of a stochastic tsunami hazard map

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[1] Fukutani, Yo., Suppasri, A., Abe, Y. and Imamura, F. (2014). Stochastic analysis and uncertainty assessment of tsunami wave height using a random slip source parameter model, Stochastic Environmental Research and Risk Assessment. (submitted)

9 Tsunami Fragility Curves for Supporting Reconstruction and Future Risk Assessment

HFA Core Indicator 2.1:
National policy and local risk assessments based on hazard data and vulnerability information are available and include risk assessments for key sectors.

Keywords:

tsunami fragility curve, risk assessment, statistical analysis, 2004 Indian Ocean Tsunami, 2011 Great East Japan Earthquake Tsunami

Context:

Tsunami fragility curves (or tsunami fragility function) are defined as empirical relationships between vulnerability and tsunami hazard[2]. Tsunami fragility curves have been developed in performing tsunami risk analysis of structural or social systems to identify vulnerability against tsunami hazards using damage data associated with past events and observed or simulated tsunami hazard information such as flow depth, current velocity and hydrodynamic force on a structure.

Tsunami fragility curves can be implemented for assessments of structural damage and fatalities within the exposed area against potential tsunami hazard scenarios. Multiplying the number of exposed structures and populations by the damage probability from the fragility curves equivalent to the estimated tsunami hazards provides the quantitative estimation of tsunami impact.

Before:

The 2004 Indian Ocean Tsunami was the major event that earthquake fragility functions were widely applied to tsunami damage data in severely hit countries such as Indonesia, Sri Lanka and Thailand. While there was a limitation due to number of surveyed damaged buildings (some hundreds or thousands), advantage of remote sensing technology was utilized to interpret building damage. Fragility curves (Fig. 2.5) were then plotted using detailed tsunami features (flow depth and flow velocity) at each damaged building obtained from numerical simulation of tsunami inundation[3].

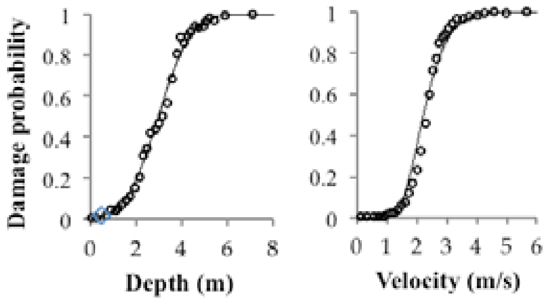

Fig. 2.5 Tsunami fragility functions for Banda Aceh, Indonesia in case of the 2004 Indian Ocean Tsunami[3]

After:

Japanese government put large effort on field survey of damaged buildings from the 2011 Great East Japan Tsunami. The database has more than 200,000 buildings with detailed information such as tsunami flow depth, building materials, number of stories, building functions and construction year[4]. This allowed us to apply more advance statistical methods that suit high quality of the disaggregate data. Fig. 2.6 shows fragility functions for damage probability of building to be washed away.

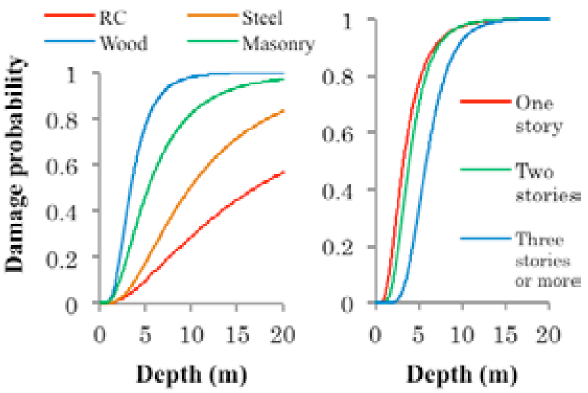

Fig. 2.6 Tsunami fragility functions in case of the 2011 Great East Japan Tsunami based on field survey data
(a) Different building material, (b) Number of stories[4]

Good practices:

Many fragility functions have been developed according to various types of building and coastal conditions in different countries. These functions were used as supporting data for land use planning during reconstruction period and risk assessment for future tsunami at the same time. For instance, in developing the post-disaster reconstruction plan of Sendai city, the tsunami fragility curve was used as supporting information in determination of building restriction area (the area subject to relocation)[5].

The tsunami fragility curves were also applied to understanding risks and vulnerabilities of other properties such as marine vessels, and offshore evacuation or risk map can be created using this data[6].

Problems:

The tsunami damage should be characterized by numerous uncertain factors. In this sense, tsunami fragility curves include some of uncertainties, and they may not be applicable in considering tsunami vulnerability when changing the areas of interest or considering other tsunami scenarios. Thus, we suggest that careful use and interpretations are required in using proposed tsunami fragility when applying.

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[6] Suppasri, A., Muhari, A., Futami, T., Imamura, F. and Shuto, N. (2013) Loss functions of small marine vessels based on surveyed data and numerical simulation of the 2011 Great East Japan Tsunami, Journal of Waterway, Port, Coastal and Ocean Engineering-ASCE (published online)

10 Small-area Population Estimates and Landscape Planning for Hazard Assessment and Reconstruction Planning

HFA Core Indicator 2.2:
Systems are in place to monitor, archive and disseminate data on key hazards and vulnerabilities.

Keywords:
small-area, population census, iterative proportional fitting, geodesign, geographic information system

Context:

Spatial datasets and a Geographic Information System (GIS) are keys for accurately measuring natural hazards and vulnerability that varies according to area. For example, the socio-demographic characteristics of victims affected by natural disasters are not evenly distributed, and therefore effective measures for disaster prevention and reconstruction should differ according to the population characteristics of particular areas. Thus, detailed population datasets about the tenure of dwelling, family type, age of the head of household, etc. allow us to create “tailored” measures against disasters and toward reconstruction. In addition to spatial datasets, geodesign, a new planning tool using spatial datasets, has also gained attention. This framework combines different evaluation maps representing values of local residents and stakeholders in the GIS environment.

Before:

However, a lack of detailed population datasets for small areas is problematic. National statistical datasets such as the Population Census of Japan and the Housing and Land Survey of Japan are tabulated only up to the municipality level. Therefore, it is difficult to grasp detailed information of affected areas from published statistical data. On the other hand, there are only a few examples of geodesign applications for reconstruction planning. There is a gap between analytical needs and available data and methods.

After:

Using statistical tables derived from the Population Census of Japan, we developed a method to create an 8-dimensional table, which represents people’s living conditions by each basic unit of the census (the minimum statistical survey unit comprised approximately 50 households and has geographical coordinates of latitude and longitude).

Items of the 8-dimensional table about living conditions are as follows: household members by area (ward/municipality/district/basic unit) × sex × age group × family type × tenure of dwelling × building type and stories of house × area of floor space × head/non-head of household. “Iterative Proportional Fitting” was applied to make estimated population counts converge to marginal totals of the census tables.

A geodesign workshop was held as an intensive course at Tohoku University to design a new land use layout of Soma City, Fukushima Prefecture. The evaluation maps and change models (new land use layout) were created by the participants (Fig. 2.7) after extensive discussion.

Good practices:

The feature of this work is to conduct data estimation at the smallest statistical unit that is geographically recorded as a point. We can count the total population by any eight items at each point of the basic unit, and it is possible to analyze people’s conditions within areas stricken by a tsunami or earthquake.

We confirmed the effectiveness of geodesign for regional reconstruction planning because it can effectively consider local variations of risks and vulnerabilities to natural hazards as well as the value and needs of residents and stakeholders. Using both spatially detailed population datasets and a geodesign framework will contribute to making more effective reconstruction plans.

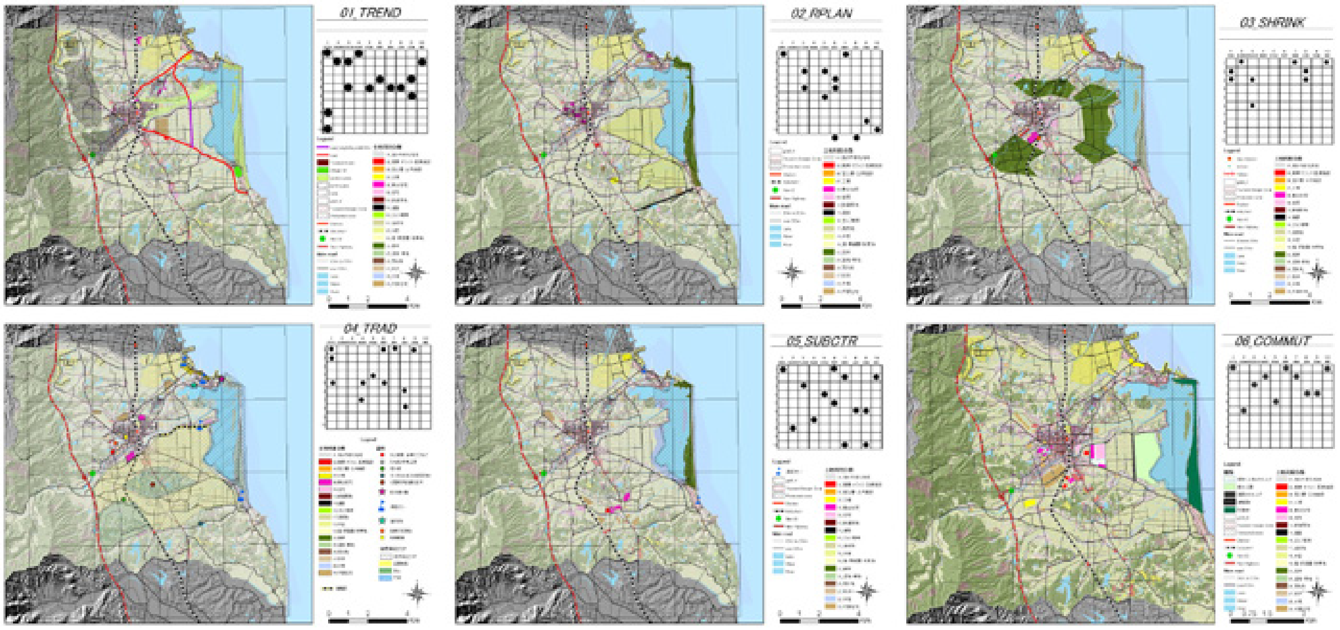

Fig. 2.7 Change models (land use layout) created at the geodesign workshop

11 Earthquake Early Warning System in Schools and at a University during the 2011 Tohoku Earthquake

HFA Core Indicator 2.3:
Early warning systems are in place for all major hazards, with outreach to communities.

Keywords:
earthquake early warning system, application in schools, 2011 Tohoku Earthquake, evacuation drill

Context:

Earthquake early warning systems (EEWS) can provide precious seconds for taking action before strong ground shaking occurs. EEWS save lives by stopping trains before they pass over damaged tracks, facilitating the evacuation of elevators, etc. Systems that detect earthquakes near their source and issue warnings before strong ground shaking occurs have been used in Japan, Mexico, and Taiwan, and similar systems are being studied for earthquakes in Southern California, US, and other seismically active areas. The Japan Meteorological Agency (JMA) has provided warning information for public users via television and radio since October 1, 2007.

EEWS in schools have been developed and applied to schools in Miyagi Prefecture [7] in order to enhance the social basis of understanding EEWS and to ensure the safety of students and staffs by providing warning information.

First successful example of EEW in schools[7]:

Fig. 2.8 illustrates an EEW evacuation drill in a school that actually adopted the EEW guidelines of JMA. In Miyagi Prefecture, EEW applications have been performed at eight schools as government projects. During the Iwate-Miyagi Inland Earthquake (M7.2) on June 14, 2008, the school EEWS worked successfully. At a junior high school in Shiroishi City, with an epicentral distance of 110 km, 102 students were evacuated thanks to an EEW 21 s before the S waves arrived.

EEW application at a University

Fig. 2.9 shows the EEW application system at Tohoku University where the university LAN has been used to transmit EEW since 2009. The EEW information is transferred to the broadcasting system of each bureau when the expected seismic intensity exceeds a preset threshold intensity.

Good practices during the 2011 Tohoku Earthquake:

During the Tohoku Earthquake, at all most all of the schools with EEW installed, pupils were able to evacuate because the warning alarm sounded before severe shaking; 1415 s before shaking in Sendai, 17 s in Furukawa, Osaki City, and 21 s in Shiroishi City [8]. At one elementary school in Sendai, students avoided being crushed by toppled shoebox thanks to EEW, and staff were able to avoid being injured by large-sized safes in the staff room, even if the safes box were fixed [8]. A teacher in charge of EEW reported that, after the experience of the Tohoku Earthquake (main shock), students were able to evacuate by themselves when the EEW sounded for the many aftershocks.

Based on this success, MEXT (Ministry of Education, Science and Culture) funded the installation of EEWS at 1,000 schools in 2012 and 500 in 2013.

At the Aobayama campus of Tohoku University, EEW was issued at buildings with EEWS 13 s before severe shaking helped students and staff evacuate to safe areas even though the building sustained severe damage.

Fig. 2.8 Response to EEW in school

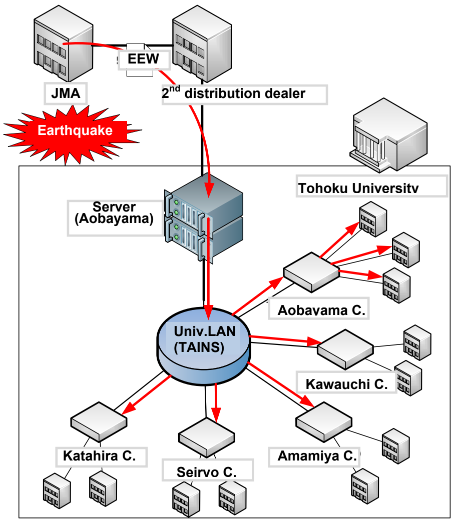

Fig. 2.9 EEWS at Tohoku University

Problems learnt from the 2011 Tohoku Earthquake:

- Determining source parameters is difficult for a huge earthquake and leads to underestimation of the magnitude. Consequently, the EEW may fail to connect to the broadcasting system depending on the threshold value.
- Evacuation drills using the drill function of EEWS and daily maintenance of EEWS are needed for evacuation during a real earthquake. The degree of maintenance divided black and white for the EEW utilization.
- Problems with false alarms are serious, especially when two aftershocks occur simultaneously behind a main shock. Countermeasures to prevent this are needed.
- Successive change of source information is needed for a huge earthquake, and EEWS would be available for this change.
- On-site earthquake observation data can be used to enhance the accuracy of ground motion prediction but are not always useful for a huge earthquake.

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[7] Masato Motosaka and Makoto Homma, Earthquake Early Warning System Application for School Disaster Prevention, Journal of Disaster Research Vol.4 No.4, 229-236, 2009

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12

Monitoring of Land Slides and Status of Buildings and Construction Areas by Radar Technology

HFA Core Indicator 2.3:
Early warning systems are in place for all major hazards, with outreach to communities.

Keywords:
GB-SAR, landslide, monitoring, radar, Arato-zawa, Miyagi-Iwate Nairiku earthquake

Context:

Radar technology is now available to monitor large-scale landslides. A demonstration in Arato-zawa shows promising results, and pertinent information should be delivered to the local inhabitants.

Before:

Landslides can be caused by earthquakes, volcanic activity, strong rain and storms. While landslides can occur sometimes very abruptly, in many cases they move very slowly. Available technologies are now being used to monitor areas prone to landslides. For example, strain meters and tiltmeters can be placed on the slope, and can continuously monitor the deformation of the land surface. Recently, high-precision GPS has also been used to monitor the movement of the ground surface. These techniques are effective when the location of the movement is obvious and these discrete sensors can be placed in the appropriate positions. However, if the position of the movement is unclear or distributed across a large area, deploying these discrete sensors is costly and largely ineffective.

After:

We propose the use of ground-based synthetic aperture radar (GB-SAR) to monitor the ground surface displacement. One GB-SAR unit can observe a wide area of the landslide, and can detect sub-millimeter displacements. Moreover, GB-SAR can monitor the ground surface condition continuously, and could be used to provide an automatic early warning if the GB-SAR detects any anomalous movement of the ground surface.

Good practices:

We have continuously monitored the ground surface condition by GB-SAR at the Arato-zawa site in Kurihara City, Japan shown in Fig.2.10 since 2011. Very large-scale landslides occurred at Arato-zawa as a result of the Iwate-Miyagi Nairiku earthquake in 2008. Fig. 2.11 shows the GB-SAR system installed at the Arato-zawa site.

Fig. 2.10 Arato-zawa landslide area. The GB-SAR system can be seen at the bottom left

Fig. 2.11 GB-SAR system installed at the Arato-zawa site

The GB-SAR system acquires radar data every 5 min, and the data are transferred to Remote PC over the Internet for analysis. Fig. 2.12 shows one of the SAR interferometry images. The color indicates the deformation of the ground surface, where the green area is stable and red and blue areas indicate small displacements. This specific SAR interferometry image was created using data before and after a small-scale earthquake, and we think that soil and rocks have fallen down as a result of the earthquake. This is indicated by the red area, which can be seen in the middle of the cliff.

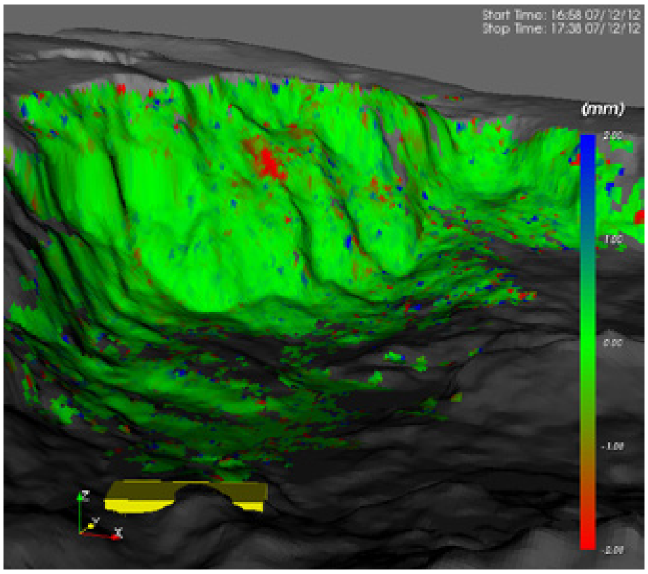

Fig. 2.12 SAR Interferometry image that shows the location of ground surface deformation

Problems:

Because the system transmits electromagnetic waves, permission to use it must be obtained from the government. If the process of obtaining permission is simplified, GB-SAR systems can be installed more easily. More experience using the system is required to increase its accuracy. The method in which the early warning information is provided to the local inhabitants must also be carefully studied.

13 *Information Sharing, Cooperation, and Expert Training Provided by Academic Research Institutes for Natural Disasters*

HFA Core Indicator 3.1:
Relevant information on disasters is available and accessible at all levels, to all stakeholders (through networks, development of information sharing systems, etc.)

Keywords:
academic research institute for natural disasters, background, mission

Context:

Various countermeasures have been implemented on the basis of the experiences of many great natural disasters, including earthquakes, volcanic eruptions, floods, tsunamis, typhoons, landslides, etc. This section focuses on the role of academics suggested by any previous great disaster. HFA Core Indicators in this section are altered from the original indicators, maintaining the original priority.

Before:

First, we summarize the century-long history of the establishment of academic disaster research institutes. The Tokyo University Earthquake Research Institute (ERI) was established in 1925, two years after the great Kanto earthquake. The principles and goals of scientific research are to promote research of the solid earth, and to pioneer a way to better understand earthquakes and volcanic activities.

The Kyoto University Disaster Prevention Research Institute (DPRI) was founded in 1951 in response to severe damage caused by a huge typhoon that struck Japan that year. Since its establishment, the DPRI has responded to a variety of natural disasters and has promoted research in the disaster sciences, with the goal of mitigating damage. Many researchers and graduate students work in the DPRI, with specialties ranging from natural science, engineering, informatics, to social sciences. It also maintains 15 experimental and observatory facilities outside the campus for unique field investigations, on-site observations, and large experiments.

The National Research Institute for Earth Science and Disaster Prevention (NIED) was established in 1963, motivated by the disastrous 1959 Typhoon Isewan. Originally, an independent administrative institution is defined as one that efficiently and effectively promotes programs that should be securely administered from the public perspective, but always need not be executed by the government itself and cannot be expected to be supported by private enterprises. Research on disaster prevention is one such work.

The Great Hanshin-Awaji Earthquake Memorial Disaster Reduction and Human Renovation Institute (DRI) offers programs in which visitors can learn the effects of that earthquake and lessons learned from the experience that should be shared with younger generations. The DRI began in 1959 as an archive project and after 2002 has also worked to convey expertise and knowledge to the public in an easy-to-understand manner so as to help our cities, communities, and the populace becomes better prepared against disasters. Such efforts are based on the concept that disaster risk management and mitigation requires the involvement of not only the national and local governments but also local communities and individuals.

Table 3.1 List of Great Natural Disasters and Academic Research Institutes for Natural Disasters

Year.	Event	Locate.
Sep.1923	*Great Kantō Earthquake*	Tokyo, Chiba, Kanagawa, etc.
Nov.1925	*Earthquake Research Institute* (ERI) established by Tokyo Univ.	Tokyo
Sep.1950	*Typhoon Jane*	Osaka,Kinki, Shikoku
Apr.1951	*Disaster Prevention Research Institute* (DPRI) established by Kyoto Univ.	Kyoto
Sep.1959	*Typhoon Ise-wan*	Japan
Apr.1963	*National Research Institute for Earth Science and Disaster Prevention (NIED)* established.	Hyogo,Ibaraki, Niigata, Yamagata
Jan.1995	*Great Hanshin-Awaji Earthquake*	Hyogo
Apr.2002	*Disaster Reduction and Human Renovation Instiution* (DRI) established.	Hyogo
Jan.2005	*Hyogo Framework for Action(2005-2015)*	
Jan.2005	*Institute for Research of Disaster Area Reconstruction* established by Kwansei Gakuin Univ.	Hyogo
2008	*Institute of Disaster Environmental Science* (IDES) established by K.I.T.	Kanazawa
Mar.2011	*Great East Japan Earthquake and Tsunami*	Iwate, Miyagi, Fukushima, etc
Apr.2011	*Institute of Disaster Recovery Revitalization* established by Fukushima Univ.	Fukushima
	Research Institute for Natural Hazards & Disaster Recovery (NHDR) established by Niigata Univ.	Niigata
	Research Institute of Disaster Prevention and Emergency Medical System(DPEMS) established by Kokushikan Univ.	Tokyo
May.2011	*Composed Crisis Research Institute* established by Waseda Univ.	Tokyo
Apr.2012	*International Research Institute of Disaster Science* (IRIDeS) established by Tohoku Univ.	Miyagi
Apr.2013	*Institute of Disaster Mitigation for Urban Cultural Heritage* (DMUCH) established by Ritsumeikan Univ.	Kyoto
		etc.

After:

For a hundred years, fundamental science and technology related to disasters has been developed in Japan based on fundamental scientific knowledge, and many experts have emerged. However, our knowledge has proven to be insufficient to save lives, to provide correct information, and to make well-informed decisions, because the damage by the 2011 Great East Japan Earthquake was extraordinarily massive and the damaged area so vast, as never before experienced. Experts in each division are less experienced in connection to that in other divisions. The highest priority is thus an integrated system of knowledge.

Such a system demands consideration of social engineering, social sciences, and humanities in implementing countermeasures. It also requires reinforcing efforts for effective risk communication about a very low frequency great disaster, including its uncertainty, limitation of predicting natural phenomena, and the promotion of integrated research among different fields such as seismology, geology, archeology, history, and practical expert training.

Having experienced the catastrophic disaster in 2011, Tohoku University founded the International Research Institute of Disaster Science (IRIDeS). Along with collaborating organizations from many countries and with broad areas of specialization, the IRIDeS conducts world-leading research on natural disaster science and disaster mitigation. Based on the lessons from the 2011 Great East Japan (Tohoku) Earthquake and Tsunami Disaster, the IRIDeS strives to become a global center for the study of disasters and disaster mitigation, learning from and building on past lessons in disaster management from Japan and around the world. Throughout, the IRIDeS will contribute to ongoing recovery/reconstruction efforts in affected areas by conducting action-oriented research and pursuing effective disaster management to build sustainable and resilient societies. The IRIDeS innovates the previous paradigm of Japan's and the rest of the world's management for catastrophic natural disasters to become a foundation of disaster mitigation management and sciences. Disaster mitigation management seeks to avoid or reduce potential losses from natural hazards, to ensure prompt assistance to victims, to achieve rapid and effective recovery, and to build disaster-resilient and sustainable societies through the five stages of the disaster management cycle: mitigation, preparedness, response, recovery, and reconstruction. The action-oriented research of the IRIDeS addresses each stage in the cycle and integrates and universalizes the scientific discoveries for implementation worldwide.

The Inter-Graduate School Doctoral Degree Program on Science for Global Safety, the Ministry of Education (MEXT) program for Leading Graduate Schools, commenced in 2012, and the IRIDeS contributes to this program. Participating students have an integrated practical program, an all-round resource, called the "Kopeito" (cultivate) model.

Good practices:

Having experienced many catastrophic disasters through history, we have established academic/research institutes and education systems from various aspects.

Problems:

Promotion of integrated research of different fields such as seismology, geology, and archeology was insufficient. The failure to anticipate massive earthquakes and tsunamis by taking every possibility into account was noted.

14

Education to Build a Culture of Safety and Resilience at All Levels around Academic Research Institutes

HFA Core Indicator 3.2:
School curricula, education material and relevant training include disaster risk reduction and recovery concepts and practices.

Keywords:
outreach, social decisions, personal action, daily training, local media, IT-network, SNS

Before:

For longer than the past decade, there were two main backgrounds for countermeasures for disaster prevention in Japan: science communication and administrative policy.

The White Paper on Science and Technology, 2004 noted the importance of scientists and engineers, as members of society, engaging in exchanges with the people, so as to strengthen mutual trust and to encourage the people to treat science and technology as issues of personal importance. In 2005, on the basis of those backgrounds, programs for science communication had begun at Hokkaido University, Waseda University, and Tokyo University by the Science and Technology Promotion Fund. Science communication programs had then spread across other universities, and many outreach programs were held at universities, large academic research projects, and academic societies.

Research institutes contributed to public programs based on the political concept. During these 10 years, the NIED has performed public services through basic research and development on disaster reduction as well as dissemination of research results for the benefit of society. Regarding the seismic hazard, two major projects proceeded utilizing the nationwide seismic network and the 3D Full-scale Earthquake Testing Facility (E-defense), both of which were constructed after the disastrous Kobe earthquake in 1995.

The DPRI serves as a national research center on natural disasters and their prevention and mitigation, authorized by the MEXT. Researchers working on natural disasters from various Japanese universities gather at DPRI, use its experimental and observatory facilities, and jointly work with DPRI researchers. Another role of the DPRI is to promptly provide diverse support at disaster sites in and outside Japan by offering advice regarding what to do, what aid is needed, how to secure and organize volunteers, and other relevant issues while working on pragmatic tasks with local personnel. In preparation for such tasks, our team is developing skills and expertise for managing potential challenges at disaster sites. Furthermore, several institutions and UN organizations related to disaster management are located in this area. This proximity enables the DPRI to serve as one of world's key centers for information on disaster risk management, in collaboration with these organizations.

The good qualities of human beings such as flexibility, kindness, generosity, strength, and joviality are the basis for building an attractive life, home, community, and society.

To promote a prosperous society of the 21st century based on harmonious coexistence with nature, the DPRI will strive to disseminate useful disaster management information and expertise, which we believe are closely linked with the mindset of appreciating the importance and preciousness of life.

After:

The ERI speedily provided scientific information on the earthquake. The ERI succeeded in making the mechanism of the earthquake and tsunami easy to understand on the basis of precise analysis.

In addition to its domestic activities, the DPRI has established formal Memoranda of Understanding (MOUs) with 40 foreign research institutions (as of August, 2012) and organizes numerous joint projects and seminars to serve as an international center for research and education on natural disasters and their mitigation. The past decade has witnessed a notable increase in the intensity of natural disasters, such as the 2011 Tohoku Earthquake and Tsunami. To respond to the serious needs for the protection of the lives and assets of our people and society, the DPRI promises to continue to enhance its research efforts, using the knowledge and experience accumulated over the last several decades.

On the basis of NIDE's practical outputs in the past 10 years, they entered "The Third Five-year Plan" period in April, 2011 through negotiation with the Ministry of Education, Culture, Sports, Science, and Technology as well as the Ministries of Finance and of Internal Affairs and Communications. Synchronized with this turning point, we have changed the organization of our institute to create a more efficient system. The research sector was reorganized into three departments: Monitoring and Forecast, Experimental Research, and Social Systems; the management sector was simplified by spinning off the planning section. Further, the Outreach and International Research Promotion Center was newly established to strengthen public services and international activities, archive projects including a rental camera system for victims, etc.

In April, 2011, "The 4th Science and Technology Basic Plan" was also launched by the Council for Science and Technology Policy, Cabinet Office, Government of Japan. In this plan, the role of science and technology is highlighted to challenge important policy goals, one of which is "Realization of Rich and High-quality Life." Lessons from the Great East Japan Earthquake are summarized in the White Paper on Science and Technology, 2012. The public's trust in scientists declined because of the gap between expectation and reality. We thus urgently need promotion of integrated research of different fields such as seismology, geology, archeology, and history to sufficiently understand earthquakes and tsunamis. There was overconfidence in embankments and technology; some people did not evacuate because they lacked knowledge of the limitations of existing countermeasures and technologies. Scientific and technological risks and uncertainty involved have not been seriously considered with regard to the government's and experts' provision of information to the public. Therefore, most of the people lacked an adequate understanding of the situation.

Social engineering, social sciences, and humanities must be considered in implementing countermeasures. Anticipating massive earthquakes and tsunamis must take every possibility into account.

The IRIDeS has created a new academia of disaster mitigation that subsumes the lessons from the 2011 Tohoku Earthquake and Tsunami and the findings of world-leading research into our societies with the purpose of establishing social systems that respond promptly, sensibly, and effectively to natural disasters, withstanding adversities with resiliency, and passing and exploiting the lessons to the subsequent disaster management cycles. Enhancing cooperation with the local municipalities and governments in the affected areas and contributing to their recovery and reconstruction efforts, the IRIDeS conducts action-oriented research. They strive to create disaster-resilient societies that can overcome the complex and diverse processes of natural disasters, not only by mitigation strategies but also by preparing for and responding to them, and achieving recovery and renovation, thus engendering the culture of disaster-resiliency incorporated into our social systems.

The action-oriented research of the IRIDeS focuses on the following points:

1) Investigating the physics of global scale natural disasters such as mega-earthquakes, tsunamis, and extreme weather,
2) Reconstructing disaster response and mitigation technologies based on the lessons of the 2011 Tohoku earthquake and tsunami disaster,
3) Inventing "Affected Area Supportology" in the aftermath of natural disasters,
4) Enhancing disaster-resiliency and performance of multiple-fail-safe systems in regional and urban areas,
5) Establishing disaster medicine and medical service systems towards catastrophic natural disasters,
6) Designing disaster-resilient societies and developing the digital archive system to pass the lessons from the disasters.

The Inter-Graduate School Doctoral Degree Program on Science for Global Safety develops human resources through integrated education in the five-year doctoral program across university departments for students in humanities, sciences, and technologies. It develops leaders in the area of global safety who have a substantial knowledge of liberal arts, international adaptability, a high sense of ethics, and a clear vision, and are able to think and act appropriately on such bases. They are expected to contribute to the protection of human lives, societies, and industries from global disasters such as the Great East Japan Earthquake.

In this program, interdisciplinary cutting-edge education and research are conducted on the basis of practical disaster prevention studies in the (IRIDeS), with participation by the Graduate Schools of Science, Engineering, Environmental Studies, Arts and Letters, and others, so that this integrated program can combine knowledge from the natural sciences, social sciences, and liberal arts. This program strives to develop excellent human resources with core specialties, the ability to apply them in various areas, and other required abilities for leaders, through activities at recovery sites from the Great East Japan Earthquake and conducting world-class research.

Finally, we focus on the action of non-experts. For roughly the past decade, many technologies have enabled people to transmit information rapidly and simultaneously. Government offices transmit disaster information and action indicator messages through mass media and people expect unified information from responsible organizations. During the past several years, Internet technology has developed. The specific information path has diverged with interactive communication. Personal interactive information excluding mass media now enables direct personal interaction.

Fig. 3.1 Evacuation Drill for Tsunamis at an Elementary School

Good practices:

1) Scientific experts have increased in Japan. The speedy supply of scientific information about the mechanism of earthquakes and tsunamis has occurred. That information is open for access and quickly archived.
2) Disaster prevention education by Dr. Katada of the University of Gunma, which underpinned the "Kamaishi Miracle," became famous after the Great East Japan Disaster. Dr. Katada said that it was skills for life, not a miracle. Kamaishi is in the Sanriku Coastal Area, where disaster prevention education and countermeasures were relatively active. He emphasized the reality of tsunamis and the existence of preconditions in the hazard map to overcome the gap between well-informed action and carelessness regarding hazards. That orderly and repeated education caused success.

Problems:

The public's trust in scientists has declined because of the gap between expectations and reality. We urgently need integrated research in different fields to sufficiently understand earthquakes and tsunamis. Communities lack a sufficient number of interpreters and coordinators between experts and non-experts.

15

Education Practice Program for Improving Response Capability to Survive a Tsunami

HFA Core Indicator 3.2:
School curricula, education material and relevant training include disaster risk reduction and recovery concepts and practices.

Keywords:

1995 Great Hanshin-Awaji Earthquake, 2011 Great East Japan Tsunami, disaster reduction education, education tools

Context:

Issues for disaster reduction education in school have become more important since the substantial loss of children due to the 2011 disaster. Education in school is one method that helps to maintain or increase disaster awareness of children to survive such catastrophic disasters.

Before:

Before the 2011 Great East Japan Tsunami disaster, the 1995 Great Hanshin-Awaji Earthquake was the most recent large-scale disaster in Japan. More than six thousand lives were lost, including almost 600 people younger than 20 years old (Fig. 3.2). However, because it was an inland earthquake that occurred in the early morning, most of the children that died were at home. The fact shows importance of disaster reduction education to improve children's risk awareness.

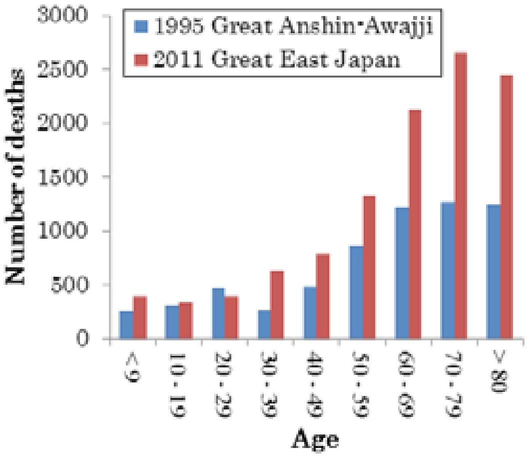

Fig. 3.2 Number of deaths by age for the 1995 Earthquake and 2011 Tsunami disasters[1]

After:

The situation surrounding the 2011 Great East Japan Tsunami differed from that of the earthquake in 1995. The tsunami hit the east coast of Japan 30–60 min after the massive earthquake struck in the afternoon. Even though the disaster occurred during the daytime when most children were supposed to be safe in school, and they had at least 30 min to evacuate, the tsunami killed nearly 700 people younger than 19 years old in the Tohoku area (Fig. 3.2). Even though the number of deaths from the 2011 disaster

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[1] Cabinet Office, Government of Japan (2011) Disaster prevention white paper, http://www.bousai.go.jp/kaigirep/hakusho/h23/index.htm.

[2] Yasuda, M., Imamura, F. and Suppasri, A. (2014) Practical education program for improving response capability to survive from tsunami, in: Proceeding of the Tohoku research group for natural disaster science, Akita University, 7-8 January 2013 (in Japanese).

for those older than 30 is quite large, the number of children is almost the same as the number for the 1995 disaster. Some successful stories emerged from this disaster, such as the “Miracle of Kamaishi”, in which all the elementary and junior high school children survived. While their schools were designated evacuation shelters, they realized that the tsunami might be bigger than that predicted by the hazard map. They finally decided to evacuate to higher ground, and all of them survived because of disaster education and drills.

Good practices:

The “Miracle of Kamaishi” is an example of a good practice, as disaster reduction education was continuously and well taught in the schools. The children had high awareness, and they were able to think of the catastrophe beyond what might be expected and find a survival route. Many ideas for new education courses for disaster reduction in school have been proposed since the 2011 disaster. An activity in Sendai[2] shows that children have higher disaster awareness, know how to survive or protect themselves and tell what they have learned in the class to their parents.

Problems:

Although there are a number of new education courses, they are mainly paper-based materials, and children might soon forget about them or infrequently review them. A new tool that applies disaster reduction information to everyday use is called “Gensai Pocket YUI”[3] and is an example of future education tools. Information such as disaster phenomena, things to have prepared and evacuation measures are printed on the handkerchief. Children can use this handkerchief to wrap their lunch boxes and test themselves with the quizzes every day. More effort needs to be spent on creating new tools for disaster reduction that are interesting for children and help maintain disaster awareness during every day life.

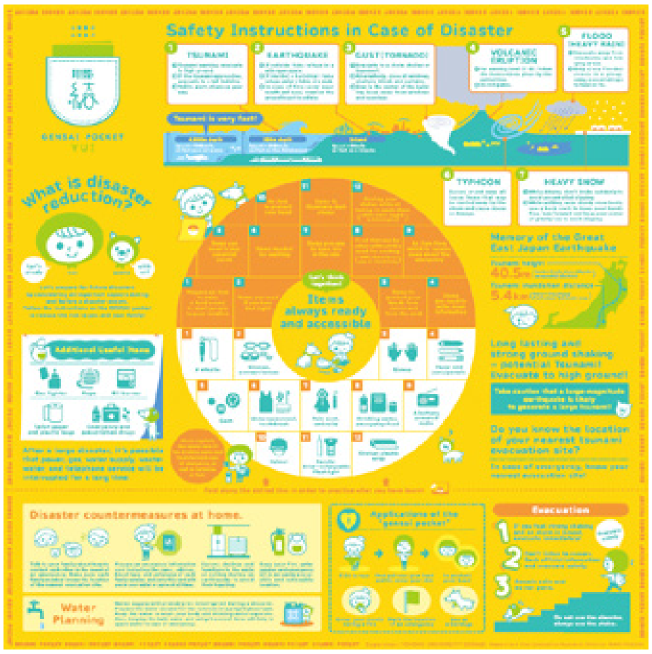

Fig. 3.3 Gensai Pocket YUI[3]

16 *Development of the Reconstruction Mapping Program at the Tsunami-affected Elementary School*

HFA Core Indicator 3.2:
School curricula, education material and relevant training include disaster risk reduction and recovery concepts and practices.

Keywords:

Post-disaster education program, tsunami-affected school, periods of integrated studies, teaching plan, town-watching

Context:

Disaster education should define in a life cycle of a disaster from preparedness, response, recovery, and mitigation. The goal of disaster education at school is to build the abilities not only to survive a disaster but also to be supporters in the reconstruction process.

Before:

Experiences of and recovery from the 1995 Hanshin-Awaji Earthquake shape the foundation of disaster education in Japan. The Ministry of Education, Culture, Sports, Science and Technology (MEXT) has been promoting disaster risk reduction in education by setting school safety guidelines and developing and distributing training and reference materials for teachers. Disaster education at school has been integrated into existing curricula such as science, social studies, and life environment studies. Though many materials and programs were developed, most of them were stand alone. Standardization of methodologies for replication and upscaling has been sought.

After:

The Great East Japan Earthquake of March 11, 2011, reaffirmed the importance of disaster education, especially in developing the ability to assess a situation and take proactive measures to protect one’s life. In 2012, MEXT announced a five-year plan called the Promotion of School Safety based on the 2009 School Health and Safety Act. The plan emphasizes promotion of systematic and comprehensive school safety measures based on scientific and practical knowledge and cooperation among schools, households, and local communities.

The Reconstruction Mapping Program[4] is a disaster education program at Kazuma Elementary School in Ishinomaki. The school is located 1 km from the coastline. Although the school re-opened in the same building on April 21, most of the school district was flooded by the March 2011 tsunami. When the Program was started in 2012, there still remained many vacant lots at the southern end of the school district due to the water outflow that washed away houses, requiring many displaced children to commute from outside of the school district.

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[3] Sendai Television Incorporated (2014) Gensai Pocket YUI: http://www.ox-tv.co.jp/topics/yui_pocket/

[4] Aiko SAKURAI, Takeshi SATO, Yoshiyuki MURAYAMA, Eriko TOKUYAMA, “Development of a School-Based Disaster Education Program: A Case of a “Reconstruction Map Making” Program in Ishinomaki-City”. Proceedings at the 9th APRU Research Symposium on Multi-Hazards on the Pacific Rim at National Taiwan University, 2013.

Source: Kazuma Elementary School

Fig. 3.4 Sample of a 2013 Reconstruction Map

The Program is aimed at helping children cope with their experiences during the disaster. The entire school district is divided into 12 groups, and each group walks through the tsunami-damaged school district. The children keep records of the reconstruction process, interview people in the community, and present this information in a "Reconstruction Map."

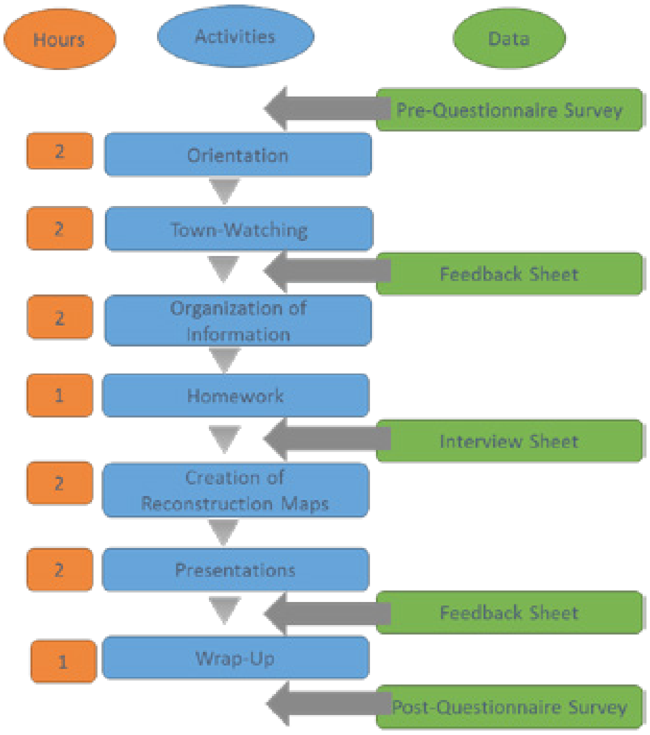

Fig. 3.5 Organization of the Program (Sample duration: 12 hours)

Good Practices:

The Reconstruction Mapping Program was started through partnerships among Ishinomaki City's Board of Education; the school's principal, teachers, and school children; an NGO; and university researchers. It has been implemented in the school curriculum during the fourth-grade Period for Integrated Studies. A teaching plan was also developed, which is structured according to the children's development phases and the objectives of the subject and the education unit. The teaching plan may implement the Program in a sustainable manner with the possibility of expansion to other areas.

The Program has given children firsthand experience in the reconstruction of their community, which has helped them better know their community and has increased their motivation to actively participate in the community's reconstruction process.

Problems:

Issues identified through the two-year implementation of the Program include

- keeping a close eye on the children's mental condition,
- providing the opportunity for children to feel they are contributing to the community's reconstruction through the dissemination of artifacts and records,
- accumulating records and artifacts collected by the children as an asset for the school to further develop educational materials,
- getting more community participation in the Program implementation, and
- examining the effectiveness of the program for dissemination to other areas in Japan and the world.

17

International Post-graduate Education Program for Disaster Medicine; Collaboration with Tohoku University Human Security Program

HFA Core Indicator 3.2:
School curricula, education material and relevant training include disaster risk reduction and recovery concepts and practices.

Keywords:
human security, education for disaster medicine, international post-graduate program

Context:
Human security is a concept of security and focuses on an individual's safety rather than state security. Its goal is "freedom from fear" and "freedom from want". The 2011 Great East Japan Earthquake and Tsunami (hereinafter GEJET) posed a "crisis of human security". Tohoku University promoted collaboration between the International Post-Graduate Program in Human Security and the International Research Institute of Disaster Science.

Before:
Human security is a concept of security. It focuses on individuals, not states, which used to be the main concern of the traditional notion of security.

The United Nations Development Programme (UNDP) had already pointed out that a disaster would be a significant threat to human security in its report published in 1994, and the importance of climate change in the study of human security has increased. However, disaster medicine is not a mainstream part of human security.

Tohoku University established the International Post-Graduate Program in Human Security in 2005. Four graduate schools, the Graduate School of Agricultural Science, the Graduate School of Medicine, the Graduate School of International Cultural Studies and the Graduate School of Environmental Studies participate in this interdisciplinary program. Before the GEJET, less attention has been paid to disaster medicine in human security.

After:
The earthquake and tsunami on March 11, 2011, killed many people and destroyed cities and villages. Evacuation centers were resource-limited and thought to be at high risk for outbreaks of infectious diseases. Furthermore, the accident at the Fukushima Daiichi Nuclear Power Plant created much anxiety concerning radiation leaks, for which the health effects remain unclear. The impact of the disaster was far beyond anyone's anticipation, and the security of people in affected areas was greatly impaired.

To address these issues, Tohoku University Human Security Program started a collaboration between disaster medicine and human security. The Division of Disaster Medicine, International Research Institute of Disaster Science (IRIDeS) and Human Security Program opened a joint lecture on "Disaster Preparedness for Public Health" as one of the subjects for the Human Security Program.

The Graduate School of Medicine, Tohoku University has developed department-level exchange agreements to operate a linkage program, a double degree course, with the University of Brawijaya and Graduate School of Agricultural Sciences, and Padjadjaran University. These two department-level exchange agreements will be developed at the university level. In addition, IRIDeS is now preparing another two department-level agreements with the School of Medicine, University of the Philippines and Public Health School of Angeles University Foundation.

Good practices:
The Human Security Program at Tohoku University provides resources for international students to learn lessons from the GEJET. Tohoku University has developed an exchange agreement at multiple levels with universities in various Asian Pacific countries.

Problems:
Although the Human Security Program at Tohoku University is open to both international and domestic students, a majority of applicants are from outside Japan. The students have few opportunities to experience directly the lessons learned from GEJET unless they are able to travel outside the university.

18

Recent Advances in Numerical Simulation for Disaster Prevention in the View of the 2011 Great East Japan Earthquake

HFA Core Indicator 3.3:
Research methods and tools for multi-risk assessments and cost-benefit analysis are developed and strengthened.

Keywords:
numerical simulations, mathematical modeling, visualization, disaster prevention, mitigation

Context:

The Great East Japan Earthquake Disaster has increased awareness of the importance of numerical simulations to much more than before and, at the same time, highlighted the immaturity of this field in various aspects. This article reviews previous and current methodologies and techniques for numerical simulations and describes the challenges faced based on the lessons learned from the 3.11 Disaster.

Before:

Individual modeling methodologies and simulation techniques seemed to be mature, both qualitatively and quantitatively, since a variety of general-purpose simulation software packages were sufficiently reliable for specific single-phase phenomena. In particular, structural analysis methods are effectively utilized for earthquake-resistant design in practical computations, and tsunami simulation programs provide good accuracies for predicting run-up regions. The main lesson learned from the Great Hanshin Earthquake Disaster was the necessity of developing robust numerical simulation schemes that enable us to predict the failure of structures with specific load bearing capacities and reproduce post-failure behavior involving large deformations. In addition, advances in computer hardware have helped to increase the size of numerical simulations that can be performed for risk prediction of disasters, as well as lifetime prediction of infrastructures in urban areas.

After:

The Great East Japan Earthquake Disaster featured complexity and wide-ranging damage. In view of numerical simulations for advanced risk mitigation, the tsunami-structure and/or tsunami-soil interactions must be noted aspects of complex disasters in widespread areas. Also, the risks due to the diffusion of contaminants and the generation and expansion of fire are manifested as a result of the complexity. Unfortunately, however, highly developed but individual methodologies and techniques for corresponding single-phase phenomena are less useful in predicting such coupled physical and/or chemo-thermomechanical phenomena. Thus, to make numerical simulations more reliable, specific algorithms for large-scale computations of complex disasters need to be developed.

Good practices:

Researchers have started to combine individual methods and have tried to solve the real coupled problems involved in complex disasters with sufficient quantitative accuracy. In particular, young engineers and scientists, being aware of the implication of developments, have established study groups to exchange ideas with different disciplines. Sophistication of the visual representation of analysis results is also recognized as important for decision-making by government officials.

Problems:

Actual complex disasters involving interactions between structures, fluids, and soils/rocks are too complicated for all the phenomena to be reproduced with sufficient quantitative accuracy. Not only technical difficulties, but also uncertainties make such predictions intractable. In fact, although numerous attempts have been made, most of them do not have a high enough level of performance for practical use in terms of reliability and versatility. Also, methods of parallel computation for huge-scale complex problems in widespread areas are still under development. To orient the research area of computational disaster science, we must create a new framework of numerical simulations for solving coupled problems in complex disasters.

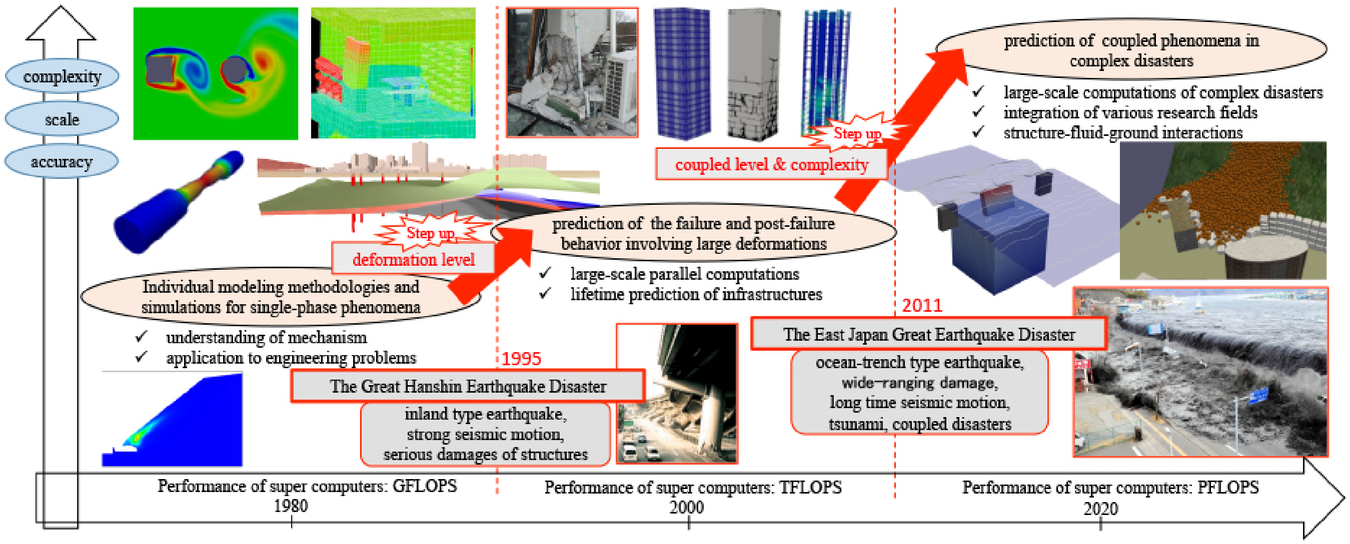

Fig. 3.6 Changing capabilities and challenges for numerical simulations

19

Post-tsunami Recovery Strategies in Sanriku Coastal Areas after the 1933 Tsunami

HFA Core Indicator 4.1:
Disaster risk reduction is an integral objective of environment-related policies and plans, including for land use, natural resource management and adaptation to climate change.

Keywords:
land use regulation, relocation to higher land, 1896 Sanriku Tsunami, 1933 Sanriku Tsunami, transition of housing location, urban recovery strategy

Context:

Land use mitigation is one of the most reliable strategies for avoiding future tsunami disaster. The Sanriku Coastal Area, one of the most tsunami-prone areas in Japan, located in the north part of the main island, was seriously damaged by catastrophic tsunamis in 1896, 1933, and 1960 before the 2011 Great East Japan Earthquake and Tsunami. The Japanese government prepared resettlement space on higher ground for the victims after the 1933 Great Sanriku Tsunami.

Before:

Fig. 4.1 illustrates the transition of housing location after the 1933 Tsunami in Hongo District, Iwate Prefecture[1]. Because of the relocation strategy, there is almost no building as of 1948, except in the higher elevations provided by the government. However, many buildings had been constructed in the vulnerable lowlands in the twentieth century.

After:

The 2011 Tsunami struck the district, washing away hundreds of buildings in the lowlands again (Fig. 4.2). In contrast, the houses on the higher resettlement area provided by the government after the 1933 Tsunami survived the destructive 2011 Tsunami.

Good practices:

The fact that the resettlement on higher ground provided by post-tsunami recovery planning and policy after the 1933 Tsunami was not damaged by the 2011 Tsunami demonstrates the importance of land use mitigation for tsunami disaster reduction. This successful experience in the tsunami-prone coastal area should be referenced in the future.

Problems:

Although the government developed the safer resettlement area for residents after the 1933 Tsunami, many people began living in the vulnerable lower lands or returned to the original tsunami-prone sites until 2011. Previous research[1] describes how several districts in Sanriku Coastal Area suffered from this hazardous situation because of the populace's lack of tsunami risk recognition, convenience, or inherited lands. The recovery planning and policy for the land use regulation was efficient in reducing tsunami risk in one sense, but it was not a mandatory strategy that required people to live only in the safe area.

Fig. 4.2 Building Damage in Hongo after the 2011 Tsunami (left) and Pre-tsunami (right)[2]

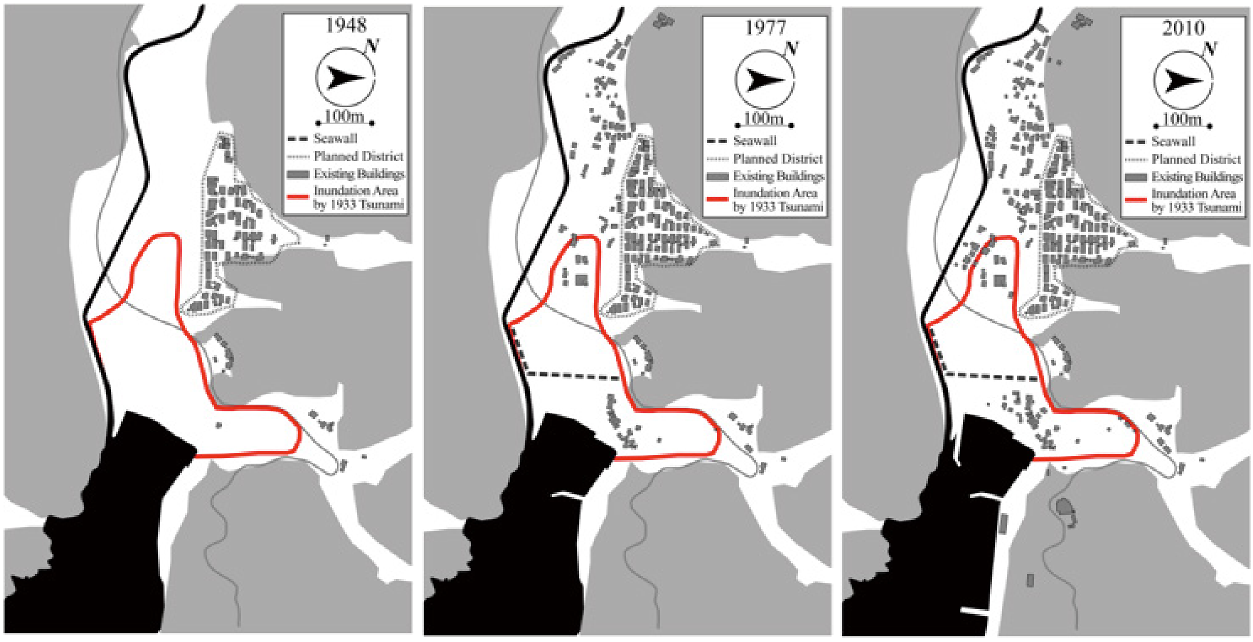

Fig. 4.1 Change of Housing Location in Hongo, Touni Village (1948–2010)[1]

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[1] Murao, O., and Isoyama, S. (2012). Transition of Housing Location in Villages in Iwate Prefecture after the Sanriku Tsunamis in 1896 and 1933, *Joint Conference Proceedings of 9th International Conference on Urban Earthquake Engineering (9CUEE) and 4th Asia Conference on Earthquake Engineering (4ACEE)* (CD-ROM), 1877-1882, Tokyo, Japan.

[2] Geospatial Information Authority of Japan. Retrieved from http://saigai.gsi.go.jp/h23taiheiyo-ok/photo/photo_dj/index.html.

20

Integrated Perspective of Civil Engineering, Architecture and Urban Planning

HFA Core Indicator 4.1:
Disaster risk reduction is an integral objective of environment-related policies and plans, including for land use, natural resource management and adaptation to climate change.

Keywords:
reconstruction plan, Oshika Peninsula, land use, residents' intentions, coastal levee

Context:

The 2011 tsunami damaged vast coastal areas of Japan, including many fishing villages, which are regarded as a significant part of a cultural tradition in Japan, a maritime nation. The fishing industry has supported the revival of small fishing villages step-by-step, although some of these villages are faced with the threat of desolation. On the other hand, large villages, which also have functions other than being a place of residence and/or a part of the fishing industry; i.e., the commercial industry, tourism, fishery processing and ship building are facing another difficulty, such as losing their centrality.

Before:

Ayukawa is a largest fishing village of Oshika Peninsula, in Ishinomaki, Miyagi Prefecture. Up until the 1970, the village prospered with the whaling industry. Today, however, tourism is an important industry for the village besides fishing. The 7.7-m tsunami heavily devastated the village's industries, commercial and tourism facilities, and houses at low elevations. The earthquake also caused land subsistence of up to 1.2 m in this area.

After:

According to the reconstruction plan for Ayukawa made by a contracted civil engineering consultant, new, higher residential areas for the relocation will be segmented into four areas with 30 to 40 households each. An opinion survey shows that 70% of the victims want to move to the western area, which is separate from the existing eastern residential area. This indicates that they did not find the reconstruction of the village center appealing. This breaking up of the community and separation between old and new residential areas casts a shadow over the future of the village. The isolation of the new residential area from the existing village functions, including the commercial and tourism industries, as well as the current residential areas, will decrease the sustainability of the town. Moreover, the TP[3] + 6.0 m high coastal levee separates the harbor area from the residential area (Fig. 4.3).

Good practices:

Tohoku University IRIDeS[4] and Y-GSA Kojima studio formulated an alternative (Fig. 4.4) by integrating civil engineering, architecture and urban planning.

-Attractive new town center: The new town center is located on the artillery battery-shaped hill, which smoothly combines the raised road and the coastal levee. The cross section is accented with old streets leading to the hillside temple, where residents can worship their ancestors.

-Compact land use: The new residential area adjoins the existing residential area in the eastern part of town.

-Multifunctional interface of levee: The gradually widening stairs and grass slopes are designed to provide access to the wharf (TP + 1.5 m) from the commercial area.

-Bringing relevant parties[5] into agreement and building consensus with local residents.

The local government executed another opinion survey after sharing the information of this alternative with the citizens. The results showed that 45% of residents want to move to the west, much lower then the 70% reported previously, and 55% want to move to the east.

Problems:

The prefectural government, the main authority overseeing the coastal levee development, was unable to decide on a clear direction, and as a result, the project was delayed. It also led to insufficient communication with residents, which biased the results of surveys about their new homes.

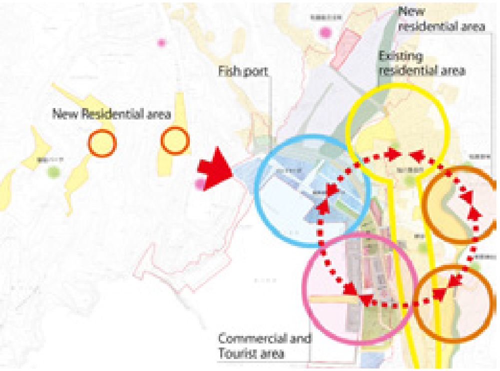

Fig. 4.3 Proposed master plan for Ayukawa

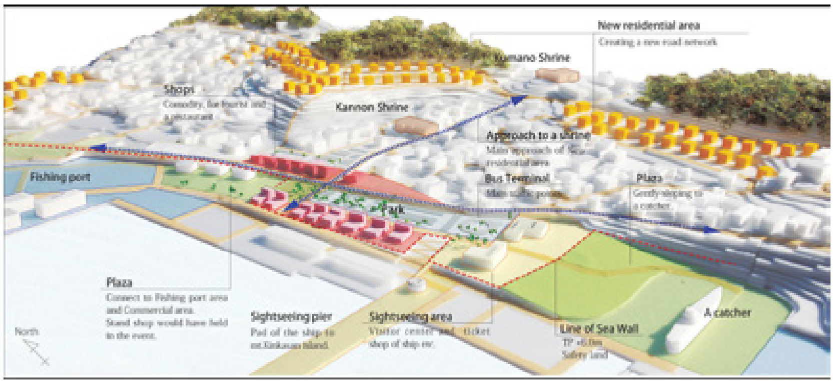

Fig. 4.4 Proposed plan for the east side of Ayukawa[6]

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[3] TP : Tokyo Peil. The height of coastal levee is indicated by T.P.

[4] IRIDeS: International Research Institute of Disaster Science, Project officer : Onoda, Y.(Architecture), Hirano, K.(Civil Engineering), et al.

[5] Local government means Ishinomaki City and Miyagi Prefecture. We coordinated some reconstruction project; river embankment, coastal levee, road, housing project.

[6] Model made by Kazuhiro Kojima studio of Yokohama Graduate School of Architecture

21

Measures for People Requiring Assistance during a Disaster

HFA Core Indicator 4.2:
Social development policies and plans are being implemented to reduce the vulnerability of populations most at risk.

Keywords:
elderly people, Guidelines for Evacuation Support of People Requiring Assistance During a Disaster, evacuation, emergency network

Context:
It is vital for the elderly and disabled to be supported and assisted by neighbors in immediately evacuating from disastrous situations. The government and neighboring communities must strive to establish a framework for managing the various aspects of this issue.

Before:
To support such community activities, the Cabinet Office released the *Guidelines for Evacuation Support of People Requiring Assistance During a Disaster* in 2005 and *the Preparation of Measures for Supporting Persons Requiring Assistance During a Disaster*, which contains case studies from recent disasters, in 2007. They were also supposed to support municipal governments in producing overall plans. The 2005 *Guidelines* document consists of the following five activities.

1. **Improving the information communications system**
    - Announcement of evacuation preparation information
    - Establishment of a support unit for people requiring assistance
    - Secure communications through various means such as the Internet and emergency call message service
2. **Sharing of information concerning people requiring assistance during a disaster**
    - Collection and sharing of information on people requiring assistance in various ways
    - Promotion of exceptional use of social-welfare-related personal information to prepare evacuation support systems
3. **Creating a tangible evacuation support plan for people requiring assistance during a disaster**
    - Creation of an evacuation support plan for each individual requiring assistance
    - Recognition of the importance of making communities resilient to disasters
4. **Assistance at evacuation centers**
    - Establishment of an information desk for people requiring assistance at evacuation centers
    - Establishment of welfare evacuation centers
5. **Collaboration among related organizations**
    - Continuity of welfare services in disaster situations
    - Wide-area support of health nurses
    - Establishment of a committee on evacuation support for people requiring assistance at the municipal level

After:
Fig. 4.5 indicates the number of casualties, by age, due to the 2011Great East Japan Earthquake and Tsunami and the 1995 Great Kobe Earthquake. Both exhibit a similar tendency of the death toll by age in that the ratio of the older populace is higher than that of the younger. However, the ratio in the 2011 event is remarkably higher than that in the 1995 Earthquake. The deaths from the 1995 Earthquake were caused largely by building collapse, so a dwelling's structural type and age were significant. In contrast, the 2011 deaths were caused largely by the tsunami, so evacuation methods from the vulnerable area to safer places were critical. Thus, residents' age or health condition was an important factor affecting their fate. Following the guidelines, many districts had striven for strong community assistance for such people, but not all community plans worked well because of the size of affected areas and geographical conditions.

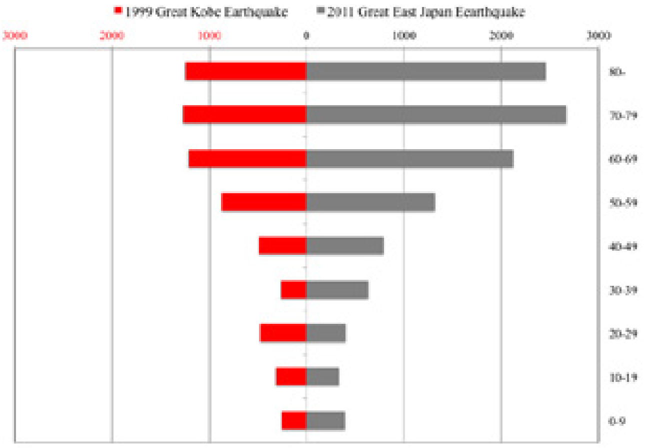

Fig. 4.5 Casualties, by Age, due to the 2011Great East Japan Earthquake and Tsunami and the 1995 Great Kobe Earthquake[7]

Good practices:
There were many elderly people needing assistance in shelters after the tsunami. Homehelpers in Japan dispatched supporters for them, and because of keeping accurate records of the elders' information, that plan worked well[4].

Problems:
The Cabinet Office[8] noted problems in each response phase clarified by the event, as follows:
Before: lack of supporting systems, including acceptance of people and organizations, lack of dissemination of the procedures, shortage of helpers, shortage of previous drills.
Emergency response: no list of the elderly, not knowing how to use the lists, no guidelines, no information on evacuation for the elderly.
At the shelters after the emergency response: difficulty in continuing to live with other people, lack of shelters, limitation of response systems to the elderly, unsatisfactory health care, lack of information and materials, insufficient support by local governments because of damage, difficulties faced by infants and expectant mothers.

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[7] The Cabinet Office (2011). Retrieved from http://www.bousai.go.jp/kaigirep/hakusho/h23/bousai2011/html/honbun/2b_sanko_siryo_06.htm.
[8] The Cabinet Office (2012). Retrieved from http://www.bousai.go.jp/taisaku/hisaisyagyousei/youengosya/h24_kentoukai.

22 Enhancement of Business Continuity Plans and Business Continuity Management

HFA Core Indicator 4.3:
Economic and productive sectoral policies and plans have been implemented to reduce the vulnerability of economic activities.

Keywords:
business continuity plans, business continuity management, resiliency

Context:

A business continuity plan (BCP), is defined as “a plan describing the policy, systems, procedures, etc. by which enterprises can avoid suspension of their critical business or resume business quickly if their business is interrupted, even when unexpected situations arise, including natural disasters such as major earthquakes, communicable disease pandemics, terrorist acts, serious accidents, disruption of supply chains and abrupt changes in the business environment[9].” The importance of an organization having a BCP had been particularly discussed in Japan since the terrorist attacks in New York on September 11, 2011. The main concept of a BCP is shown in Fig. 4.6.

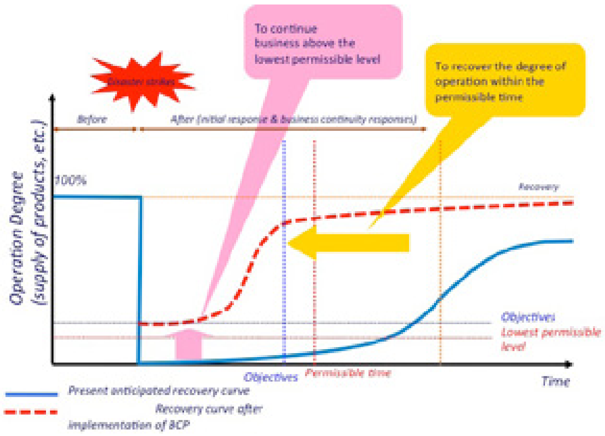


Fig. 4.6 Concept of a BCP[10]

Before:

The Cabinet Office released the first version of the “Business Continuity Guidelines” in 2005. The guidelines strongly recommended that organizations develop their BCPs, and the diffusion rate of BCPs has been steadily increasing. The guidelines were updated in 2009 to include responses to pandemic influenza and so on. The Cabinet Office continuously conducted “Surveys on Companies’ Status on Business Continuity” in 2007, 2009 and 2011. In 2009, before the Great East Japan Earthquake (hereinafter GEJE), 27.6% of large-scale companies and 12.6% of mid-sized companies had completed their BCPs (Fig. 4.6).

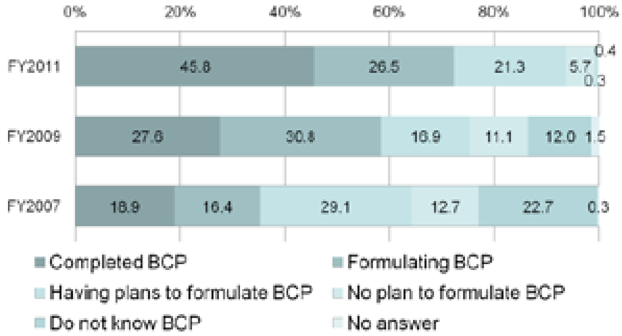
After:

The GEJE severely influenced companies located in the damaged areas, but also affected companies throughout Japan. The above-mentioned survey by the Cabinet Office in November 2011 revealed the status of 5,409 companies throughout Japan, and is summarized as follows:

(1) The ratio of companies whose important business was disrupted by the GEJE was 34.5% (43.8% as for large-scale company).

(2) Reasons for disruption (multiple answers permitted) were: electric power supply: 54.8%, traffic systems and roads: 37.8%, telephone and internet: 29.9%, employees: 28.0%, machinery, facilities: 26.6%, suppliers: 25.6%, water: 25.4%

As of November 2011, eight months after the GEJE, 45.8% of large-scale companies had completed their BCPs (Fig. 4.6); a 19.8 percent-point increase from 2009. The rate for mid-sized companies was 20.8%; an 8.2 percent-point increase.



Note:“FY” means “Fiscal Year”
No. of answers : 1,134 (FY2007), 736(FY2009), 1108(FY2011)
Source: Survey by Cabinet Office, Japan FY2007-2011

Fig. 4.7 Diffusion of BCPs (Large-scale Companies)[9]

Good practices:

Oil Plant Natori Co. Ltd., a waste oil treatment company in Miyagi Prefecture, released its BCP in January 2011. Instead of self-refining, they partly outsourced the process to a different company in another prefecture, assuming the damage on refining plants by tsunami. It reopened after a one-week interruption following the disaster by outsourcing. A similar case was Suzuki Kogyo Co. Ltd. in Miyagi Prefecture, which operates waste treatment business. By outsourcing to another company in an adjacent prefecture, they recovered their main business within a week after the GEJE and started accepting tsunami debris. Their rapid recovery was very supportive to the damaged area because they devoted themselves to cleaning up the debris and waste around the damaged coastal area.

Problems:

First, only a small number of companies in the area affected by the GEJE had BCPs. Second, not all BCPs functioned well after the event because the BCPs were not prepared for severe incidents that require “alternative strategies”, including a substitute business site. Finally, BCPs did not efficiently function because they had not accounted for supply chain continuity (See Topic 23).

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[9] Cabinet Office “Business Continuity Guidelines 3rd version”, 2014
[10] Source: same as note 9

23 Disruption of Supply and Supply Chain Management

HFA Core Indicator 4.3:
Economic and productive sectoral policies and plans have been implemented to reduce the vulnerability of economic activities.

Keywords:
disruption of supply, supply chain management, business continuity management

Context:

In the production process in Japan, external dependency and outsourcing have grown as part of efforts toward rationalization and efficiency. Much of the production of parts and raw materials is outsourced, and the supply of essential utilities such as electricity, gas, water, and telecommunications depends on external providers. As a result of this dependency, even if a company sustained limited damage, the company would unavoidably have to halt its own activities almost simultaneously with their suppliers who suffered serious damage. Moreover, since these suppliers are increasingly dependent on other companies' activities, the supply chain becomes longer and more complex.

Damage:

After the Great East Japan Earthquake (hereinafter GEJE), disruptions of this long, complex supply chain had considerable influence on the production capabilities of many companies that suffered no direct damage from the GEJE. About one month after the GEJE, from April 8 to 15, the Ministry of Economy, Trade, and Industry (METI) conducted its "Emergency survey on the actual status of industries after the GEJE", which was directed at 80 major companies (55 in manufacturing and 25 in retail/service). Of the manufacturing businesses located in the damaged areas, 64% had already restored their production bases; 26% estimated that they would be restored by the middle of July; and 3% estimated that restoration would require from six months to less than one year.

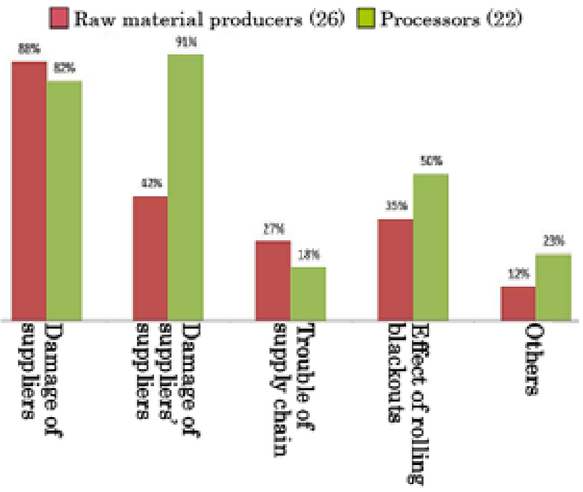

Fig. 4.8 Reasons for Difficulty in Obtaining Raw Materials and Parts/Components (one month after the earthquake)

Regarding the reasons for difficulty in obtaining raw materials and parts/components (multiple answers), 88% of companies in the raw materials-producing industries cited "damage to the suppliers we procure from" and 42% cited "damage to the suppliers supplying the companies we procure from," while 82% and 91%, respectively, of the companies of the processing industries cited these reasons. These responses indicate that the processing industries were strongly impacted by events two levels up the supply chain.

METI also conducted a second survey from June 14 to July 1, surveying 123 major enterprises (65 in manufacturing and 58 in retail/service). This represents a period around three and a half months after the GEJE. According to this survey, out of 91 production bases of manufacturing companies that were directly damaged by the earthquake, tsunami or both, 93% had already been restored by this time. Regarding production levels, 80% had regained or surpassed pre-earthquake levels. Of the remaining 20% who replied that their production levels were still lower than before the earthquake, some 70% said they expected to return to pre-earthquake production levels before the end of 2011. The second survey found that, compared to the April survey, the proportion of materials industries responding that there were no alternate suppliers fell from 12% to zero, while these figures fell from 48% to 18% for processing industries[11]. The processing industries, which have a longer supply chain above them, were indeed more strongly affected by indirect damage from the earthquake, but their recovery progressed during the intervening three months.

After:

Many enterprises were not struck directly but faced a disruption in the supply of essential parts or components. Their response fell under three general approaches: (A) assisting in the recovery of their damaged suppliers; (B) acquiring alternate sources of procurement for unobtainable parts and components; and (C) redrawing specifications so that the unobtainable parts and components need not be used. From these, the companies would choose one or several options that would solve their problems the quickest.

In June 2011, METI's Industrial Competitiveness Subcommittee of the Industrial Structure Council released a report[12] that put forth the following five directions as measures for strengthening its position:

1) Use of multiple production bases for critical parts and materials, decentralization of these production bases and alternate production on other production lines.
2) Restructuring and forming joint businesses to decentralize the production bases on a nationwide level.
3) Alternate supply with multiple suppliers.
4) Organize and commonalize specifications and parts; integrate upstream and downstream industries.
5) Reorganize BCPs to address the entire supply chain, including clients.

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[11] Multiple answers were permitted if a company used multiple materials or parts/components.

[12] "Problems and Responses Regarding Japan's Industrial Competitiveness after the GEJE – Moving beyond a Crisis of Unprecedented Hollowing Out"

24 *Promotion of the Earthquake-proof Retrofit of Buildings after the 1995 Great Kobe Earthquake*

HFA Core Indicator 4.4:
Planning and management of human settlements incorporate disaster risk reduction elements, including enforcement of building codes.

Keywords:
1995 Great Kobe Earthquake, building damage, earthquake-proof retrofit, seismic reinforcement

Context:

More than 100,000 buildings were severely damaged and roughly 150,000 were moderately damaged by the Hyogoken-Nanbu (Kobe) Earthquake on January 17, 1995. Most human casualties were caused by building collapse, and the building damage conditions depended on structural type and construction period (Fig. 4.9)[13]. Specifically, buildings constructed after the 1971 and 1981 amendments of the 1950 Building Standard Law were less damaged.
Consequently, that event indicated the importance of strengthening buildings to reduce future building collapse risk.

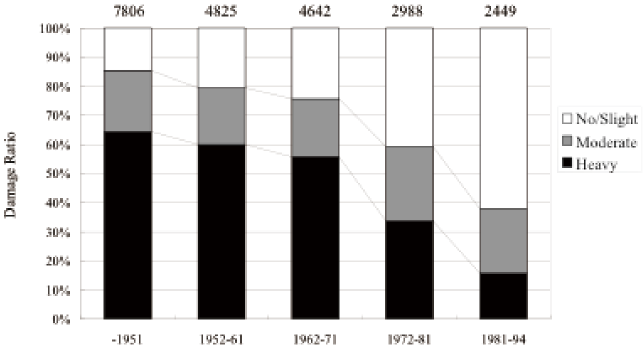


Fig. 4.9 Damage Ratio of Wood-frame Buildings by the 1995 Kobe Earthquake Classified by the Construction Period[13]

Before:

The Act on Promotion of Earthquake-proof Retrofit of Buildings was passed in 1995 after the Kobe Earthquake. It was amended in 2006 after the 2004 Niigata-ken Chuetsu Earthquake. The act serves to increase the ratio of earthquake-resistant buildings from 75% in 2005 to 90% by 2015. Fig. 4.10 shows the change in the number of earthquake-resistant buildings in a 2010 report released by Ministry of Land, Infrastructure, Transport, and Tourism[14]. Each local government had supported to strengthen buildings in the jurisdiction.

After:

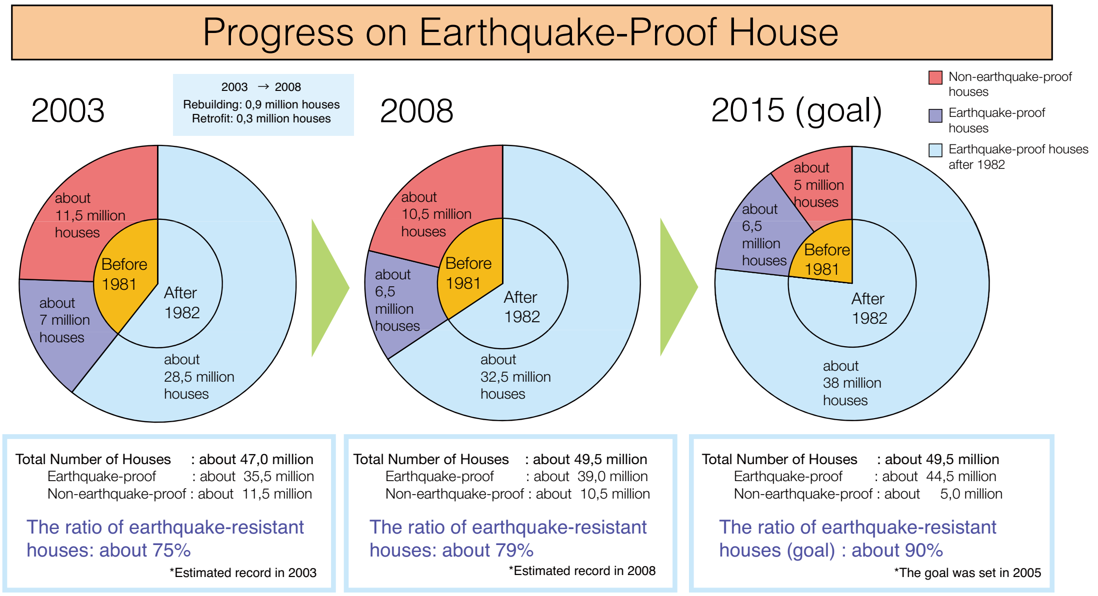
The 2011 Great East Japan Earthquake's building damage was not as great as that by the Tsunami or by the 1995 Great Kobe Earthquake because of the relationship between the structural natural period and seismic characteristics. However, slightly damaged buildings, including destruction of non-structural elements, were widely distributed.
Having strong misgivings about building damage due to the estimated destructive earthquake occurring in the Nankai Trough, the government amended the act again in 2013. The amended act requires the evaluation of seismic capacity of lrge-scale public facilities and publication of that information, among other actions.

Good practices:

Learning from previous disasters, the government passed and repeatedly amended the act. This cycle is vital for future disaster management. Setting a quantitative goal for the proportion of earthquake-resistant buildings in near future would also be effective.

Problems:

Some residents are not willing to strengthen vulnerable houses because of (1) uncertainty of the cost, (2) doubt about the building strength after the retrofit, and (3) the idea that it is inefficient to spend much money for reinforcing old buildings.



Total Number of Houses : about 47,0 million
Earthquake-proof : about 35,5 million
Non-earthquake-proof : about 11,5 million
The ratio of earthquake-resistant houses: about 75%
*Estimated record in 2003

Total Number of Houses : about 49,5 million
Earthquake-proof : about 39,0 million
Non-earthquake-proof : about 10,5 million
The ratio of earthquake-resistant houses: about 79%
*Estimated record in 2008

Total Number of Houses : about 49,5 million
Earthquake-proof : about 44,5 million
Non-earthquake-proof : about 5,0 million
The ratio of earthquake-resistant houses (goal) : about 90%
*The goal was set in 2005

Fig. 4.10 Change in the Number of Earthquake-resistant Buildings (2003-2015)[10]

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[13] Yamazaki, F., and Murao, O. (2000). "Vulnerability Functions for Japanese Buildings Based on Damage Data due to the 1995 Kobe Earthquake," *Implications of Recent Earthquakes on Seismic Risk,* Series of Innovation in Structures and Construction, Vol. 2, pp. 91-102, Imperial College Press.

[14] Ministry of Land, Infrastructure, Transport, and Tourism (2010). Retrieved on [date] from http://www.mlit.go.jp/common/000188412.pdf.

25 Public Housing for the Mitigation on the Negative Impact of Environmental Transition on the Victims

HFA Core Indicator 4.4:
Planning and management of human settlements incorporate disaster risk reduction elements, including enforcement of building codes.

Keywords:
public housing for victims, actual housing needs, quality of living condition, community

Context:
Municipalities affected by the 2011 tsunami are responsible for providing land and public housing for the victims based on the national reconstruction policy (Fig. 4.11). A vast number of projects must be implemented in a short period of time with a limited budget; thus, there is little room to consider quality. Referring to previous disaster experiences, including the Great Hanshin Earthquake, the environmental transition of the victims is a critical phase of the reconstruction. Victims face an unstable situation after moving from temporary housing to new settlements; therefore, they require appropriate support. In the case of the Great Hanshin Earthquake, numerous solitary deaths were reported after victims moved to public housing.

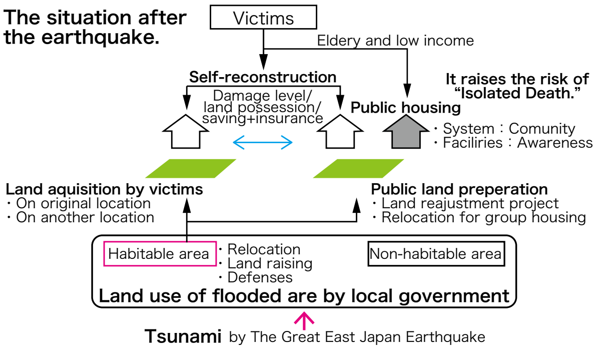

Fig. 4.11 Accommodation situation after the 2011 tsunami[15]

Before:
The area affected by the 2011 tsunami had problems associated with an aging and decreasing population even before the disaster. On the other hand, these communities have sufficient social resources to support older people.

After:
The damage not only exacerbates these difficulties but also changes the community itself. Spending more than 3 years in temporary housing is sufficient time for a community to deteriorate. On the other hand, victims are able to receive social support while living in temporary housing; however, this support will be cut off after they move to permanent housing.

Good practices:
The amount of public housing was estimated based on an opinion survey of the victims; however, the results of these surveys are sometimes unreliable. For instance, the number of people who wish to live in public housing was found to be exaggerated. Thus, both the amount and quality of public housing should be controlled carefully. In the case of Shichigahama Town, which had good collaboration with advisers[16], the municipality established a good strategy for the planning, as follows:
1) Adequate information sharing with the victims in the early phase to reduce the number of public housing units that they need to build (Fig. 4.12); 2) establishing good relationships between the existing community and relocated victims; 3) community-oriented planning of the public housing to encourage communication between residents (Fig. 4.13); 4) a participatory process of planning and organizing the residents' association; and 5) conducting a rational management process supported by the prefecture.

Problems:
The construction boom in the area affected by the 2011 tsunami is leading to skyrocketing construction costs. These escalating costs make elaborate designs, for which construction costs are difficult to estimate, a high risk for constructors.

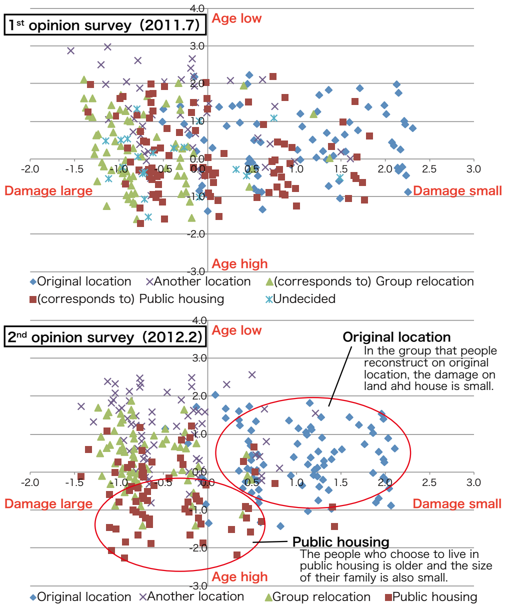

Fig. 4.12 Change in victims' demand for accomodation[15]

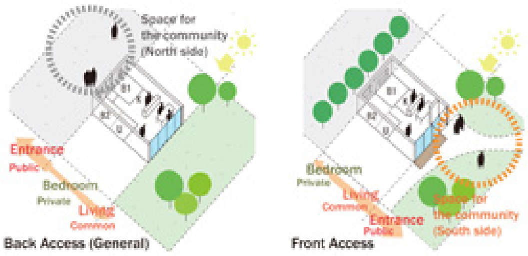

Fig. 4.13 Diagram of community-oriented housing[17]

Fig. 4.14 Image of new public housing building[18]

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[15] Tsukuda. H, Onoda, Y., The situation of housing reconstruction from the disaster, Conference of UN. Habitat and IRIDeS,March 14th 2014, Sendai, Japan.
[16] Onoda,Y.(Architecture and Urban Planning, Tohoku Univ.), Miyagi, T.(Natural Disaster Science, Tohoku Gakuni Univ.) Miyagi, S.(Landscape, Nara Women's Univ.)
[17] Onoda, Y., Kanno, M.,(2005), New Alternatives for Public Housing in Japan, EDRA, 36, The Environmental Design Research Association, Vancouver, pp.61-67
[18] Atlier Hitoshi Abe (2014).

26

Post-tsunami Recovery for Risk Reduction after the 2011 Great East Japan Earthquake and Tsunami

HFA Core Indicator 4.5:
Disaster risk reduction measures are integrated with post-disaster recovery and rehabilitation processes.

Keywords:
urban recovery strategy, land use regulation, relocation, concentration, avoiding, slowing, steering, blocking, compacted terraces and berms, reinforcement

Context:

Post-disaster recovery is a significant process for rebuilding a society with new, improved disaster reduction systems for the future. The Tohoku Region coastal areas had previously experienced several huge tsunamis and took measures to mitigate tsunamis' damage through the twentieth century. However the March 11, 2011, Tsunami struck them again and washed away the residential areas. Every district examined and designed its recovery plan according to its circumstances, and they are exploring strategies to build their new towns in the context of certain problems.

Before:

As described in **Topic 19**, the government developed inland resettlements for the 1933 Sanriku Tsunami victims, but houses again increased in the lower elevations by the ocean, only to be washed away. The death toll including missing people was 21,000 as of March 26, 2013.

After:

The number of damaged municipalities by the Tsunami was 62, and 43 municipalities had released their post-tsunami recovery plans for future tsunami damage mitigation as of May 2012. According to a survey for 208 damaged districts conducted by the Ministry of Land, Infrastructure, Transport, and Tourism[19], the post-tsunami recovery plans can be classified into five types and comprise four mitigation systems: (1) relocation as a land use mitigation system; (2) levee to block tsunamis; (3) compacted terraces and berms to avoid, slow, or steer tsunamis; and (4) tsunami mitigation design for facilities. The five classifications are as follows (Fig 4.15):

A. Relocation (127)
B. Concentration (6)
C. Compacted terraces and berms (19)
D. Relocation and compacted terraces and berms (18)
E. Reconstruction on the original site with facility reinforcement (38)

Good practices:

Every damaged district in Japan devised its recovery plan that reduces future tsunami risk based on previous experience. Public involvement has been recognized as an especially significant factor in devising recovery plans since the 1995 Great Kobe Earthquake.

Problems:

Now that the damaged municipalities have announced their recovery plans, each local government must implement it. However, they encounter several challenges in implementing actual projects, depending upon the regional situation, such as the following examples:

- Disagreements between governments and residents about the destruction of a beautiful piece of scenery by levee construction, or levees' adequate assurance of safety
- Shortage of available land for relocation
- Shortage of construction materials and workers for the extraordinarily large damaged area
- Construction costs

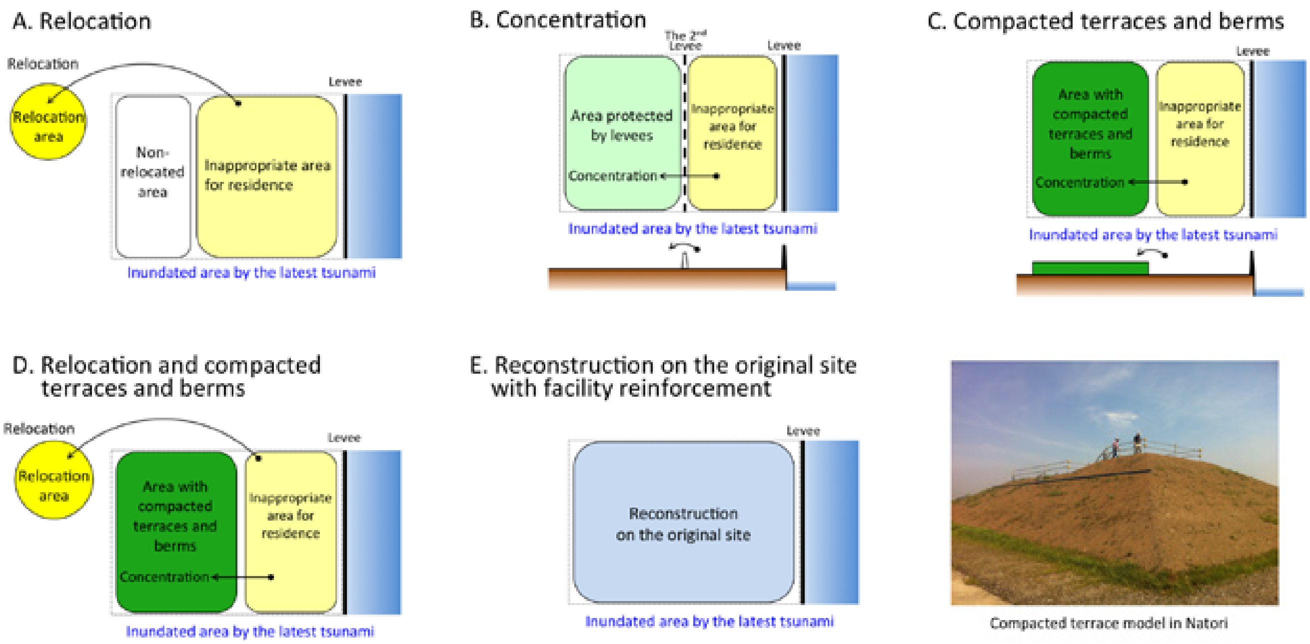

Fig. 4.15 Regional Urban Recovery Types Proposed after the 2011 Great East Japan Earthquake and Tsunami[3]

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[19] Ministry of Land, Infrastructure, Transport, and Tourism (2012). Retrieved from http://www.mlit.go.jp/common/000209868.pdf (revised for this material by the author).

27 *Destruction of Coastal Levees by the 2011 Tsunami and their Reconstruction*

HFA Core Indicator 4.6:
Procedures are in place to assess the disaster risk impacts of major development projects, especially infrastructure.

Keywords:
Level 1 and 2 tsunamis, return period, design tsunami, disaster mitigation, robust structures

Context:

The 2011 tsunami overtopped almost all the coastal defense facilities in Iwate and Miyagi prefectures, such as breakwaters, inlet gates and coastal levees, destroyed assets as well as facilities and resulted in an enormous loss of life. In June 2011, the Central Disaster Management Council (CDMC) established the following tsunami countermeasure policies: 1) to classify the tsunamis into two levels, namely Level 1 tsunamis that occur at a high frequency and have the potential to cause extensive damage, and Level 2 tsunamis that occur at a very low frequency but with a maximum magnitude, and that have the potential to cause catastrophic damage; 2) to protect human lives and assets from Level 1 tsunamis using defense facilities; and 3) to protect human lives from Level 2 tsunamis with the highest priority through effective evacuation and to adopt integrated mitigations using all possible methods. This is an important paradigm shift from disaster prevention to mitigation based on the lessons learned from the 2011 tsunami.

Following the policies of the CDMC, in July 2011, the Ministry of Land, Infrastructure, Transport, and Tourism (MLIT) established the following guidelines for reconstruction of the coastal levees: 1) the return period of a Level 1 tsunami is to be in the range of several tens of years to one hundred and several tens of years. This corresponds to the guidelines of another prevailing flood disaster. The return period is 10 to 50 years depending on the importance of the hinterland of the rivers, and 200 years for the Tone River, which has potential to inundate Tokyo. A tsunami with a specified return period is defined as the design tsunami. The height of the design tsunami is to be adjusted with the management and available utilities of rivers, harbors and fishing ports. It should be noted that the there is a rather wide range of selectivity for the return period in the guideline. 2) The height of the coastal levee is to be determined from the higher elevation of the design tsunami and design storm surge. 3) The reconstructed levees are to be robust even for the overtopping of Level 2 tsunamis, because more frequent disasters including Level 1 tsunamis and storm surges have to be blocked by the surviving levees, and because mitigation by the surviving levees for the next Level 2 tsunami attack is expected. This expectation means that the reconstructed levees are required to maintain their robustness during the return period for Level 2 tsunamis, which is estimated to be 1000 years in the Sendai Bay area. This is discussed later in Problems.

Iwate, Miyagi and Fukushima prefectures immediately received the guidelines and started the procedure to determine the levee height. The prefectures determined the return period of the design tsunami to be approximately 150 years uniformly for all of the coasts, and included the 1896 Great Sanriku tsunami, which killed at least 20,000 people worst in this area. The determined return period is at the high end of the range in the guideline. Miyagi Prefecture divided the 258 km coast into 22 units and selected the design tsunami for each unit. The 1896 tsunami is selected for most units, while the 1960 Chilean tsunami is selected for the leeside of the Ojika peninsula and for the Matsushima bay. The Ishinomaki coast and the Southern Sendai bay coast also selected the 1896 tsunami which is, however, lower than the design storm surges because these two coasts are in the shaded area by the peninsula for the 1896 tsunami. The design storm surges determined he levee height of 7.2 m above the mean sea level. Miyagi Prefecture determined a levee height of all the units in September 2011, started to discuss with the related municipalities, and reached an agreement for all but a few units.

Following the prefectural plan on coastal levee reconstruction, municipalities in the Sendai bay area developed an urban plan that specifies a disaster danger zone behind the levee in which people are prohibited from residing and are moved to inland areas according to the large-scale movement plan for disaster prevention. Residential areas are specified as locations where the inundation depth for Level 2 tsunamis is less than 2 m. To expand the area, the inland road will be raised because the highway located about 4 km from the coast stopped further inundation of the 2011 tsunami. Municipalities along the Sanriku coast mostly selected higher areas instead of inland areas to move because plains at the bay head area are narrow and are the major route of the tsunami run-up. These urban plans follow up the CDMC policies on the mitigation for the Level 2 tsunamis.

Before:

The coasts heavily damaged by the 2011 tsunami are classified into three coasts: the Sanriku coast, the Sendai bay coast, and the Joban coast. The Sanriku coast is characterized by the train of submerged valleys that amplifies the tsunami height due to the effect of energy concentration and resonance. Furthermore, large tsunamis have repeatedly occurred off the Sanriku coast, including the 1896 and 1933 tsunamis. The Sendai bay coast is bounded by the Ojika peninsula from the Sanriku coast and characterized by fluvial plains, big rivers, sandy coasts and shallow water. Large cities, such as Sendai, Ishinomaki, Shiogama, etc. are located on the plains. Especially, Ishinomaki was developed as a harbor city along the Kitakami River, which concentrates the population near the waterfront of the river and sea with relatively low levees to avoid disrupting harbor activity. Ishinomaki is vulnerable to large tsunami attacks. The height of the 1896 and 1933 tsunamis along the Sendai bay coast was much lower than that along the Sanriku coast because the tsunami source areas off the Sanriku coast and the peninsula functioned as a natural breakwater. Therefore, people living along the Sendai bay coast were not accustomed to large tsunami attacks. Major hazards in this area over the last 150 years are therefore not tsunamis but storm surges. However, if we look well into the past, the Sendai bay plains experienced deep inland inundation due to the 869 and 1611 tsunamis.

After:

The 2011 tsunami source has not only large vertical displacement but also large horizontal extension from off the Sanriku coast to off the Chiba coast, and it produced a gigantic tsunami. The maximum tsunami trace height reaches up to 40 m above the mean sea level along the Sanriku coast and 15 m along the Sendai bay coast. The tsunami overtopped almost all coastal defense facilities, took numerous lives and destroyed assets as well as facilities. Destruction of the coastal levees proceeded in two steps: 1) the impact from the first wave broke weak structures, such as parapets, joints, thin slabs of concrete, moved strong rigid-frame structures, and/or eroded backside mounts via overtopped jets; 2) the return flow of a huge amount of inundated water concentrated at the break points from the first step, rivers, and ditches and resulted in large-scale scouring. Fig.4.16 and Fig.4.17 show aerial photographs of the Yamamoto coast before and after the tsunami. T-shaped jetties and steep slope levees with a parapet were installed along the coast because it had been suffering from serious coastal erosion. The first wave of the tsunami initially broke the parapets and thin slab. The return flow then concentrated at the break points and caused massive erosion behind breach points, an area referred to as the tsunami bay. The return flow also caused long erosion behind levees, which is referred to as a tsunami channel. To avoid this kind of large-scale scouring, appropriate control of the return flow is necessary.

Good practices:

1) The paradigm shift from disaster prevention to mitigation is necessary for catastrophic disasters. Not everything can be secured against huge hazards by the facilities. Prioritizing the security for human lives enables effective mitigation.
2) Robustness of the defense facilities for Level 2 tsunamis is necessary for important structures but not for every structure. For example, the Kamaishi tsunami breakwater was constructed at the bay mouth with a maximum depth of 63 m. The breakwater cost 12 billion USD and should last 30 years. It was designed based on Level 1 tsunamis, such as the 1896 tsunami, and was completed in 2009. Although the 2011 tsunami overtopped the break water and blew off some caissons at the shallow water and opening, the other was almost safe. The Port and Airport Research Institute (PARI) evaluated the mitigation by the breakwater and found that the inundation height was decreased by 30% and transmission of the tsunami was delayed 6 min. The breakwater was robust. The repair costs are estimated to be 49 billion USD.

Problems:

1) Setting of the return period of Level 1 tsunamis uniformly at the high end of the range, 150 years, which is close to that for Tokyo's defenses, may be excessive, especially for ageing communities. Other effective mitigations should also be considered.
2) Most of the funding for the reconstruction of the defense facilities and urban areas comes from the national treasury without considering the costs and benefits. It was an urgent political decision and necessary to start the recovery process as soon as possible. However, at this stage, effective use of the budget should be used effectively is necessary to avoid making unnecessary defenses.

Fig. 4.16 The Yamamoto coast before the tsunami, photographed by MLIT in March 2010

Fig. 4.17 The Yamamoto coast after the tsunami, photographed by Kyodo News, on March 19, 2011

28 *Comprehensive Post-tsunami Recovery after the 2011 Great East Japan Earthquake and Tsunami*

HFA Core Indicator 4.6:
Procedures are in place to assess the disaster risk impacts of major development projects, especially infrastructure.

Keywords:
post-tsunami recovery projects, tsunami simulation

Context:

To support local governments to arrange proper regional plans for tsunami disaster reduction, the Japanese government published the "*Tsunami Disaster Estimation Manual*" and "*Guideline to Strengthen Tsunami Disaster Management in Local Disaster Prevention Plans*" in 1997, followed by the "*Tsunami and Tidal Wave Hazard Map Making Manual* (2004)" and "*Guideline for Management of Tsunami Evacuation Buildings* (2005)."

Before:

Considering these guidelines, local governments in the damaged areas had developed their disaster management systems according to regional conditions. However, the 2011 Earthquake off the Pacific coast of Tōhoku was greater than expected, and some management systems failed to work well.

After:

Each municipality performed two types of tsunami simulations, depending on the occurrence risk to devise recovery plans for resettlement. The Japanese government[20] prepared several projects (Fig. 4.18) to support their plan development and implementation. Figure 4.19 and 4.20 show the examples.

Good practices:

Problems:

HFA Core Indicator 4.6 good practices and problems are those previously described for Topic 19.

Fig. 4.19 Seawall Under Construction in Natori City

Fig. 4.20 Town Development in Taro Town

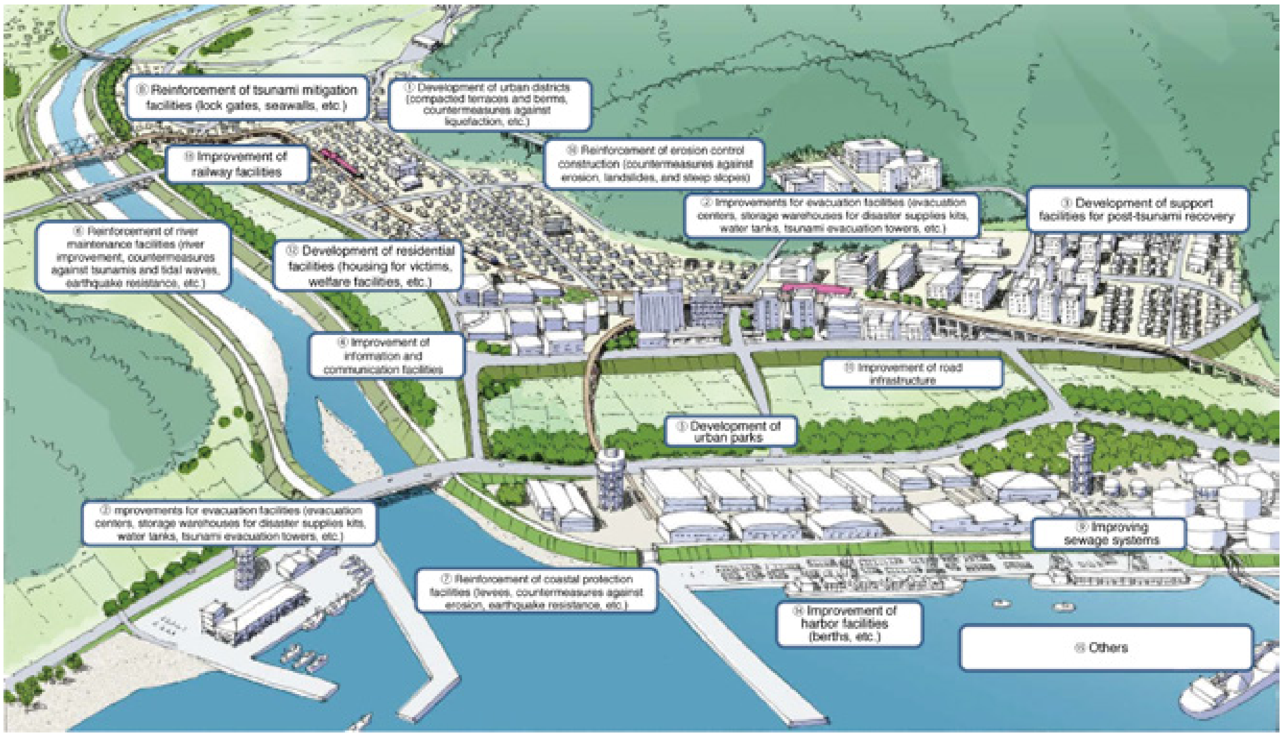

Fig. 4.18 Urban Recovery Projects at a Glance after the 2011 Great East Japan Earthquake and Tsunami[20]

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[20] Ministry of Land, Infrastructure, Transport, and Tourism (2013). Retrieved from http://www.mlit.go.jp/report/fukkou-index.html.

HFA Priority for Action 5: *Strengthen disaster preparedness for effective response at all levels.*

29 *Measures and Agenda for Large-scale Disasters in Japan: from the Perspective of Personal Information and Disaster Prevention Education*

HFA Core Indicator 5.1:
Strong policy, technical and institutional capacities and mechanisms for disaster risk management, with a disaster risk reduction perspective, are in place.

Keywords:
Disaster Countermeasures Basic Act, Personal Information Protection Law, local knowledge

Context:
Because of the several disasters such as typhoons, earthquakes, tsunamis, and heavy snowfall in Japan, the country has suffered a great loss of people's lives and assets and a massive economic loss. On the basis of these experiences and lessons learned, disaster-related acts, policies, and legal frameworks have been developed and enacted to prepare for and respond to disasters.

Before:
The 1961 Disaster Countermeasures Basic Act was enacted on the basis of the experiences of the 1959 Typhoon Isewan. Before that, the national and local government roles and responsibilities had not been stated clearly. The Act regulated the roles and authorities of each level of government for disaster risk reduction, response, and recovery to secure the victims' welfare and social order by protecting citizens' lives and assets from disasters. Municipalities have the responsibility of establishing a disaster response office; however, to respond to a massive disaster (causing damages beyond the capacity of prefectures and municipalities), the national government is required to establish a disaster response office to provide the necessary assistance.

After the 1995 Great Kobe Earthquake, major revisions to the Act included 1) easing the conditions of establishing the disaster response office and strengthening the disaster response office's authority; 2) mayors' issuing a request for the deployment of the Japan Self-Defense Force (JSDF) to the governor and reporting the disaster situation to the Director-General of the Defense Agency; 3) traffic control; and 4) training of the local voluntary organizations for disaster risk reduction, including measures for the elderly and persons with disabilities.

After:
The experiences from the 2011 Great East Japan Earthquake and Tsunami revealed that the existing act was insufficient for response to such an unexpected disaster. The April 2005 Personal Information Protection Law hampered the confirmation of people's safety, making it difficult to obtain the information and pre-determine whether people would require extra support lives. The leaders of community-based organizations and the chairpersons of neighborhood associations addressed such issues. As a result of such problems, the number of casualties of the elderly and persons with disabilities reached was double that of ordinary persons.

Another issue was the citizens' lack of awareness of tsunamis. The areas affected by the 2011 Tsunami included regions with no previous tsunami experience, and a number of citizens there had no proper knowledge and believed that a tsunami poses no danger. They held such beliefs from their knowledge of the 1961 Chile Earthquake and were convinced that their residential areas were safe as they had no such earlier incidents.

On the basis of the lessons learned from the 2011 Tsunami, the Act was again revised, and local governments gained the authority to develop a list of affected people, specifically through information gathered by municipalities, and the information on the elderly and persons with disabilities, in particular, can now be submitted to relevant offices, with the individuals' consent. In addition, the dissemination of the lessons learned and disaster education will strengthen the capacity for local disaster risk reduction.

Good practices:
Quick response is required after a disaster, whereas enactment of a law is, by its nature, a post-process. Therefore, now is the time to revise the fundamental act for disaster measures on the basis of the experiences of the 2011 Tōhoku Earthquake and Tsunami and the 1995 Hyogoken-Nanbu Earthquake.

In an attempt to determine the essential knowledge, for example, the education committee of Shizuoka Prefecture has established the Fundamental Education Policy of Disaster Presentation of Shizuoka Prefecture (2012 revision) to prepare for a Tokai Earthquake. The policy addresses several guidelines with two main purposes of education for disaster prevention. Beginning in preschool, the first purpose is to develop knowledge and understanding, interest, motivation and attitudes, thinking and judgment, and skills (social contribution, etc.). At each stage of maturation, the second purpose comprises developing the abilities of self-preservation (kindergarten to lower grades of elementary school), actively applying knowledge (mid-high grade of elementary school), contributing to local society's safety, understanding and responding to the situation (middle school), and rebuilding a safe society (college/university student, working people).

Problems:
Preventing municipal access to private information is the largest barrier constraining local networks. When the chairman of the municipality, who is a local community leader, is not concurrently a member of the public welfare committee, it is difficult to understand the issues of a community's vulnerable people such as senior citizens.

Furthermore, a dilemma exists in that the idea of being in a "safe place," handed down from olden times, continues in the community with no validity. This phenomenon is understandable for the short-term to mid-term stage of recent history; people might have difficulty understanding the reality of a once-in-a-thousand-years event. This mindset has become clear from the precedent that migrants to higher places have returned to the coast repeatedly in the Sannriku region.

30 National Preparedness of Disaster Medicine as Tertiary Risk Reduction

HFA Core Indicator 5.1:
Strong policy, technical and institutional capacities and mechanisms for disaster risk management, with a disaster risk reduction perspective, are in place.

Keywords:
disaster medicine, disaster base hospitals, command control, disaster medical-public health coordinator

Context:
The medical response after the Great Hanshin Awaji Earthquake was not sufficient to deal with the mass casualties and vast areas of damage that disrupted hospital functions. Preventable deaths were postulated since rapid search and rescue, on-site confined space medicine and wide-area transportation was not systematically available. Thus, the Japanese government established the medical response system including Disaster Base Hospital (DBH), Disaster Medical Assistance Team (DMAT), Staging Care Unit (SCU) and wide-area transportation, Emergency Medical Information System (EMIS) and disaster medical-public health coordinator.

Before:
There were 609 DBHs under the management of the Ministry of Health, Labour and Welfare in Japan before the GEJE. Most of the tertiary hospitals were assigned as DBHs that provide intensive care for patients with multiple injuries, crush syndrome and severe burns following a disaster. DBHs respond to incoming and outgoing wide-area patient transportation and provide DMATs. DBHs also provide medical resources to affected hospitals. The National Disaster Medical Center is assigned as the General Headquarters of the Japan DMATs. Fifty-five central DBHs and more than 200 DBHs were ready to dispatch a DMAT. A DMAT is specifically trained to deal with confined space medicine and wide-area transportation as well as to effectively assist the local headquarters. EMIS provides the physical and functional capacity information of hospitals nationwide. In 1996, Hyogo Prefecture assigned the medical coordinator that coordinates the various medical needs and resources, but only three prefectures followed suit.

After:
The system is strengthened by increasing the number of DBHs and DMATs. The building code of DBHs was revised to further strengthen seismic control and emergency lifelines. Hospital BCPs are also improving. Prioritization of EMIS to all hospitals and its daily use is now promoted. Specific training courses have rapidly increased the number of disaster medical-public health coordinators nationwide (Fig. 5.1).

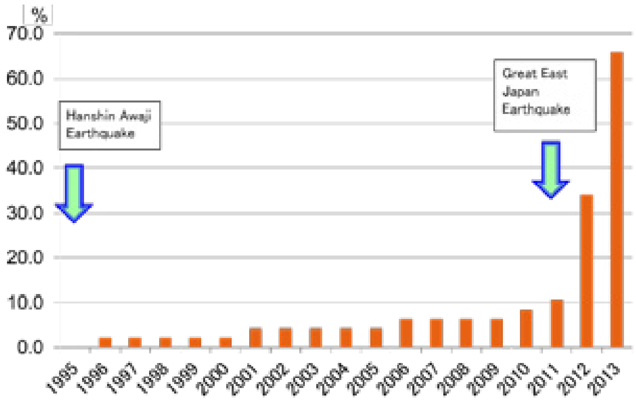


Fig. 5.1 Increase in the number of medical-public health

Good practices:
No DBH was destroyed by the 2011 tsunami. DBHs within the affected area responded to the surge in medical needs and acted as the hub of medical-public health aids. Distant DBHs accepted patients from the affected area to decrease the medical loads of the affected area. DBHs provided DMATs rapidly to the affected area under control of the general headquarters. From March 11 to 22, 383 DMATs, a total of 1,800 members, were dispatched to provide medical assistance. SCU and wide-area transportation were performed for the first time since their establishment and saved more than 90 patients who needed hemodialysis. SCU worked as a pool of doctors to help nearby hospitals. EMIS handled the basic hospital information to assist medical coordination at the DMAT general headquarters.

Problems:
- Several hospitals built on the coast were destroyed and many patients and staff members were lost along with their function as a safety net.
- Hospitals had to accept the evacuees as a shelter despite their damage and the surge in medical needs.
- Lifelines of the hospitals were damaged, which impaired their function.
- Hospital workers also lost family members and property because of the disaster, but had to deal with the surge in medical needs.
- Impairment of communication tools made coordinating activities difficult.
- DBHs within the affected area were paralyzed by the excess requests from local hospitals and outside medical assistant teams that lacked trained coordinators.
- Health care at evacuation centers was not well prepared because the recovery of local health care providers was delayed.
- DBHs that were supposed to deal with the nuclear disaster were not fully functional.
- SCU at the airport was not well equipped with supporting devices and vehicles.
- EMIS coverage was limited and failed to dispatch adequate medical relief.
- There were not enough trained medical coordinators at the time of the disaster.

31 Enhancement of Plans for Operational Continuity of Government

HFA Core Indicator 5.2:
Disaster preparedness plans and contingency plans are in place at all administrative levels, and regular training drills and rehearsals are held to test and develop disaster response programmes.

Keywords:
business continuity plans of governments, operational continuity

Context:

To avoid suspension of critical operation, plans for continuity of important operation or business continuity plans (BCPs) in the public sector are necessary for public organizations as well as private enterprises, even for unexpected situations, including natural disasters such as major earthquakes, communicable disease pandemics, terrorist acts or serious accidents. (For private company BCPs, see Topic 22 of Indicator 4.3)

"The Disaster Countermeasure Basic Act" prescribes that ministries (including local branches) and local governments should keep disaster management plans in accordance with "the Disaster Management Basic Plan" issued by the Central Disaster Management Council (supported by the Cabinet Office). However, if these organizations suffer serious damage to their critical resources for important operations, such as personnel, government buildings, ICT systems, electric power supply, telecommunications, water and so on, they need governmental organization BCPs.

Before:

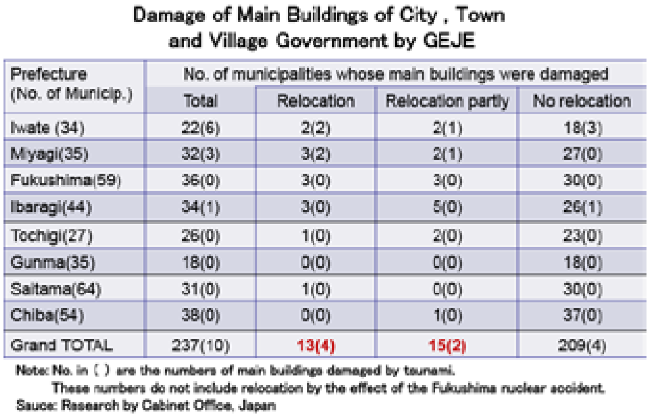
The Cabinet Office released the first version of the "Business Continuity Guidelines" in 2005[1]. The guidelines were designed as applicable to both public organizations and companies. Then, in June 2007, "Business Continuity Guidelines for Ministries" was published, considering the probability of a Tokyo Inland Earthquake. Based on the guidelines, all ministries and agencies of the central government were requested to formulate their BCPs, and had finished them before the Great East Japan Earthquake (hereinafter GEJE) occurred.

For local governments, "Manual and Guidance on Business Continuity of Local Governments at the Time of Earthquake" was published in April 2010 by the Cabinet Office. However, formulating a BCP does not prevail easily, and less than half of prefectural governments had formulated their BCPs at the time of the GEJE. As for municipalities, only a limited number of the city governments had BCPs at that time.

Damage:

The GEJE damaged the main buildings of many local governments. Table 5.1 shows the damage. A total of 273 municipalities suffered damage. Among them, 13 municipalities had to relocate their main building and other 15 municipalities had to relocate a portion of it. Additionally, the main building of the Fukushima prefectural government was not usable for a while because of its poor antiseismic properties.

Table. 5.1 Damage from the GEJE to main buildings of local governments



Damage of Main Buildings of City , Town and Village Government by GEJE

Prefecture (No. of Municip.)	No. of municipalities whose main buildings were damaged			
	Total	Relocation	Relocation partly	No relocation
Iwate (34)	22(6)	2(2)	2(1)	18(3)
Miyagi(35)	32(3)	3(2)	2(1)	27(0)
Fukushima(59)	36(0)	3(0)	3(0)	30(0)
Ibaragi(44)	34(1)	3(0)	5(0)	26(1)
Tochigi(27)	26(0)	1(0)	2(0)	23(0)
Gunma(35)	18(0)	0(0)	0(0)	18(0)
Saitama(64)	31(0)	1(0)	0(0)	30(0)
Chiba(54)	38(0)	0(0)	1(0)	37(0)
Grand TOTAL	237(10)	13(4)	15(2)	209(4)

Note: No. in ( ) are the numbers of main buildings damaged by tsunami.
These numbers do not include relocation by the effect of the Fukushima nuclear accident.
Sauce: Research by Cabinet Office, Japan

Damage to critical resources for important operation of local governments was not limited to the facilities. The mayor of Otsuchi Town in Iwate Prefecture was killed by the tsunami, and many other high-ranking officials were killed in many municipalities within the damaged area. The serious damage to facilities and loss of personnel delayed the rescue action, refugee support and recovery of the facilities and towns. The need for plans of operational continuity (i.e. BCPs) of local governments has been clearly realized, considering the high probability that Japan will be struck by major natural disasters in the future.

After:

The Cabinet Office conducted a review of all BCPs of ministries in 2012 that were prepared for a possible Tokyo Inland Earthquake, and serious weak points were found by BCP specialists in charge of the review. "BCP of the Central Government" was issued by the Central Disaster Management Council in March 2014. This plan was formulated to respond to the demand by the new acts for special countermeasures for a Tokyo Inland Earthquake (November 2013) and for National Resilience (December 2013).

The number of prefectures formulating BCPs increased after the GEJE. Approximately 60% of prefectures have formulated BCPs[2] for earthquakes and other major disasters and incidents. The Cabinet Office plans to revise both the business continuity guideline for ministries and the manual/guidance for local government BCPs in fiscal year 2014.

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[1] The newest version is "Business Continuity Guidelines, third version", published in August 2013, available at http://www.bousai.go.jp/kyoiku/kigyou/pdf/guideline03.pdf

[2] Source: News of Jiji.com, Feb.28, 2014, http://www.jiji.com/jc/zc?k=201402/2014022800541

32

Three Coastal Districts in Iwaki City, Fukushima Prefecture: Differences Resulting from the Local Residents Organization Disaster Response Activities

HFA Core Indicator 5.2:
Disaster preparedness plans and contingency plans are in place at all administrative levels, and regular training drills and rehearsals are held to test and develop disaster response programmes.

Keywords:
neighborhood association, regional activities, disaster prevention

Context:

Overview of three coastal districts in Iwaki City:
Iwaki City, Fukushima Prefecture, is located approximately 50 km south of the Fukushima Daiichi nuclear power plant. There are about 33 million people in less than 500 districts. Coastal areas in this city were also damaged by the tsunami caused by the 2011 Earthquake, resulting in the deaths of fewer than 300 people. The population of the coastal areas discussed here is roughly 5,000: over 2,000 in districts A and C, and less than 1,000 in B. Fig. 5.2 and Table 5.2, respectively, present each district's location and population.

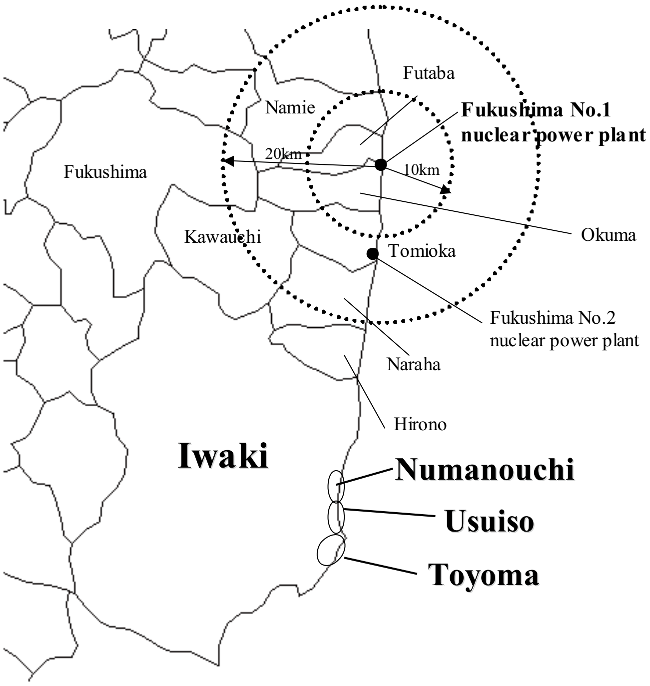

Fig. 5.2 Map of Iwaki City Area

Table 5.2 Overview of each district

		poplation	households	damage
Iwaki City		343,008	133,270	･death 310, missing 37 ･completely destroyed 7,640 houses
District	A	2,200	660	･death 85 ･completely destroyed 420
	B	760	260	･death 130 ･completely destroyed 230
	C	1,600	700	･completely destroyed 47

Table 5.3 reports disaster-related activity evaluations before and after the earthquake. The next section explains the details of this evaluation.

Table 5.3 Activity Evaluation before and after the Earthquake

District	Before		After		Future
	Activities	Preparation of disaster	call for evacuation	management or search	
A	○	○	○	○	○
B	△	△	△	△	△
C	○	◎	○	◎	○

Before:

(1) Pre-disaster activities of each district

A : ○ There was an activity at each district level (Gyosei-ku), block associations (Chonai-kai), and neighborhood associations (Tonari-gumi). This district has many festivals and activities organized by each block association.

B : △ Activities in the latter were mainly in the district and neighborhood associations. The only event was the Children's Day Festival, which is held once a year in May.

C : ○ The district is divided into small towns (Buraku), composed of neighborhood associations and a district with many festivals.

(2) Preparation for disaster in each district

The "Iwaki Regional Disaster Prevention Plan" (Iwaki Conference on Disaster Reduction, revised 2010) had been enacted before the earthquake. However, efforts to ensure its effectiveness were left to the districts because this is only a "guideline." Disaster preparedness in each district is as follows.

A : ○ Although planning occurred in the district, block associations had insufficient time to effectively support it.

B : △ This district was the only well-known refuge for residents.

C : ◎ District officers have created primarily a hazard map that was well known to residents.

After:

(1)Communication of each area of the disaster immediately afterward: call for tsunami evacuation

A : ○ The mayor personally performed the call for evacuation. Residents escaped to the shelter while helping each other.

B : △ There was no particular communication plan as a district; it had only a refuge by neighborhood association unit.

C : ○ The mayor personally performed the call for evacuation and opened the shelter (community center). Then the officers gathered without a specific call to them because there was a tacit understanding that everyone should "Go to the community center, if there is a disaster."

(2)Communication of each area of the disaster afterward: shelter management or missing person search.

A : ○ Under the mayor's direction, district officers kept in touch with other districts and the system engineer

(SE) volunteered to help make a missing persons list.

B：△ It was difficult for the district to support communications immediately.

C：◎ After performing their roles (foods, communication, health, collecting information, etc.), officers of districts took action to manage shelters and seek missing persons.

(3) Future response plans: activities for disaster prevention and mitigation, from the efforts of the emergency drill on August 31, 2013.

Iwaki City has presented for each district the “2013 Comprehensive Disaster Training in Iwaki City.” The document provides an outline that includes an overview of training, time schedule, and publicity materials in each district. The districts had to revise it according to the actual situation for shelters and response methods.

A：○ The emergency drill was supported at the block association level. The mayor conducted it, with three district conductors and the heads of the neighborhood associations. Under each conductor, the association head called for evacuation and guided residents to shelter. After the head confirmed the number of people displaced in the primary evacuation site, he reported it to each conductor.

B：△ The district asked two neighborhood associations to collaborate via a circular notice. The others were difficult to implement for the disaster drill.

C：○ The district conducted the drill at the neighborhood association level. Thirty association heads had residents evacuate to the primary place of refuge, and reported the number of evacuated people to the district officers. After moving evacuees to the secondary shelter according to the officers’ instructions, officers reported the results to the mayor.

Good practices:

Daily regional activities enhance disaster prevention awareness and lead to involvement in creating the hazard map, which enables better post-disaster support by organizations. Furthermore, autonomous organizations formed by local residents (A, C) can utilize various functions to prevent disasters.

Problems:

Even if there is partial solidarity, such as a blood–territorial relationship, if the community is not active and the self-government organization function is weak, the community’s disaster response capabilities before and after the earthquake are also weak (B).

33 *Pre-Disaster Activities to Preserve Historical Materials and the Great East Japan Earthquake*

HFA Core Indicator 5.2:
Disaster preparedness plans and contingency plans are in place at all administrative levels, and regular training drills and rehearsals are held to test and develop disaster response programmes.

Keywords:

preservation of local historical materials, pre-disaster networking, 2003 Miyagi Earthquake, 2011 Great East Japan Earthquake, cooperative activities to preserve and pass on historical and cultural heritage

Context:

Historical documents, old tools and implements, and antique art objects are to be found in an overwhelming quantity and variety in local society throughout Japan. These documents are unparalleled throughout the world for their quality and quantity as a record of human activities in the early modern era.

The majority of these historical materials are held as the private property of either old families or local communities. With the increasing social fluidity of living patterns, local historical materials are being lost to posterity,[3] and large-scale natural disasters further accelerate this loss of irreplaceable historical materials. In this mass disposal of wreckage and debris after disasters, historical materials abandoned inside condemned buildings are disposed as well. With the destruction of these materials, the history of the region that they contain is also forever lost to posterity.

After Hanshin-Awaji Earthquake of 1995, people have become conscious of the need to preserve endangered historical materials, and many salvage operations have been conducted to preserve historical materials.

Miyagi Prefecture was hit by an epicentral earthquake on 26th July 2003. This led to the formation of the ‘Miyagi Rekishi Shiryō Hozon Net’ (Miyagi Shiryō Net ‘MSN’) to provide an organizational structure to coordinate preparation work for saving historical materials in future disasters.

Fig. 5.3 Old official documents of Ōkago Village, (early 19th century), found in a private warehouse (Ichinoseki City, Iwate Prefefcture, Aug.8,2009)

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[3] OKUMURA Hiroshi Dai-shinsai to Rekishi Shiryō Hozon (Yoshikawa Kōbunkan, 2011)

Before:

When MSN was founded in 2003, we knew that another large earthquake was certain to occur in the near future.[4] In preparation for this impending disaster, the MSN began to locate and digitally record materials in private hands throughout Miyagi Prefecture, in what we call 'historical preservation activities.'[5] Prior to March 2011, MSN had succeeded in conducting 415 such preservation operations.

After:

Many original historical materials were lost in the tsunami and earthquake of March 2011. However, there were several cases where MSN had recorded the lost originals with digital cameras beforehand. Moreover, the activities of MSN before the disaster had provided MSN with an interpersonal network linking together collection owners, interested local citizens, and local government officials. This existing network enabled MSN to quickly and efficiently react. As of December 2013, MSN has conducted salvage operations for 78 collections of endangered historical materials.

Fig. 5.4 Salvage Operations of Honma Family Historical Materials (Ishinomaki city, Miyagi Prefecture, Apr.6,2011)

Good Practices:

In order to protect local historical materials from disasters, it is important to start preservation activities prior to the actual event.

It is essential to locating and digitally record materials. This process also creates interpersonal networks which function as sources of information on endangered materials when regular communications are sundered. Involving ordinary citizens in these activities provides a source of skilled and informed manpower to supplement the limited resources of specialists.

Fig. 5.5 Emergency first aid treatment for damaged materials (Sendai City, Miyagi Prefecture. July 11, 2013)

Problems:

Three years have passed since the events of 2011, but there is still no end in sight in the process of salvaging and preserving endangered and damaged historical materials. However, it is becoming increasingly difficult to obtain funding and manpower for continuing operations.

Another problem we face is how to find a suitable keeping place for materials we have salvaged and preserved. There is a dearth of public storage facilities, and there are cases where we cannot return collections to their original owners.

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[4] Miyagi Ken Oki Jishin no Chōki Hyōka' 27th Nov. 2000 http://www.jishin.go.jp/main/chousa/00nov4_2/miyagi.htm

[5] HIRAKA Arata (2005) 'Shinsai"Go" no Shiryō Hozen kara Saigai "Mae" no Bōsai Taisaku he' "Rekishi Hyōron" 666

34 DMAT as the First and Long-lasting Responder

HFA Core Indicator 5.2:
Disaster preparedness plans and contingency plans are in place at all administrative levels, and regular training drills and rehearsals are held to test and develop disaster response programmes.

Keywords:
DMAT, disaster base hospitals, training drills, coordinator program

Context:

September 1, the day in 1923 when the Great Kanto Earthquake devastated the Tokyo metropolitan area and killed 105,000 people, is designated as Disaster Drill Day. Based on experiences from the Great Hanshin Awaji Earthquake, a system of medical responder teams, called Disaster Medical Assistance Teams (DMATs), was established in 2005 throughout the nation to provide rapid on-site confined space medicine, “Load-and-Go” and wide-area transportation. The founding elements to support the activities of DMATs, i.e. Disaster Base Hospital (DBH), Disaster Medical Assistance Team (DMAT), Staging Care Unit (SCU) and wide-area transportation, Emergency Medical Information System (EMIS) and disaster medical-public health coordinator were established as described in Core Indicator 5.1.

Before:

Under the management of the Ministry of Health, Labour and Welfare, there are more than 1,000 DMATs, with a total of 6,000 members throughout Japan. The National Disaster Medical Center is assigned as the Headquarters (HQ) of the Japan DMATs. There are six fundamental HQ functions that make the DMAT activities possible: a) Planning and direction, b) Recording, c) Coordination, d) Intelligence and analysis, e) Tactics and command control, and f) Management of resources. A DMAT comprises one or two medical doctor(s), one or two nurse(s), one pharmacist and one logistician (4–5 people in total), and can access the affected site within 48 h with self-standing equipment, drugs, food and a vehicle. The concept of DMAT activities are defined as Command & Control, Safety, Communication, Assessment, Triage, Treatment and Transport (CSCATTT). It was strongly recognized that profound knowledge about disasters and preparedness is necessary to be a DMAT. There are also traditional medical relief teams (MRTs) of the Japan Medical Association, Public Hospitals, Japan Red Cross and others. These teams are designated to give medical care to the people in shelters, public health aid until the recovery of local health care providers.

Table 5.4 Difference between Japanese DMATs and other MRTs

1. Preordered and legislative preparedness and agreement with prefectures.
2. Only educated and trained individuals are registered so that the common languages make the coordinated action possible.
3. Collective and collaborative action is possible by the coordination of HQ
4. Abilities to coordinate with related organizations especially with police and fire department
5. Self-control of their own safety.

The DMAT Standard Textbook was first published in Feb. 2011 as a product of its 10-year training program. DMAT members are hospital workers with daily duties, but they will be dispatched and must take continuing education courses. DMAT leaders are certified after taking an advanced course and can assist the local HQ as coordinators. Every September 1, DMAT HQ organizes a simulation drill.

After:

DMATs are increasing to 1,300 as of April 2014. DMAT guidelines were modified to deal with the emerging problems associated with large-scale disasters. The concept of a prepared response is propagated to other MRTs including pediatric, psychiatric, primary care and other disaster-related medical-public health responders. The number of prefectures assigning medical-public health coordinators is increasing.

Good practices:

A total of 383 DMATs, 1,800 members, were rapidly dispatched to the affected area from March 11 to 18. DMATs provided medical aids, assisted the local HQ with medical-public health coordinators, in addition to management of SCU and wide-area transportation of severely ill patients. DMATs utilized EMIS and the Medical Air Transport Tracking System (MATTS) as much as possible for efficient coordination. SCU became the source of substitute medical workers to reduce the load in the affected hospitals. DMATs conducted hospital evacuation of 507 patients from the restricted area near the nuclear power plant without any mortality.

Problems:

- Responses were required for not only injuries and acute conditions, but also chronic illnesses and public health consequences.
- The time gaps until the arrival of other MRTs or recovery of local health care providers were unexpectedly long, although the medical needs of those affected were increasing.
- Some DMATs did not have the necessary tools to overcome the damage and congestion of the telecommunication systems.
- EMIS was not fully utilized by multiple sectors including the government, fire departments and Self Defense Forces.
- The number of DMAT leaders, medical-public health coordinators and supporting staff was insufficient to maintain effective HQ function.
- Logistics to support DMATs were insufficient especially for food, drugs, medical resources and fuel.
- The lack of prepared facilities for SCU and wide-area transportation, and the lack of wide-area transportation plans delayed the first flight.
- The lack of general understanding of the function of DMATs by the health professions in the affected area made help requests and use of materials and human resources inefficient.

35 Legal and Financial Frameworks for Recovery and Reconstruction

HFA Core Indicator 5.3:
Financial reserves and contingency mechanisms are in place to support effective response and recovery when required.

Keywords:
disaster recovery and reconstruction acts, Reconstruction Agency

Context:

As a disaster-prone country, Japan has a long history of recovery and reconstruction of major cities including the capital city Tokyo. Reconstruction has been necessary with recurrent disasters, including earthquakes, conflagrations, wars as well as other types of natural and manmade disasters. However, the Japanese modern disaster management system based on the Disaster Management Countermeasures Basic Act (enacted in 1961) has no fixed system or framework for reconstruction, regardless of the many provisions for recovery.

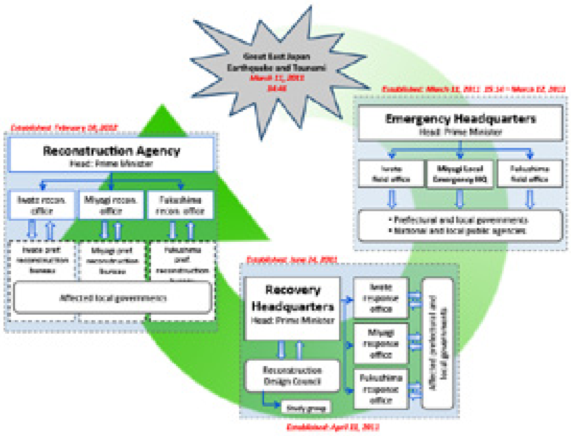
Before:

The Headquarters for Reconstruction of the Hanshin/Awaji Area, mandated for orchestrating recovery efforts, was set up about one month after the Great Hanshin-Awaji Earthquake (January 1995) occurred, and was based on a new "Act for the Basic Principle and Organization for Reconstruction after the Great Hansin/Awaji Earthquake", which is not regulated in the existing Disaster Countermeasure Basic Act.

After:

Organizations for Reconstruction

About three and a half months after the Great East Japan Earthquake (hereinafter GEJE), the Recovery Headquarters was set up based on the new act "the Basic Act of Reconstruction after the GEJE." This was a similar situation to the post-Great Hanshin/Awaji Earthquake. Under this headquarters, the Reconstruction Design Council was organized to discuss the basic concept of reconstruction (See Figure 5.6).



Source: Modified from Iuchi, K., Johnson, A., and Olshansky, R (2013) [6]
Fig. 5.6 Evolution of Japan's Recovery Governance Structure

The devastation of the Tohoku region further led to the creation of a new reconstruction agency for the third time in Japanese history, following the 1923 Great Kanto Earthquake and World War II. The Reconstruction Agency officially debuted on February 10, 2012, and is a 10-year operation reporting directly to the Cabinet. Created under "the Act Establishing the Reconstruction Agency", this agency is primarily responsible for coordinating various ministries' budgetary and reconstruction procedures so that reconstruction efforts in all localities can proceed in a timely manner.

New System for Reconstruction after the GEJE[7]

The Special Area for Reconstruction: In these areas, advanced medical and welfare services, deregulation of emergent temporary buildings, special taxation arrangements for capital investment, interest subsidies for loans, etc. has been executed.

The Reconstruction Support Grant System: From March 2012 to March 2013, 1,937 billion yen (national funds: 1,570 billion yen) were issued for seven prefectures and 94 cities, towns and villages. Use of this grant was highly flexible compared to previous grants.

The Liquidation-type Revival Fund: Introduced to nine prefectures, the total amount of 196 billion yen is for filling the gap between existing support systems and establishing flexible arrangements for victims. It was increased by 104.7 billion yen for inhabitants of the tsunami disaster area.

New Legal Framework

In June 2013, the Diet passed "the Act Concerning Reconstruction after Major Disasters", and coincided with the amendment of the Disaster Countermeasures Basic Act. The aim of this new act is to prepare the governmental framework for quick reconstruction after major disasters. The main contents are:[8]

-Set up of the Headquarters for Reconstruction: The Prime Minister can set up a headquarters in the Cabinet Office at the time of a major disaster. No new act is necessary for setting this up.
- Formulate the Reconstruction Basic Principle
- Draw up the Reconstruction Plan: Prefectural governments can draw up the Prefecture Reconstruction Principle. The plans will include restructuring of land use for smooth and quick reconstruction and so on.
- Special Arrangement for the Reconstruction Plans: 1) change of the Land Use Plan in a one-stop manner, 2) relaxation of the authorization for reconstruction projects, 3) city planning for of reconstruction will be applied.
- The central government's execution of disaster recovery project instead of local governments: Such as fishery ports, roads, coastal protection facilities and rivers for which the local government are responsible in ordinary times.
- Special finance arrangement: When a major disaster occurs, the government will execute special finance arrangements quickly by enacting other new acts, if it is recognized as being specifically necessary.

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[6] Source: Iuchi, K., Johnson, L. A., & Olshansky, R. B. (2013). Securing Tohoku's future: Planning for rebuilding in the first year following the Tohoku-oki earthquake and tsunami. Earthquake Spectra,

[7] Source: Cabinet Office "White Paper on Disaster Management, Fiscal Year 2013"

[8] Source: Materials explaining the Act Concerning Reconstruction after Major Disasters, the Cabinet Office.

36 Preparedness for Low-frequency and High-impact Disasters from a Medical Perspective

HFA Core Indicator 5.3:
Financial reserves and contingency mechanisms are in place to support effective response and recovery when required.

Keywords:
disaster response preparedness, medical assistance, public health, clinical data

Context:
After the 1995 Great Kobe Earthquake, Japan enhanced its disaster management mechanism, especially in the medical-assistance field. However, the 2011 Great East Japan Earthquake and Tsunami raised the issue of the need for further enhancement in both short- and long-term medical services provision in a disaster situation, including public health issues.

Before:
Japan's disaster response and management have been regulated by the 1961 Disaster Countermeasures Basic Act, which was enacted after Typhoon Isewan in 1959. The Act specifies that municipalities and/or prefectures are responsible for developing a regional disaster risk reduction plan, along with the Basic Disaster Prevention Plan, and for responding to disasters. However, the Act was developed without the expectation of a largescale disaster such as the 2011 Tsunami, with damages and impacts beyond the management capacity of prefectures and municipalities. Based on the experiences of the 1995 Great Kobe Earthquake, the disaster base hospitals and Disaster Medical Assistance Teams (DMATs) were established to minimize casualties under disaster conditions, and a wide-area medical transportation system and Emergency Medical Information System (EMIS) were developed to share clinical and logistics information between the related hospitals and the government. At the time of the Chuetsu-Oki Earthquake in 2007, whose damage occurred within a limited area, the disaster medical response was successfully implemented immediately after the event and provided effective assistance by transporting the seriously injured to a disaster base hospital. In addition, since 2008, EMIS has been established in most prefectures and municipalities, 603 disaster base hospitals have been constructed, 1,000 DMATs have been formed and 6,000 DMAT members have been trained.

During:
More than 15,000 people were killed by the 2011 tsunami, and more than 2,600 people are still consider missing. The cause of more than 90% of the deaths was drowning, which was completely different from the case of the Hanshin-Awaji Earthquake, wherein the major cause was crushing by building collapse. A large number of patients suffered from aggravation of chronic diseases because of the short supply of medicines and a lack of clinical information. Ishinomaki City was severely affected by the Tsunami. In the City, several hospitals located along the coast areas were forced to evacuate. Only the Ishinomaki Red Cross Hospital, which had just moved inland prior to the 2011 Tsunami, could remain functioning and played a central role in disaster medicine at the frontline as a disaster base hospital.
In most affected areas, wide-area medical transportation was required for dialysis and other treatments. One characteristic of such a massive disaster is creating a much wider variety of medical needs, not only at hospitals but also at evacuation centers and homes.

After:

- Based on the 2011 tsunami, the existing law was modified to enable prefectures to provide the necessary support to municipalities for their own initiatives.
- DMATs were empowered to provide short-term, middle-term, and long-term medical assistance.
- The Disaster Countermeasure Basic Act was modified and specified that municipalities must create a list of people requiring special and additional assistance during emergencies.
- Creation of a manual for public health in emergency situations has been discussed and coordinated in a series of meetings organized by relevant organizations, agencies, and groups to unify the medical information in disaster situations.
- Efforts to enhance public health, medicine, and social welfare in emergency situations have been undertaken at different levels, including the establishment of specialized medical teams to respond to radiation disasters; developing psychosocial care teams, such as the psychological first aid promoted by WHO; and initiating a lecture series for disaster medical coordinators to train them to respond effectively to large-scale disasters.
- A national project was launched to back up clinical information among national and public university hospitals. Various local projects were also launched to share clinical data as a backup.

Good practices:

Practices developed after the Hanshin Awaji Earthquake

- Several medical teams, including DMATs, hastened to provide medical services at evacuation centers in the affected sites and provided assistance for hospital evacuations.
- Initiatives adapted after the Hanshin Awaji Earthquake were implemented at the time of the 2011 tsunami, including the operation of disaster base hospitals, psychosocial support teams, networks for dialysis, EMIS, and a wide-area medical transportation system.

Disaster medical coordinator

- Under the leadership of the prefecture and municipality-level coordinators, collaboration and cooperation between public and private sectors including the Japan Self-Defense Forces and DMATs were strengthened. The coordinators played an important role in many efforts, including autopsying victims, requesting accommodation for injured people, and disaster medical team deployment after the sub-acute phase.

University hospital

- The university hospitals located in three affected prefectures played crucial roles as disaster base hospitals in providing support to the local hospitals, receiving patients, assisting with wide-area medical transportation for dialysis, and collaborating with prefecture-level disaster medical coordinators.

- They provided and provisioned the required medical personnel such as doctors, nurses, and pharmacists to the hospitals and medical facilities in the affected areas.

Activities at evacuation centers

- Based on the experiences and the lessons learned from the 1995 Great Kobe Earthquake, there was a concern about the increasing number of patients suffering from post-traumatic stress disorder (PTSD), depression and alcoholism. However, with active intervention by psychosocial teams, the occurrence of these symptoms was minimized.

Relocation of hospitals to higher grounds and hills

- The Ishinomaki Red Cross Hospital, which had just moved to higher ground prior to the 2011 tsunami, played a central role as a disaster base hospital.

Problems:

Preparedness and measures against massive tsunamis

- Earthquakes had been the main focus of existing measures. Following the 2011 tsunami, many needs emerged that had not been seen during the 1995 Great Kobe Earthquake and were thus factored into the required response.
- There were insufficient preparations and countermeasures for handling both the interruption of regional public health systems and other serious damage.
- It was extremely difficult to obtain information on the situation and the needs of expectant mothers, infants, elderly persons, persons with disabilities, and foreigners who require extra support and assistance.
- The medical records in hospitals around the tsunami area were lost or completely destroyed. The electronic medical records were temporally unavailable because of power outages.
- Hospital damage included not only the buildings and equipment, but also loss of human resources and medical personnel, requiring hospital evacuation.

Disaster public health

- When a large-scale disaster occurs, the functions of the municipal-level disaster countermeasures offices and those of the prefecture and municipality public health centers cease. The current policies and laws do not clearly state how the national and prefectural governments can assist these offices with the medical response in such situations, nor do they provide planning tools or guidelines.
- After the 1995 Great Kobe Earthquake, the calculation of "disasters=DMAT=external injuries" was widely acknowledged, and there was no concept of "disaster public health risk management." Even the Disaster Relief Act did not target activities related to public health, sanitation, nutrition and welfare. Therefore, the adoption of public health measures for welfare and nutrition, relief activities for persons requiring extra support, and infection control were delayed.
- The absence of a comprehensive/holistic control and coordination mechanism delayed the establishment of the relief system. The interruption of communication and information sharing and the severe damage in the affected areas hampered medical relief activities at evacuation centers.

Preparation of receiving support

- The affected hospitals were not sufficiently prepared for receiving and managing assistance from external organizations effectively, although they were familiar with providing medical assistance. There was no clear guideline describing the mechanism of receiving support, such as how the affected hospitals can request assistance over a wide area.

Relief supply

- The stockpile of emergency supplies was insufficient because it had been prepared under the assumption that the lifeline could be secured from private power generation and well water use facilities.
- It was impossible to respond to the affected areas' requests immediately because of insufficient manpower and equipment.

37 Prospect of Future Information Exchange Methods in the Event of a Disaster by Taking Advantage of SNS

HFA Core Indicator 5.4:
Procedures are in place to exchange relevant information during hazard events and disasters, and to undertake post-event reviews.

Keywords:
mass media, social network service (SNS), Twitter, risk communication

Context:

In the past two decades, there were two greatest earthquakes, in 1995 and 2011. During this period, the methods of delivering and sharing disaster information to the public have changed considerably. In 1995, the most widely used form of communication was newspapers and TV, whereas in 2011, Internet social network service (SNS) such as Facebook and Twitter were used. SNS have figured prominently as an instant info-sharing cybertool, despite the presence of ethical and privacy issues for individual account holders. As a future goal, methods to respect and protect SNS account users should be implemented, while maximizing the instant info-sharing potential of SNS.

Before:

When the 1995 Great Kobe Earthquake occurred, TV and newspapers were the main source of sharing information. Immediately after the disaster, these media conveyed the damage situation. It remained difficult to obtain information regarding damage conditions in the early stages. Over time, the information contents changed to the victim's perspective such as sharing information about shelter locations, their conditions, and confirming people's whereabouts. With time, the relevance of information contents changed for victims' long-term living environment in evacuation facility such as life lines, preventing second disasters, medical services, and school re-opening. The origin of the information was mainly the government, and mass media delivered it to the public. However, there was a lot of incorrect information or rumors around. The mass media also had ethical issues; for example, the roar of broadcasting company helicopters reporting on damage conditions, such as destroyed buildings or roads, caused search-and-rescue crews difficulty in hearing the voices of victims who were underground or in collapsed buildings. Moreover, those mass media concentrated on areas of massive or shocking events. Thus, it is difficult to say that they provided sufficient information about rescuing outcomes and emergency treatments. Community radio and news programs for people with disabilities and foreigners have earned positive reviews. At that time, the Internet had just begun to spread widely, and it was considered the first full-scale media attention devoted to a disaster. One of online communication network, Nifty Serve, has launched an earthquake information hub and provided diverse information on administration, shelter, and volunteer activities. However, much of the information had previously been announced by the government, and in other cases, concerns existed about the information's reliability because of its origin.

After:

Using a wide range of mass media, including the Internet (SNS), for exchanging disaster information during the 2011 Earthquake and Tsunami was novel. The huge tsunami, with more than 10 m waves, followed a magnitude 9.0 earthquake and reached an elevation of 40.1 m, catastrophically damaging the Japanese Pacific coastal area. TV and radio announced warning information such as aftershocks and the second and third waves of the Tsunami. After the Fukushima nuclear power plant accident, they also announced evacuation information by removal order and the radiation diffusion of contamination areas. Media also reported in detail on the rescue activities by the Japan Self-Defense Forces (JSDF) and experts from abroad. It informed the public about the damage from liquefaction to the coastal areas in Chiba Prefecture, and train and bus schedules for commuters in the central Tokyo area. NHK and certain commercial television stations provided real-time disaster-related information via their websites to people who could not watch TV due to power outage[9] and so on. According to the result of a survey of 100 companies in the Kanto area, the percentage of the purpose of SNS usage including Facebook and Twitter in April 2011 (immediately following the disaster) increased: the percentage for communicating with family and friends before the disaster and for receiving early information after the disaster rose from 32% to 49%, for supplying media report but with lack of information by TV and newspaper rose from 20% to 33%, for informing to large numbers of people rose from 22% to 29%. Receiving domestic and international information from mass media ranked fourth (22%), and confirming family members' and friends' whereabouts and safety occupied 21% of SNS usage. Public information could be obtained via SNS[10], but they can also transfer private information. In addition to affecting a wide area, the Great East Japan Earthquake and large-scale Tsunami caused the Fukushima nuclear plant accident and subsequent secondary disasters. Therefore, it is increasingly thought that a Nankai Trough Earthquake has a high probability of occurrence, and discussion has begun addressing it as a real and practical matter. Regarding the effects of a large-scale earthquake in a big city, the 2011 disaster triggered broad perspective discussions on TV forums about disaster prevention and relief among individual, academic, industrial, and government experts. In 2011, smartphones also played an important role. Despite a phone charging problem due to power outage or communication towers being broken, many people sent real-time messages/news of affected areas using SNS through smartphones.

Good practices:

By tying up with NHK, certain commercial television stations and internet sites provided Nico-Nico movie news and Ustream for people with disabilities and those unable to watch TV because of the power outage. Yahoo Japan

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[9] The Cabinet Office (2011). Retrieved from http://www.bousai.go.jp/kaigirep/hakusho/h23/bousai2011/html/honbun/2b_sanko_siryo_06.htm.

[10] The Cabinet Office (2012). Retrieved from http://www.bousai.go.jp/taisaku/hisaisyagyousei/youengosya/h24_kentoukai.

and Google Japan launched a real-time disaster-related information site and a people's whereabouts information site, respectively.

Moreover, people using SNS exchanged considerable information. For example, fuel for cars or house heating systems was not delivered to the affected areas, including lightly affected areas, because of a malfunction of the logistics system. Twitter users frequently shared information via Twitter about the available gas stations. Twitter messages also shared information on when aid and medical supplies were not delivered on time, requesting the rescue supplies, and people's emotions, such as anxiety for the aftershocks and fears about cold temperatures. Information on volunteer activities and people's whereabouts was also shared via SNS. SNS played an especially important role for foreigners who did not understand Japanese, sharing real-time information in their native language.

Problems:

In virtual online space such as SNS, the first uploader's opinion on the information occasionally has more powerful influence, for better or worse. The point is that a vast amount of information is spread to public with no verification, which could cause chaos.

Future Recommendations for Post Hyogo Framework for Action

HFA Priority for Action 1:

Ensure that disaster risk reduction is a national and a local priority with a strong institutional basis for implementation.

HFA Core Indicator 1.1:
National policy and legal frameworks for disaster risk reduction exist and include decentralized responsibilities and capacities at all levels.

1 *National Policy and Legal Frameworks for Disaster Risk Reduction*

- Japan's history of institutionalizing a disaster management system highlights three key points.First, national level leadership in establishing a disaster management system helps to organize horizontal and vertical structures effectively. Second, creating a law to implement a disaster management system will further legitimize the system and thus support further actions. Third, shaping an institutional basis in which all levels of organizations — national, regional, and local participate. All these actions will take considerable time, but initiating a system and revising it as necessary through post-disaster assessments is critical for improving disaster management.

- Various national recovery agencies have been established after large-scale disasters worldwide. In many cases, such agencies are only created for an interim period, usually between five and ten years, their responsibility and power in recovery are critical. As these agencies often set the stage for long-term rebuilding and future resilience, identifying funding and allocating decision-making power within the existing relationship of ministries and departments (e.g., public works, building construction, social welfare, and health) prior to large-scale disasters are extremely important for effective implementation of recovery. As in the case of post-GEJE in Japan, starting a new agency outside existing regulatory framework is not an easy task, as it often causes confusion and disorder delaying the recovery effort.

HFA Core Indicator 1.2:
Dedicated and adequate resources are available to implement disaster risk reduction activities at all administrative levels.

3 *Dedicated and Adequate Resources for Disaster Management in Japan*

- In-kind support systems are becoming increasingly important. As we exist in an insecure world, where vulnerabilities to disasters are increasing and single-government financial security and liability are declining, preparing mutual support networks between various players in society is crucial. Such networks include supporting structures among local, prefectural, regional, and national governments, where financial obligations are a non-primary concern. The participation of citizens as well as private sector entities in this in-kind system is also essential, as disaster size and degree are unforeseeable.

4 *University Faculty as a Non-Governmental Resource to Support Disaster Risk Reduction in Recovery Planning with Local Government*

- Local governments and experts should build relationships of trust during non-disaster periods.
- Experts should support the local governments as a team, which makes it possible to respond comprehensively and complementarily.
- Experts should connect the local government and the local community.

HFA Priority for Action 2:

Identify, assess and monitor disaster risks and enhance early warning.

HFA Core Indicator 2.1:
National policy and local risk assessments based on hazard data and vulnerability information are available and include risk assessments for key sectors.

8 *Importance of Quantitative Assessment of Uncertainties and their Visualization in Tsunami Hazard Assessment*

- We need to qualitatively assess the uncertainties of the tsunami hazard assessment and visualize comprehensibly the uncertainties in the tsunami hazard map. By visualizing the uncertainties, people can clearly perceive that the tsunami hazard assessment includes large uncertainties. Moreover, clearly showing regional characteristics of the uncertainties could benefit residents who live in coastal areas.

9 *Tsunami Fragility Curves for Supporting Reconstruction and Future Risk Assessment*

- Characterizing tsunami fragility curves in different tsunami hazards, geographic, and social conditions so that they can be used as universal measure of tsunami risk assessment.
- Tsunami fragility curves should be updated and implemented for use in terms of risk assessment of reconstruction and urban planning in national, local and community levels.

<u>HFA Core Indicator 2.3</u>:
Early warning systems are in place for all major hazards, with outreach to communities.

11 *Earthquake Early Warning System in Schools and at a University during the 2011 Tohoku Earthquake*

- EEW reduces the number of causalities by providing information for both physical and mechanical reactions. Based on experiences from the Tohoku earthquake, successful utilization in schools is important to enhance the social understanding for EEW. EEWS will be installed in all schools in the future.
- To avoid false alarms, EEWS should be reliable, and applicability to inland earthquakes would be enhanced by combining on-site earthquake observation data.
- Accurate ground motion estimation is needed. Successive use of observation data from not only on-site but also from local/regional observation networks is recommended. Front-site observation data could be efficiently used to enhance the accuracy.

12 *Monitoring of Land Slides and Status of Buildings and Construction Areas by Radar Technology*

- GB-SAR systems should be tested under various conditions. At the beginning, experts must support assist with the analysis of GB-SAR data.
- A protocol for providing the early warning information through local governments must be established.

HFA Priority for Action 3:

Use knowledge, innovation and education to build a culture of safety and resilience at all levels.

<u>HFA Core Indicator 3.1</u>:
Relevant information on disasters is available and accessible at all levels, to all stakeholders (through networks, development of information sharing systems, etc.)

13 *Information Sharing, Cooperation, and Expert Training Provided by Academic Research Institutes for Natural Disasters*

- The establishment of a domestic system for local hazard risk is the highest priority effort, comprising an observation system, a system for archiving and extracting data, expert training, and other elements. The establishment of an integrated knowledge system is the next priority.

<u>HFA Core Indicator 3.2</u>:
School curricula, education material and relevant training include disaster risk reduction and recovery concepts and practices.

14 *Education to Build a Culture of Safety and Resilience at All Levels around Academic Research Institutes*

- Education about disaster prevention for non-experts is very important. We learned from the Great East Japan Earthquake that it is effective to teach people the preconditions of hazard estimation. During the emergency, people themselves had to decide how to avoid hazards and protect property because of the inadequate information from outside their community.

15 *Education Practice Program for Improving Response Capability to Survive a Tsunami*

- Disaster risk reduction education including lessons from the 2011 disaster that judgment by themselves on the situation save the lives should be implemented at all grade levels to increase the disaster awareness of children.
- New types of practical education tools should be developed to further interest children, including tools that can be used outside the classroom.

16 *Development of the Reconstruction Mapping Program at the Tsunami-affected Elementary School*

In order for disaster education to further contribute to building a culture of safety and resilience in the community,

- disaster education should be developed by fully reflecting the local context, including the community's disaster history, natural environments, and social and economic backgrounds; and
- the validity of each disaster education program should be examined for sharing effective approaches.

17 *International Post-graduate Education Program for Disaster Medicine; Collaboration with Tohoku University Human Security Program*

- Disaster medicine is an interdisciplinary subject. An interdisciplinary course such as Tohoku University's Human Security Program is suitable for implementing subjects related to the study of disasters. The international educational program is suitable for international students to learn lessons from the GEJET. However, students in the international program have few opportunities to learn from local people, so the organizer of the course should consider providing more of these kinds of opportunities.

HFA Priority for Action 4:
Reduce the underlying risk factors.

HFA Core Indicator 4.1:
Disaster risk reduction is an integral objective of environment-related policies and plans, including for land use, natural resource management and adaptation to climate change.

19 *Post-tsunami Recovery Strategies in Sanriku Coastal Areas after the 1933 Tsunami*

- Relocation to higher land from the waterfront area as a post-tsunami recovery strategy should be performed by national/local government purchase of the lowlands to avoid future private usage of vulnerable waterfront space.

20 *Integrated Perspective of Civil Engineering, Architecture and Urban Planning*

After the disaster, a number of projects are under way simultaneously; however, each of them has to be coordinated to comprise entire future vision of a village.

- Multidisciplinary cooperation among various experts; architect, a civil engineer or an urban planner, with locals, is important to build up a project.
- Sharing future vision of the village among the people prior to their opinion survey works well to lead their intentions to an appropriate direction.
- To build up consensus for the village planning, the complementary communication with local stakeholders is invaluable.

HFA Core Indicator 4.2:
Social development policies and plans are being implemented to reduce the vulnerability of populations most at risk.

21 *Measures for People Requiring Assistance during a Disaster*

- More thorough business operation analysis should be performed to devise BCPs including the network required for maintaining the supply chain.

HFA Core Indicator 4.3:
Economic and productive sectoral policies and plans have been implemented to reduce the vulnerability of economic activities.

22 *Enhancement of Business Continuity Plans and Business Continuity Management*

- All organizations including companies are recommended to develop its BCP, and the governments should make efforts to diffuse BCPs. Furthermore, BCPs should be prepared in anticipation of severe incidents that require “alternative strategies”, including a substitute business site.

23 *Disruption of Supply and Supply Chain Management*

- Efforts should be made toward knowing about suppliers that make up the supply chain. Companies should become aware that centralized purchasing to reduce cost and sticking to original specifications make it difficult to resort to alternate procurement.

HFA Core Indicator 4.4:
Planning and management of human settlements incorporate disaster risk reduction elements, including enforcement of building codes.

24 *Promotion of the Earthquake-proof Retrofit of Buildings after the 1995 Great Kobe Earthquake*

- Pre-disaster recovery planning worked well in Kobe’s Mano District after the 1995 Great Kobe Earthquake as well as in Tokyo after the 1923 Great Kanto Earthquake. Pre-disaster recovery planning is an important process for reaching agreement among the local government and residents on a future vision of the district. Sharing the future vision prior to a disaster may avoid emotional conflicts at the stages of developing or implementing the post-disaster recovery plan.

25 *Public Housing for the Mitigation on the Negative Impact of Environmental Transition on the Victims*

To avoid degradation of the community caused by long-term stays in temporary housing and drastic changes in living conditions:

- The new housing community should be interconnected with the existing community.
- The new living environment should encourage residents’ communication, especially to prevent the isolation of older persons, who represent a large number of the residents.
- Sharing sufficient information concerning the reconstruction plan and allowing the public to participate in the planning of the housing are essential.

HFA Core Indicator 4.5:
Disaster risk reduction measures are integrated with post-disaster recovery and rehabilitation processes.

26 *Post-tsunami Recovery for Risk Reduction after the 2011 Great East Japan Earthquake and Tsunami*

- Prediction of available resources as well as disaster damage is necessary for implementing reconstruction activities. Reconstruction activity estimation should be considered at the national, local, and community levels corresponding to predicted damage levels.

HFA Priority for Action 5:
Strengthen disaster preparedness for effective response at all levels.

HFA Core Indicator 5.1:
Strong policy, technical and institutional capacities and mechanisms for disaster risk management, with a disaster risk reduction perspective, are in place.

29 *Measures and Agenda for Large-scale Disasters in Japan: from the Perspective of Personal Information and Disaster Prevention Education*

- It is important to establish legislation for responding to large-scale disasters and re-establishing the network among residents in the municipalities and lower levels.
- One goal is to develop an information-sharing system by reviewing how personal information may be excessively protected, and by creating a database with detail, a management strategy, and the system's application under the regulation, through cooperation among residents, local governments, and the national government.
- The other goal is to share and hand down local knowledge, including disaster information. To accomplish sharing and handing down requires encouraging citizens to perform daily activities positively for their local community and embedding activities that increase safety awareness and disaster relief (local knowledge), which can reduce community vulnerability to disaster.

30 *National Preparedness of Disaster Medicine as Tertiary Risk Reduction*

- Disaster risk assessment and reinforcement of risk reduction of all hospitals as "the building last standing in a disaster" are necessary.
- National standardization of DBHs and hospitals as evacuation shelters is necessary
- Strengthening of emergency lifelines together with hospital resource stocks including drugs, food, medical gases should be considered as a BCP.
- The medical relief to the affected hospital should comprise substitute workers rather than assistance for decreasing the physical and mental load of local workers who were also victims of the disaster.
- Communication tools including network infrastructures and satellite phones should be strengthened to make the hospitals more functional.
- Hospitals should build capacities to receive support by hiring disaster manager and disaster medical-public health coordinator.
- Health care at the evacuation center should be continuously supported by DMATs and other medical assistant teams to prevent the outbreak of infectious disease, mental depression, deep vein thrombosis and other diseases.
- DBHs should build capacities to deal with chemical, biological, radioactive, nuclear and explosive (CBRNE) hazards.
- Utilization of SCU as the hub of medical resources should be better prepared.
- Daily usage of EMIS as a medical management system in the community will increase the coverage of hospitals and health-related institutions.
- Assignment of medical-public health coordinators together with education and supporting resources is necessary.

HFA Core Indicator 5.2:
Disaster preparedness plans and contingency plans are in place at all administrative levels, and regular training drills and rehearsals are held to test and develop disaster response programmes.

31 *Enhancement of Plans for Operational Continuity of Government*

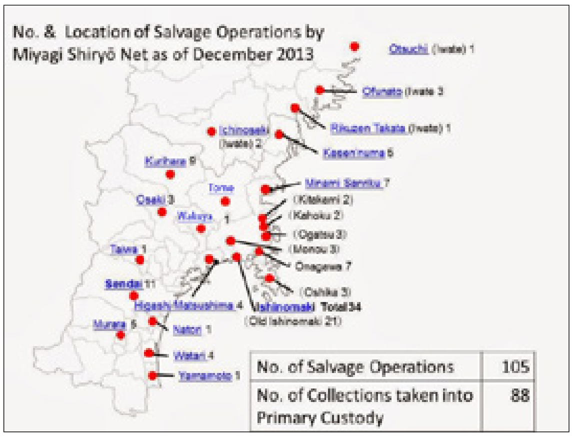
- Operational continuity of the ministries and local authorities (BCPs of public organizations) is essential for quick rescue action, to support refugees and to recover facilities and towns, even if these organizations suffer serious damage to their critical resources for important operations. It is strongly recommended that the plans have an alternative strategy for critical resources including their main buildings.

32 *Three Coastal Districts in Iwaki City, Fukushima Prefecture: Differences Resulting from the Local Residents Organization Disaster Response Activities*

- As the countermeasures required of local municipalities (counties and cities) are only to present an outline, voluntary, autonomous communication (such as hazard mapping) at the community level is very important for the plan to be effective. Specifically, a disaster prevention and mitigation system in accordance with the historical path dependency of each district is required. Examples include spatial hierarchy such as district ― block association ― neighborhood association (A) and district ― neighborhood association (B, C); various forms of governing such as top-down decision-making (A) and combination of bottom-up decision-making and roles by officers (B, C).
- Community development and enhancement of the activities of resident organizations is one key to achieving these goals.

33 *Pre-Disaster Activities to Preserve Historical Materials and the Great East Japan Earthquake*

- It is necessary to bring together owners of local collections, interested local citizens, local government employees and specialists on a continuing basis to build a consensus that there is a real need to protect historical materials from disasters.
- Disasters are not the only cause of attrition of historical materials. Social isolation and aging is another major threat, and it is important build social bonds to provide latent social support within local society for private owners of collections of historical materials.



No. of Salvage Operations	105
No. of Collections taken into Primary Custody	88

- It is important to develop new and innovative ways of engaging freely interested citizens in this preservation process, and developing social structures to implement this. It is also necessary for national and local governments to start to study ways of supporting and promoting these kinds of activities.

34 *DMAT as the First and Long-lasting Responder*

- The concept of DMATs should be developed by each country considering their geographical, climate, cultural and socioeconomical characteristics.
- DMATs should be endorsed by the central government as effective medical-public health responders together with sufficient logistics support.
- The concepts of DBH, EMIS, SCU, wide-area transportation and medical-public health coordinators should be propagated as the fundamental structure for the activities of DMATs.
- DMATs should be trained for primary care of patients under various conditions, including CBRNE disasters together with confined space medicine, “Load-and-Go” and wide-area transportation, as specialists of disaster medicine.
- Continuous dispatch or logistics support should be pre-planned to fulfill any gap until the arrival of other MRTs and recovery of local health care providers.
- Regular training of DMATs should be endorsed and assured by the government and affiliated hospitals to maintain the preparedness of DMATs.
- Multilayered information sharing should be prepared, including EMIS, by every responder.
- Every hospital and medical professional should learn about the function of DMATs to enhance the support-receiving capacities. Disaster medicine should be part of the curriculum for every medical and public health school as fundamental knowledge to cope with emergencies and disasters.
- Multi-sectorial collaborative preparedness should be established between DMATs and other responders through agreements.
- Every prefecture or province should strengthen the function of airports or other facilities for SCU to support DMATs for efficient wide-area transportation and to become a logistics hub for relieving resources and medical professionals.

HFA Core Indicator 5.3:
Financial reserves and contingency mechanisms are in place to support effective response and recovery when required.

35 *Legal and Financial Frameworks for Recovery and Reconstruction*

- Creating financial mechanisms that allow flexible use is essential for a recovery reflecting local needs. After the Great Hanshin Awaji Earthquake and Chuetsu Earthquake, foundations to manage and operate pooled recovery funds were established. After the GEJE, recovery funds were also pooled to be managed directly by the affected Prefectural governments. Pooling these funds and providing power to foundations and Prefectures to manage these funds better accommodates the needs of localities, which could incorporate multiple stakeholders and use the funds for various non-structural programs. Nevertheless, such mechanisms would need to be altered according to macro socio-economic conditions of that time.

36 *Preparedness for Low-frequency and High-impact Disasters from a Medical Perspective*

- Relocation to higher land from the waterfront area as a post-tsunami recovery strategy should be performed by national/local government purchase of the lowlands to avoid future private usage of vulnerable waterfront space.
- More thorough business operation analysis should be performed to devise BCPs including the network required for maintaining the supply chain.
- Reinforcement of buildings is essential to reduce the risk of collapse. Setting quantitative goals and education figure strongly in promoting this effort.
- Pre-disaster recovery planning worked well in Tokyo after the 1923 Great Kanto Earthquake as well as in Kobe’s Mano District after the 1995 Great Kobe

Earthquake. Pre-disaster recovery planning is an important process for reaching an agreement among the local government and residents on a future vision of the district. Sharing the future vision prior to a disaster may avoid emotional conflicts at the stages of developing or implementing the post-disaster recovery plan.

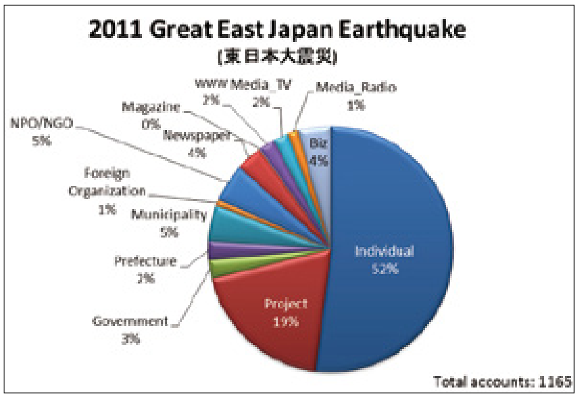
- Prediction of available resources as well as disaster damage is necessary for implementing reconstruction activities. Reconstruction activities should be estimated at the national, local, and community levels and correspond to predicted damage levels.
- Clinical information in hospitals should be backed up, and comprehension of medical activity typical to the local area should be required.

HFA Core Indicator 5.4:
Procedures are in place to exchange relevant information during hazard events and disasters, and to undertake post-event reviews.

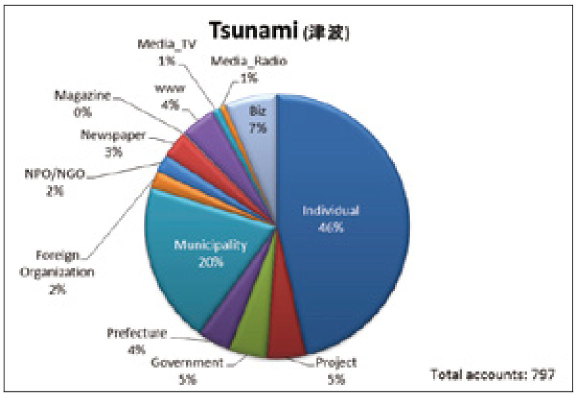
37

Prospect of Future Information Exchange Methods in the Event of a Disaster by Taking Advantage of SNS

- Figures depict Twitter account classification by the keywords “Great East Japan Earthquake” for August 30th and “Tsunami” for September 4th, 2013, respectively. The total number of accounts for “Great East Japan Earthquake” was 1,165 and that for “Tsunami” was 797. Uploading messages and providing information regarding the earthquake by individual occupied 52% of the total accounts, suggesting a project by individuals or communities occupying 19% by the keyword “Great East Japan Earthquake.” The keyword “Tsunami” occupied 46% of uploads from individual accounts and 20% from municipalities managing the account. This phenomenon can be interpreted as demonstrating the power of individuals sharing information via SNS and proving SNS to be the most effective method for sharing/exchanging information, anytime and anyplace.
- As another point, personal information such as bank account, tax, or health information that are stored by municipalities must be digitized and backup data kept in a secure place, safe from natural disasters. In the big data era, legal restrictions must be created as a filter ensuring the high quality and quantity of data, analysis methodology, and method of interpretation. Early ethical education for sharing information via SNS is also required. Risk-related communication using traditional multimedia, SNS, and WebGIS techniques can figure more importantly as next-generation communication methods.



Classification of Twitter Accounts by Keyword “Great East Japan Earthquake”



Classification of Twitter Accounts by Keyword “Tsunami”

*Since the keyword was searched in Japanese, it is possible that results in English differ.

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*The number in parentheses is a topic the author is in charge of in Chapter 6.

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