Disaster Preparedness for Natural Hazards in Japan (Case Studying in Hyogo Prefecture)

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(Fulfillment of Visiting Researcher Program in Asian Disaster Reduction Center, Kobe, Japan)

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Disclaimer

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Summary of the report

As per the requirement of ADRC visiting researcher program, this report was made for the submission of ADRC and DMC in Sri Lanka. Basically the main objective of this research program was to get better exposure on Japanese Disaster Risk Management system and identifying the best practices Japanese government currently practicing as disaster preparedness counter measures, and identifying the best match technologies and other parameters which can be directly applied to Sri Lanka Disaster Management System focusing the attention to Hyogo prefecture.

The research method mainly focused on participation and practical involvement of disaster management program carrying out by Hyogo Prefecture government. Specially participating disaster drills such as fire drill, emergency management drill, and community school preparedness drill gave comprehensive ides on the practical intervention of the Japanese DRM system. By visiting places such as disasters museum like Great Hanshin Awaji Memorial museum, mount Unzen volcanic eruption museum, DM institutions such as JMA, Hyogo Disaster Management Center, Crisis Management Center Kobe, Strom-surge Fire Emergency Institutes (119), Police call center (110), Water Management Bureau, Drainage System and Sewage system management board etc collected more information on disaster preparedness countermeasures and overall disaster management system in the country. Further, during this period, by participating International Symposium such as **International Disaster Risk Reduction Symposium conducted by University of Kobe; International Conference on Geotechnical Engineering for Disaster Mitigation and Rehabilitation (4th GEDMR) conducted by University of Kyoto; International Symposium on Water related Disaster organized by ICHAM in Tokyo; Asian Studies symposium on The State and Prospect of Risk Management for Natural Disaster in Asia organized by Kanagawa University and International Workshop on Implementing of Practical Disaster Risk Reduction organized by IRIDes Tohuku University.** These occasions were very valuable to participate brainstorming sessions with academia to enrich the knowledge on Japanese natural disaster management and related issues, best practices, universities responsibilities in the field of DRM and research needs. In Japan, universities and other research institutes doing yeomen service to their DRM system when compared with other Asian countries.

Collecting information by secondary data was main resource fool in the research. Based on research them one of objective was to study the disaster legal framework and revolutionary changers of the disaster acts and policy document. After collecting the information through reference materials, questioner is prepared to further verification and additional information from particular authority or visited them for presentation or clarification.

By visiting the main historical disaster happened places such as Sendai (Tohuku earthquake), Nagasaki atomic bomb museum, epicenter and park place, recent landslide sites places, Hanshin Awaji Earthquake Museum, Unzen volcanic eruption places and surrounds, Unzen

Geo-Park, etc comprehensive knowledge was accumulated on impact on disasters and lesson learn countermeasures.

In addition to that, to measure the preparedness level of citizens in Hyogo prefecture a survey was carried out using online surveying technique to avoid the prejudice when selecting the sample. Mostly random probable sample has been used and around 40 people have been replied for the questioner. Based on surveying results, community level preparedness are still not in the appropriate level. Although annually, government of Japan and Hyogo prefecture government invested large number of money for the preparedness planning activities, CBDM activities are not in the appropriate level. Further, peoples' care and sense for next large scale disasters were very poor concern. Main reason, people thoroughly rely on all technologies and government. Even they didn't care on their preparedness. As per ideas on dwellers in Hyogo, the risk transferring mechanism is not in proper understanding level. Due to various reasons, people's disaster risk transferring through insurance is not considerable level.

Finally, Japanese government has invested huge money for disaster mitigation projects for the betterment of civilians. When compared with other countries in the world that seems the highest per capita investment for disaster mitigations. Hyogo is the best example to the world that has been developed the entire development projects considering disaster risk reduction measures.

Key words are: Disaster Preparedness, Disaster Management Framework, Hyogo Prefecture

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Abbreviation

ADPC	: Asian Disaster Preparedness Center
ADPC	: Asian Disaster Preparedness Center
BOKUMI	: Kobe City Volunteers for Disaster Management
CBDRM	: Community Based Disaster Risk Management System
DMC	: Disaster Management Center
DRR	: Disaster Risk Reduction
EC	: Evacuation Center
EEWs	: Earthquake Early Warnings
EOC	: Emergency Operation System
EQ	: Earthquake
EW	: Early Warning
FDMA	: Fire and Disaster Management Agency
FEMA	: Federal Emergency Management Agency
GIS	: Geographical Information System
HEN	: Hyogo Emergency Net
HFA	: Hyogo Framework for Action
HPDMC	: Hyogo Prefectural Disaster Management Center
JDR	: Japanese Disaster Recovery
JICA	: Japanese International Cooperation Agency
JMA	: Japanese Meteorological Agency
KBE	: Kobe city Board of Education
PERH	: Prefectural Emergency Relief Headquarters
QGIS	: Quantum Geographical Information System
SDGs	: Sustainable Development Goals
SM	: Social Media
UNISDR	: United National International Strategy for Disaster Reduction
USGS	: US Geological Survey
VCEW	: Volunteer for the Promotion of Community Early Warning

1. Introduction

1.1. Geographical, administrative, economic structure in Japan

Japan is formally known as **Nippon-koku** or **Nihon-koku** (The state of Japan). Japan is considered as island nation in the East-Asia in the Pacific Ocean. It lies to the east of the Sea of Japan, China, North Korea, South Korea and Russia, stretching from the Sea of Okhotsk in the north to the East China Sea and Taiwan in the south. Japan has the world's tenth-largest population, with over 126 million people. Tokyo is the capital of the Japan. With surrounding prefectures, Tokyo metropolitan is considered as world largest populated city around 30 million peoples living. Japan has world third largest economy. Its peoples' Human Develop Index, Life Expectancy and Infant Mortality are within first five in the world.

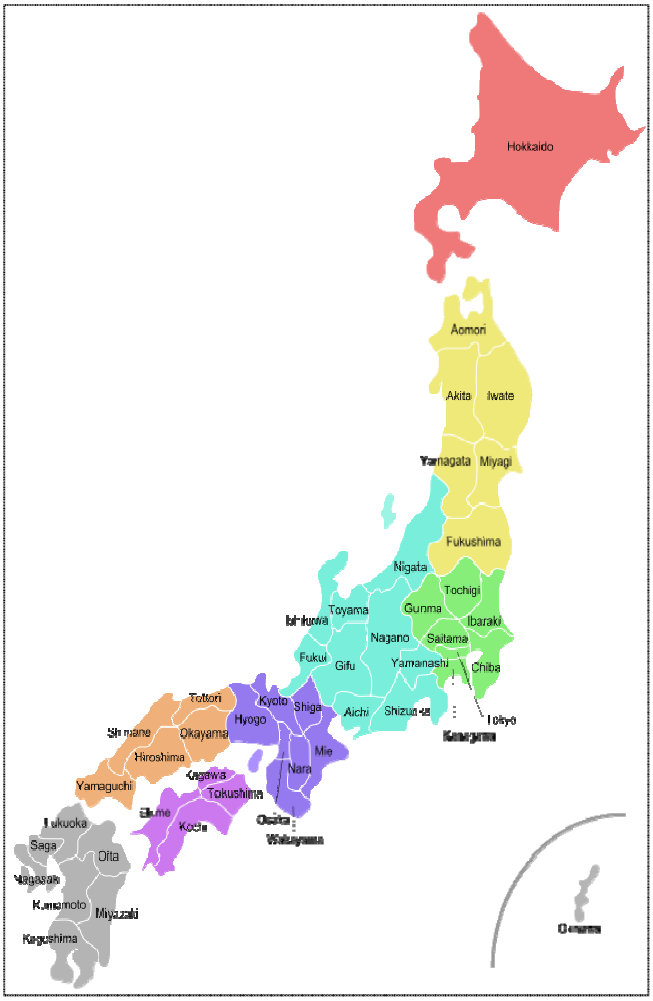


Figure 01. Map of Japan (source Wikipedia)

Figure.2. map of Pacific Ring of Fire

Japan is a stratovolcanic archipelago of 6,852 islands (Wikipedia). The main four largest islands are Honshu, Hokkaido, Kyushu and Shikoku which together comprise about ninety-seven percent of Japan's land area. Japan has made in main four plates. They are Philippine plate, Eurasian Plate, North-American plate and Pacific plate. Japan is located in the main volcanic zone on the Pacific Ring of Fire.

Frequent low intensity earth tremors and occasional volcanic activity are felt throughout the islands. Destructive earthquakes, often resulting in tsunamis, occur several times a century.

1.2. Overview of Japan Climate

Japan has four distinct seasons with a climate ranging from subarctic in the north to subtropical in the south. Conditions are different between the Pacific side and the Sea of Japan side. Northern Japan has warm summers and very cold winters with heavy snow on the sea side of Japan and in mountainous areas. Eastern Japan is hot and humid summers and cold winters with very heavy snow on the Sea of Japan side and in mountainous areas. Western Japan is very hot and humid summers (with temperatures sometimes reaching 35 ^{o}C or above) and moderate cold winters. Okinawa and Amami have a subtropical oceanic climate. These areas have hot and humid summers (with temperatures rarely reaching 35 ^{o}C or above) and mild winters.

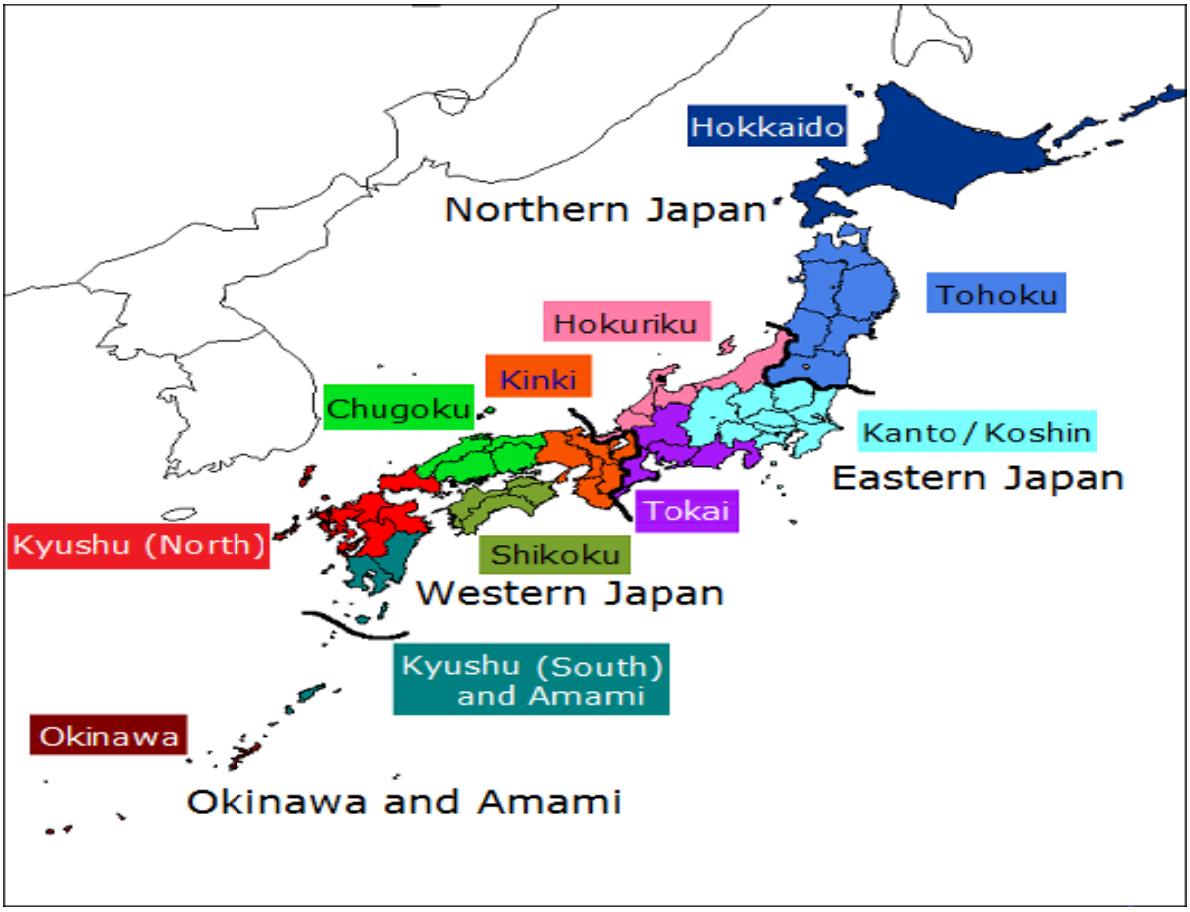


Figure.03.General information Map of climate of Japan

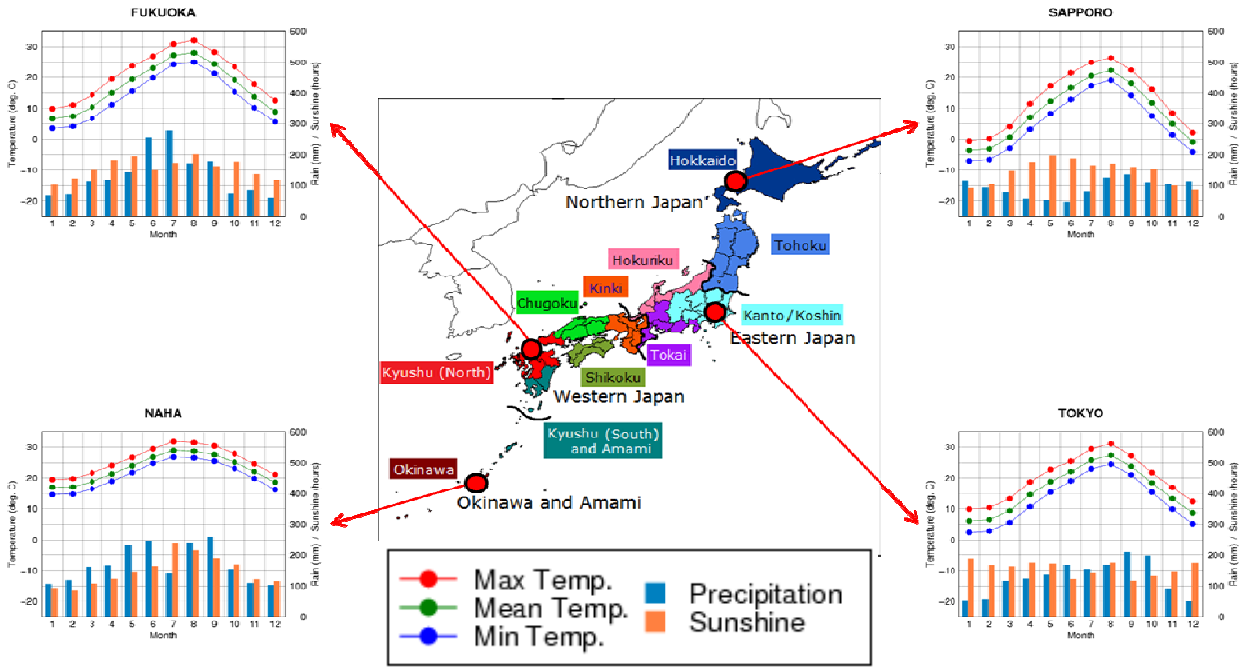


Figure.04. Seasonal variation of meteorological elements in Sapporo, Tokyo, Fukuoka, and Naha

Autumn (September-Octmber-December)

In autumn (September-October-November), temperatures fall gradually. Monthly precipitation amounts are large in September due to the active autumnal rain front and tropical. In October, the frequent passage of anticyclonic systems brings sunny conditions and refreshing air to Japan. The frequency of cold northwesterly flows across Japan and precipitation (rainfall or snowfall) on the Sea of Japan side of the country show an increasing tendency in November. (JMS wesites)

Summer (June-July-August)

Early summer is the rainy season, known as the Baiu, in Japan. Its precipitation is caused by a stationary front, called the Baiu front, which forms where a warm maritime tropical air mass meets a cool polar maritime air mass. In the second half of summer, the North Pacific High extends northwestward around Japan, bringing hot and sunny conditions to the country. Western Japan sometimes experiences temperatures of 35°C or above. On the other hand, the Okhotsk High sometimes appears over the Sea of Okhotsk and causes cool and moist easterly winds (known as Yamase), which bring cloudy and rainy conditions to the Pacific side of northern and eastern Japan. The number of tropical cyclonesapproaching Okinawa/Amami peaks in August. (JMA websites)

Winter (December-January-February)

In winter (December-January-February), the Siberian High develops over the Eurasian Continent and the Aleutian Low develops over the northern North Pacific. Prevailing northwesterly winds cause the advection of cold air from Siberia to Japan and bring heavy snowfall to Japan's Sea of Japan side (upstream of mountainous land) and sunny weather to its Pacific side (downstream of

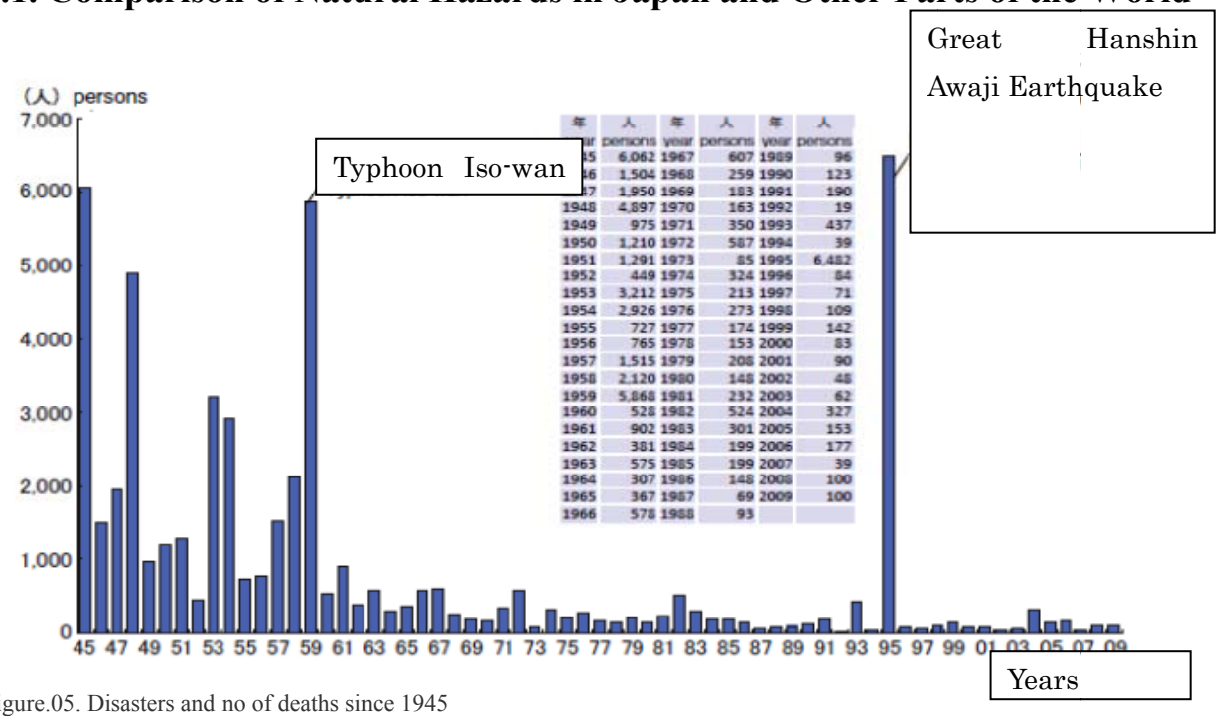
mountainous land). Temperatures as low as -20°C are frequently observed in inland areas of Hokkaido, while Okinawa and Amami have mild winters due to their subtropical location.

Spring (March-April-May)

In spring (March-April-May), migratory cyclones and anticyclones that alternately move eastward prevail across Japan. Temperature increases (decreases) in front (back) of cyclonic systems due to warm southerly (cold northerly) flow. Temperature rises gradually with large short-term variations. Sunshine duration is long in the second half of spring due to the predominance of anticyclonic systems. The rainy season (known as the Baiu) begins in early May in Okinawa and in mid-May in Amami.

2. Natural Hazard in Japan

2.1. Comparison of Natural Hazards in Japan and Other Parts of the World



year	persons	year	persons	year	persons
	6,062	1967	607	1989	96
	1,504	1968	259	1990	123
	1,950	1969	183	1991	190
1948	4,897	1970	163	1992	19
1949	975	1971	350	1993	437
1950	1,210	1972	587	1994	39
1951	1,291	1973	85	1995	6,482
1952	449	1974	324	1996	84
1953	3,212	1975	213	1997	71
1954	2,926	1976	273	1998	109
1955	727	1977	174	1999	142
1956	765	1978	153	2000	83
1957	1,515	1979	208	2001	90
1958	2,120	1980	148	2002	48
1959	5,868	1981	232	2003	62
1960	528	1982	524	2004	327
1961	902	1983	301	2005	153
1962	381	1984	199	2006	177
1963	575	1985	199	2007	39
1964	307	1986	148	2008	100
1965	367	1987	69	2009	100
1966	578	1988	93		

Figure.05. Disasters and no of deaths since 1945

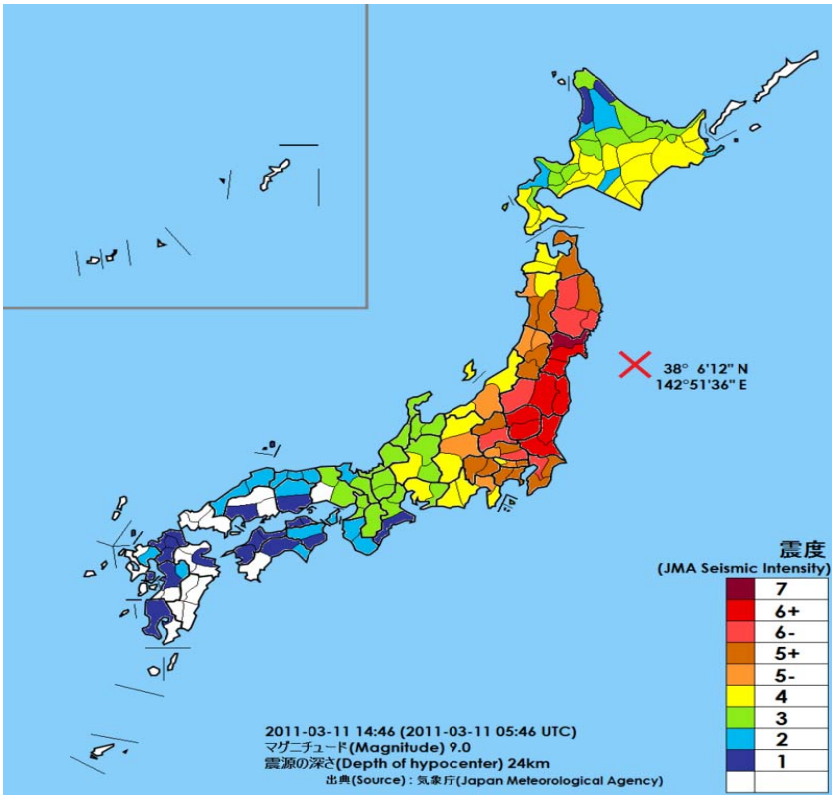


Figure .06. Seismic intensity in Japan

Japan is identified as a country which many natural hazards are prevailing. From past to present it has been facing many large scale natural hazards claiming large number of deaths and destroying large scale economic losses. In the history of Japan, thousands of millions losses have been recorded and 2011 Tohuku earthquake was considered the world largest economic lost 100-250

$ Billion. (some reports say Tohuko as 2nd losses and 1st is Katrina in USA lost 250 $ billions)

2.2. Major earthquake caused huge impact to lives and economy

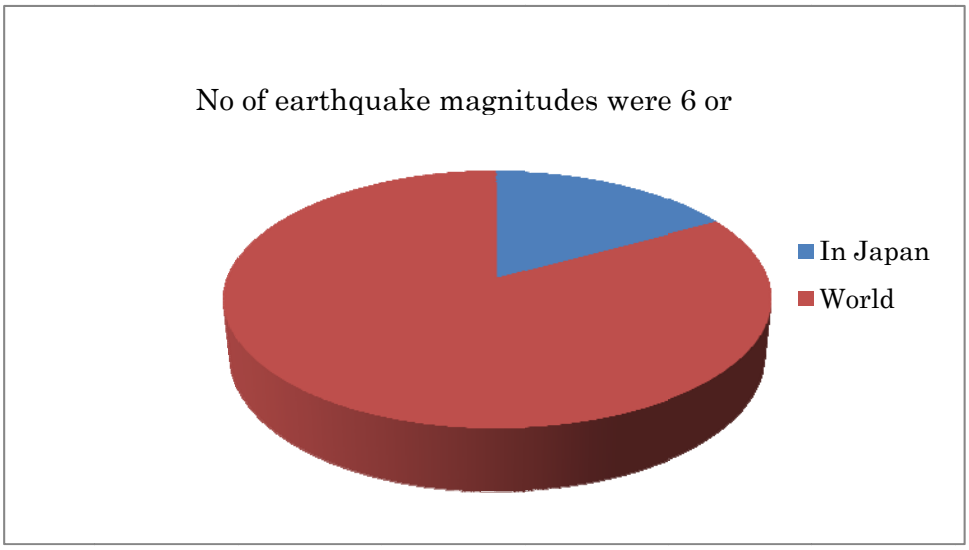


Figure.07.Earthquake occurrence with the world context

When compared with the possibility of occurrence of the earthquake with whole world, Japan represented bigger portion of natural hazard occurrence

2.2.1. Great Hanshing Awagi earthquake

The great Hanshin Awaji Eartheuake occurred on 17 January 1995. The damage to highways and subways was the most graphic image of the earthquake, and images of the collapsed elevated Hanshin Expressway made front pages of newspapers worldwide. Most people in Japan believed those structures to be relatively safe from earthquake damage because of the steel-reinforced concrete design. Though the initial belief was construction had been negligent, it was later shown that most of the collapsed structures were constructed properly according to the building codes in force in the 1960s. However, the steel-reinforcement specifications in the 1960s regulations had already been discovered to be inadequate and revised several times, the latest revision being in 1981, which proved effective but on The damage to highways and subways was the most graphic image of the earthquake, and images of the collapsed elevated Hanshin Expressway made front pages of newspapers worldwide. Most people in Japan believed those structures to be relatively safe from earthquake damage because of the steel-reinforced concrete design. Though the initial belief was construction had been negligent, it was later shown that most of the collapsed structures were constructed properly according to the building codes in force in the 1960s. However, the steel-reinforcement specifications in the 1960s regulations had already been discovered to be inadequate and revised several times, the latest revision being in 1981, which proved effective but only applied to new structures. (Wikipedia)

Ten spans of the Hanshin Expressway Route 43 in three locations in Kobe and Nishinomiya were knocked over, blocking a link that carried forty percent of Osaka-Kobe road traffic. Half of the elevated expressway's piers were damaged in some way, and the entire route was not reopened until September 30, 1996. Three bridges on the less heavily used Route 2 were damaged, but the highway was reopened well ahead of Route 43 and served as one of the main intercity road links for a time. The Meishin Expressway was only lightly damaged, but was closed during the day until February 17, 1995 so that emergency vehicles could easily access the hardest-hit areas to the west. It wasn't until July 29 that all four lanes were open to traffic along one section (Kitamura, Yamamoto & Fujii 1998:240). Many surface highways were clogged for some time due to the collapse of higher-capacity elevated highways.

Most railways in the region were also damaged. In the aftermath of the earthquake, only 30% of the Osaka-Kobe railway tracks were operational. Daikai Station on the Kobe Rapid Railway line collapsed, bringing down part of National Route 30 above it. Wooden supports collapsed inside supposedly solid concrete pilings under the tracks of the Shinkansen high-speed rail line, causing the entire line to shut down. However, the railways rebounded quickly after the quake, reaching 80% operability in one month.

Artificial islands, such as the modern Rokkō Island and Port Island, in Kobe suffered some subsidence due to liquefaction of the soil; the water breaking to the surface did not come from the sea. However, the newly completed artificial island supporting Kansai International Airport was not significantly affected, due to being further away from the epicenter and because it was built to the latest standards. The Akashi Kaikyo Bridge, under construction near the earthquake's epicenter, was not damaged but was reportedly lengthened by a full meter due to horizontal displacement along the activated tectonic fault. (en.wikipedia.org/wiki/Great_Hanshin_earthquak)

At the Great Hanshin-Awaji Earthquake Disaster in 1995, the number of building collapse or heavily damaged. It is around 250,000 and the number of people captured in the buildings is around 35,000. After the earthquake happened, in the situation that telephone didn’t work and there was a heavy traffic on the road, 27,000 people were rescued by neighbors and 80% of them were alive. However, 8,000 people were rescued by Army, Police or Fire Fighters and less than 50% of them were alive. This fact gives us a lesson that the activity of local community is the key to mitigate earthquake disaster.

2.2.2. Great East Japan Earthquake

The 2011 earthquake off the Pacific coast of Tohuku was magnitude 9.0(M_w) undersea mega thrust earthquake off the coast of Japan that occurred at 14:46 JST (05:46 UTC) on Friday 11 March 2011, with approximately 70 kilometers (43 miles) east of the Oshika Peninsula of Tohoku and the hypocenter at an underwater depth of approximately 30 km (19 mi). The earthquake is also often referred to in Japan as the **Great East Japan Earthquake** and also known as the **2011 Tohoku earthquake** and the **3.11 Earthquake**. It was the most powerful earthquake ever recorded to have hit Japan, and the fifth most powerful earthquake in the world since modern record-keeping began in 1900. The earthquake triggered powerful tsunami waves that reached heights of up to 40.5 m (133 ft) in Miyako in Tōhoku's Iwate Prefecture, and which, in the Sendai area, travelled up to 10 km (6 mi) inland. The earthquake moved Honshu (the main island of Japan) 2.4 m (8 ft) east and shifted the Earth on its axis by estimates of between 10 cm (4 in) and 25 cm (10 in), and generated sound waves detected by the low-orbiting GOCE satellite. (Cabinet office, Japan)

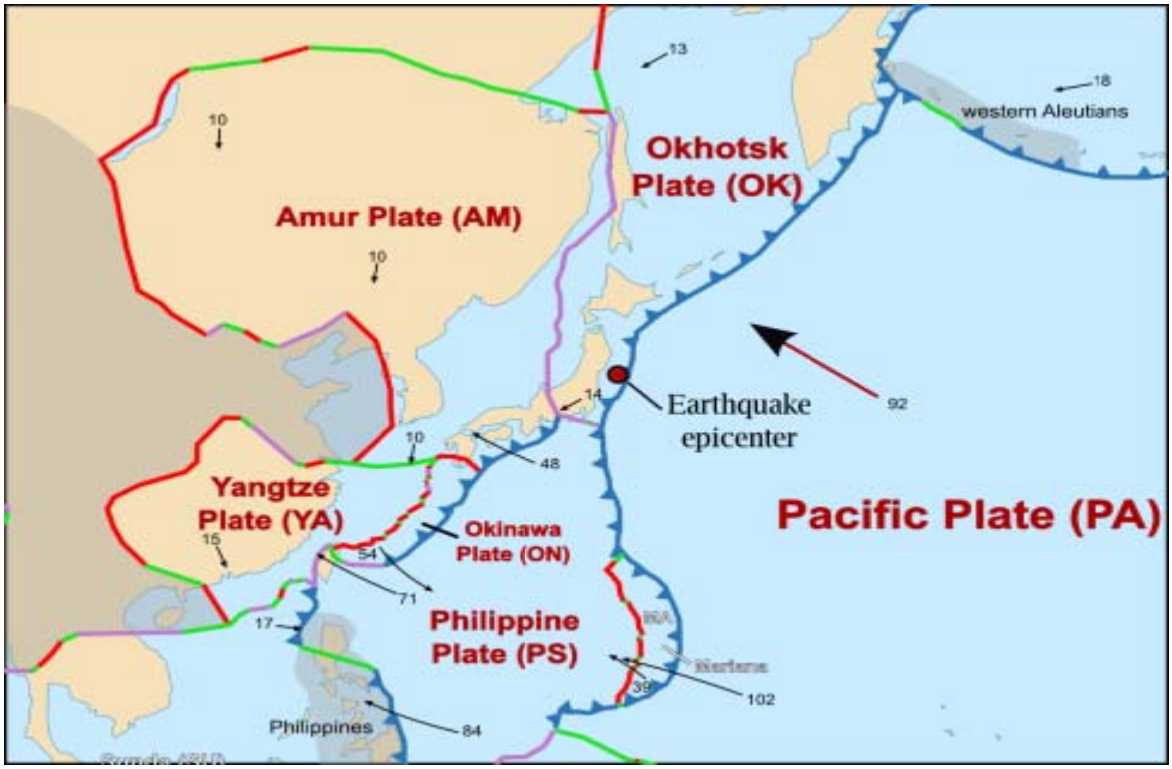


Figure.08. Earth plates across the Japan

On 10 February 2014, a Japanese National Police Agency report confirmed 15,889 deaths, 6,152 injured, and 2,609 people missing across twenty prefectures, as well as 127,290 buildings totally collapsed, with a further 272,788 buildings 'half collapsed', and another 747,989 buildings partially damaged The earthquake and tsunami also caused extensive and severe structural damage in north-eastern Japan, including heavy damage to roads and railways as well as fires in many areas, and a dam collapse. Japanese Prime Minister Mr. Naoto Kan said, "In

the 65 years after the end of World War II, this is the toughest and the most difficult crisis for Japan." Around 4.4 million households in northeastern Japan were left without electricity and 1.5 million without water.

The tsunami caused nuclear accidents, primarily the level 7 meltdowns at three reactors in the Fukushima Daiichi Nuclear Power Plant complex, and the associated evacuation zones affecting hundreds of thousands of residents. Many electrical generators were taken down, and at least three nuclear reactors suffered explosions due to hydrogen gas that had built up within their outer containment buildings after cooling system failure resulting from the loss of electrical power. Residents within a 20 km (12 mi) radius of the **Fukushima Daiichi Nuclear Power Plant** and a 10 km (6.2 mi) radius of the Fukushima Daini Nuclear Power Plant were evacuated. In addition, the U.S. recommended that its citizens evacuate up to 80 km (50 mi) of the plant.

Early estimates placed insured losses from the earthquake alone at US$14.5 to $34.6 billion. The Bank of Japan offered ¥15 trillion (US$183 billion) to the world banking system on 14 March in an effort to normalize market conditions. The World Bank's estimated economic cost was US$235 billion, making it the costliest natural disaster in world history. (Wikipedia)

Human losses from the 2011 off the Pacific coast of Tohoku Earthquake amounted to about 20 thousands. More than 99 percent of the losses were caused by gigantic tsunamis. Casualties resulted directly from the seismic vibration are estimated to be less than 2 hundreds. Run-up heights of the tsunamis were about 15 – 30 meters at the Sanriku rias coasts, which are more than two times of the heights at the straight coasts neighboring to the south. Human casualty ratio at the Sanriku rias coast areas was about two times of that at the straight coast areas, though the rias coasts were frequently attacked by high tsunamis and high lands available for evacuation exist nearby. The fundamental factor that induced the large tsunami damage is significant expansion of urban areas onto coastal lowlands which are highly vulnerable to tsunami hazards. (Takshi, 2011)

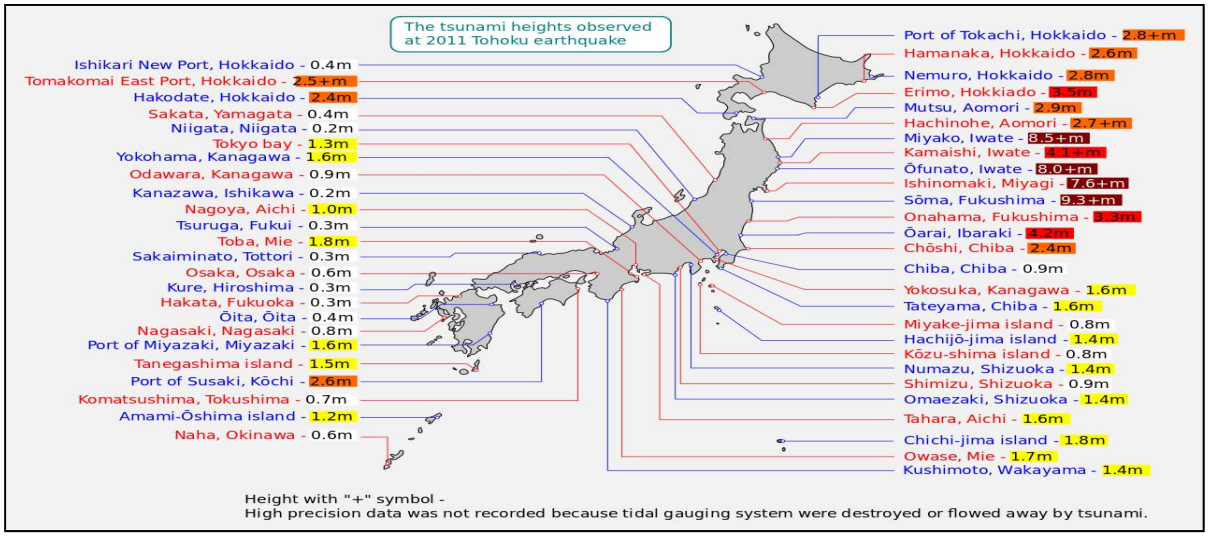


Figure.09. Tsunami inundation depth for different places in Thuko earthquake

2.3. Historical evaluation of earthquake in Japan

Date	Magnitude	Name of quake	Epicenter	Death toll
November 29, 684(Gregorian calendar) November 26, 684(Julian calendar)	8.4*M*	Hakuhou Nankai earthquake	32.8°N 134.3°E	101–1000
June 5, 745(G) June 1, 745(J)	7.9 *M*	occurred atMinoh	34.8°N 135.5°E	
July 13, 869(G) July 9, 869(J)	~9.0 *M*	869 Jogan Sanriku earthquake	38.5°N 143.8°E	1,000+[4]
May 27, 1293(G) May 20, 1293(J)	7.1–7.5	1293 Kamakura earthquake	35.2°N 139.4°E	23,024[6]
August 3, 1361(G) July 26, 1361(J)	8.25~8.5 M	Shōhei earthquake	33.0°N 135.0°E	
September 20, 1498(G) September 11, 1498(J)	8.6 M_K	1498 Meiō Nankaidō earthquake	34.0°N 138.1°E	31,000[12]
January 18, 1586	7.9 *M*	Tensho or Ise Bay earthquake		
February 3, 1605	*7.9 M*	1605 Keichō Nankaidō earthquake	33.5°N 138.5°E	5,000+[16]
December 2, 1611	8.1	1611 Keicho Sanriku earthquake	39.0°N 144.4°E	2,000+
December 31, 1703	8 *M*	1703 Genroku	Edo	5,233

Date	Magnitude	Name of quake	Epicenter	Death toll
		earthquake		
October 28, 1707	8.6 *M*	1707 Hōei earthquake	Off the Kii Peninsula	5,000+
April 24, 1771	7.4 *M*	1771 Great Yaeyama Tsunami	24.0°N 124.3°E	13,486[20]
May 21, 1792	6.4 *M*	1792 Unzen earthquake and tsunami	32.8°N 130.3°E	15,448[21]
December 23, 1854	8.4 *M*	1854 Ansei-Tōkai earthquake	Suruga Bay	2,000 (estimated)
December 24, 1854	8.4 *M*	Ansei-Nankai earthquake	Nankai Trough	10,000+
November 11, 1855	6.9 *M*	Ansei Edo earthquake	Edo, near the mouth of the Arakawa River	6,641
April 9, 1858	7.0-7.1	Hietsu earthquake	Atotsugawa Fault	200–300
July 28, 1889	6.3	1889 Kumamoto earthquake	Tatsuda fault	20
October 28, 1891	8.0 *M*	1891 Mino-Owari earthquake	Neodani Faultline	7,273
June 20, 1894	6.6 *M*	Meiji Tokyo earthquake	Tokyo Bay	31
June 15, 1896	8.5 M_L	Meiji-Sanriku earthquake		22,000

Date	Magnitude	Name of quake	Epicenter	Death toll
September 1, 1923	8.3 *M*	1923 Great Kantō earthquake	Izu Ōshima	142,800
May 23, 1925	6.8 *M*	1925 Kita Tajima earthquake	Toyooka inHyogo Prefecture	428
March 27, 1927	7.6 *M*	1927 Kita Tango earthquake	Tango Peninsula in Kyoto Prefecture	3,020
November 26, 1930	7.3 *M*	1930 North Izu earthquake	Izu Peninsula	272
March 2, 1933	8.4 *M*	1933 Sanriku earthquake	290 km (180 mi) east of the city ofKamaishi, Iwate	3,000+
November 3, 1936	7.2 *M*	1936 Miyagi earthquake	offshoreMiyagi	
September 10, 1943	7.2 *M*	1943 Tottori earthquake	offshore from Ketaka District	1,083
December 7, 1944	8.1 *M*	1944 Tōnankai earthquake	34.0°N 137.1°E	1,223
January 13, 1945	6.8 *M*	1945 Mikawa earthquake	Mikawa Bay	1180 + 1126 missing
December 20, 1946	8.1 *M*	1946 Nankaidō earthquake	Nankai Trough	1,362
June 28, 1948	7.1 *M*	1948 Fukui earthquake	nearMaruoka, Fukui	3,769

Date	Magnitude	Name of quake	Epicenter	Death toll
March 4, 1952	8.1 *M*	1952 Hokkaido earthquake	42.3°N 144.9°E	28
June 16, 1964	7.6 *M*	1964 Niigata earthquake	50 km north of Niigata	26
April 1, 1968	7.5 *M*	1968 Hyūga-nada earthquake	Hyūga-nada Sea	
May 16, 1968	8.2 *M*	1968 Tokachi earthquake	Offshore ofMisawa, Japan	52
May 9, 1974	6.5 *M*	1974 Izu Peninsula earthquake	near Izu Peninsula	25
June 12, 1978	7.7 *M*	1978 Miyagi earthquake	just offshoreMiyagi Prefecture	28
July 12, 1993	7.7 *M*	1993 Hokkaidō earthquake	42.851°N 139.197°E	202
December 28, 1994	7.7 *M*	1994 offshore Sanriku earthquake	40.451°N 143.491°E	3
January 17, 1995	**7.2 *M***	**Great Hanshin earthquake**	**northern end of Awaji Island**	**6,434**
May 4, 1998	7.5 *M*	1998 Ryukyu Islands earthquake	22.30°N 125.30°E	0
March 24, 2001	6.7 *M*	2001 Geiyo earthquake	34.083°N 128.020°E	2
September 25, 2003	8.3 *M*	2003 Hokkaidō	41.78°N 143.86°E	1

Date	Magnitude	Name of quake	Epicenter	Death toll
		earthquake		
October 23, 2004	6.9 *M*	2004 Chūetsu earthquake	Ojiya, Niigata	40
March 20, 2005	7.0 *M*	2005 Fukuoka earthquake	In theGenkai Seaabout 6 km (3.7 mi) northwest ofGenkai Island at the mouth of Fukuoka Harbor	1
August 16, 2005	7.2 *M*	2005 Miyagi earthquake	about 55 km (34 mi) due east of the Oshika Peninsula in Miyagi Prefecture	0
November 15, 2006	8.3 *M*	2006 Kuril Islands earthquake	about 160 km (99 mi) due east of the southern tip of Simushirin the Kuril Islands	0
January 13, 2007	8.1 *M*	2007 Kuril Islands earthquake	46°28.8′N154°04.48′E	0
March 25, 2007	6.9 *M*	2007 Noto earthquake	about 11 km (6.8 mi) due west of the southern end of the town of Wajima	1
July 16, 2007	6.6 *M*	2007 Chūetsu offshore earthquake	about 29 km (18 mi) west of Niigata	11
June 14, 2008	6.9 *M*	2008 Iwate-Miyagi Nairiku earthquake	about 1 km (0.62 mi) east of Narusawa Onsen in northwestIwate Prefecture	12
August 9, 2009	6.9-7.1 *M*	2009 Izu Islands earthquake	33.144°N, 138.040°E, depth 303.1 km	0

Date	**Magnitude**	**Name of quake**	**Epicenter**	**Death toll**
August 11, 2009	6.5-6.6 *M*	Tokai Area Earthquake	33.8°N, 138.50°E, depth 20.0 km	1
February 26, 2010	7.0 *M*	Ryūkyū Islands earthquake	25.902°N, 128.417°E, depth 22.0 km	1
December 21, 2010	7.4 *M*	Bonin Islands earthquake	26.866°N, 143.739°E, depth 14.9 km	0
March 9, 2011	7.2 *M*	2011 Tōhoku earthquakeforeshock	38.424°N, 142.836°E, depth 32 km	
March 11, 2011 05:46:23 UTC (14:46 JST)	**9.0 *M***	**2011 Tōhoku earthquake**	**38.510°N, 142.792°E, depth 24.4 km**	**15,889 deaths, confirmed.**
March 11, 2011 06:25:50 UTC	7.1 *M*	2011 Tōhoku earthquakeaftershock	38.106°N, 144.553°E, depth 19.7 km	
April 7, 2011 23:30:00 JST	7.1 *M*	2011 Miyagi earthquakeaftershock	38.253°N, 141.640°E, depth 49 km	4
April 11, 2011 17:16:13 JST	7.1 *M*	2011 Fukushima earthquakeaftershock	37.007°N, 140.477°E, depth 10 km	6
July 10, 2011 10:57:12 JST	7.0 *M*	2011 Fukushima earthquakeaftershock	38.040°N, 143.287°E, depth 49 km	0
January 1, 2012 14:27:54 JST	6.8 *M*	Izu Islands, Japan	31.416°N, 138.155°E, depth 348.5 km	3
December 7, 2012 17:18:24 JST	7.3 *M*	2012 Kamaishi earthquake	37.700°N, 144.600°E, depth 32.0 km	0

Table.01. History of earthquake in Japan (source Wikipedia)

Specially except few incidents all other times death toll was very low. There are many reasons behind that secrets and major reason is they have applied building code for resilience of the buildings and all infrastructure development projects DRR had been applied as well.

2.4. Severe damage caused by major typhoon and after flood

Year	Typhoon	Death Toll
1945	Makurazaki Typhoon	3,756
1947	Catherine Typhoon	1,930
1948	Ion Typhoon	838
1949	Kitty Typhoon	160
1950	Jane Typhoon	539
1951	Ruth Typhoon	943
1954	Toyamaru Typhoon (with big ferry shipwreck)	1,761
1958	Kanogawa Typhoon	1,269
1959	Ise-wan Typhoon	5,098

Table 02. Major Typhoons with death toll (Source international recovery platform)

A typhoon (Japanese: taifu) is a large low pressure system, originating over the Northwest Pacific Ocean. It is accompanied by strong winds of up to around 200 km/h, a rise of the sea level and torrential rain falls. Over the Atlantic Ocean, typhoons are known as hurricanes.

About thirty typhoons form each year over the Northwest Pacific Ocean, of which typically about seven or eight pass over Okinawa Prefecture, and about three hit the Japanese main islands, especially Kyushu and Shikoku. But any region in Japan including Tokyo, Osaka and Hokkaido can be visited by typhoons. Most typhoons hit Japan between May and October with August and September being the peak season. Typhoons later in the season tend to be stronger than typhoons earlier in the season. In Japan, typhoons are numbered rather than being given a personal name. For example, the twelfth typhoon of the year is known as "typhoon number 12". In the past, catastrophic typhoons have sometimes caused hundreds of casualties, such as the Isewan Typhoon in 1959, which cost the lives of more than 5000 people. In recent decades, however, the number of people killed by typhoons has been much lower. The biggest dangers posed by typhoons are landslides and the sudden rise of water levels. (Japanguide.com)

2.5. Volcanic Disaster in Japan

Figure.10. Mount Ontake erupts in September killing 51 people

Japan's first documented historical eruption was from Aso volcano in 553 AD, the year after Buddhism was introduced from Korea. It holds a record in the number of historically documented eruptions. Japan's largest historical eruption (Towada, 915 AD), 17 Japanese volcanoes had been documented in eruption, more than the rest of the world combined (including 10 in Europe).

Japan has over 100 active volcanoes, more than almost any other country and accounts alone for about 10 % of all active volcanoes in the world. The volcanoes belong to the Pacific Ring of Fire, caused by subduction zones of the Pacific plate beneath continental and other oceanic plates along its margins.

Japan is located at the junction of 4 tectonic plates - the Pacific, Philippine, Eurasian and North American plates, and its volcanoes are mainly located on 5 subduction-zone related volcanic arcs where the Pacific Plate descends under the North American Plate along the Kuril Trench and the Japan Trench and underneath the Philippine Sea Plate along the Izu-Bonin Trench. (www.glgarcs.net/intro/subduction.html)

3. Objectives and Methodology

3.1. Objective of this studying

- Studying the Japanese Disaster Risk Management System, Legal framework and related preparedness planning countermeasure.
- Studying Hyogo prefecture's people's preparedness for natural hazards and evaluates the success of the CBDRM program.
- Getting exposure participation DRR activities by Japanese authorities

3.2. Methodology

Basically, research plan was consist of exploring the disaster risk management framework in Japan. Collecting information by secondary data was main resource fool in the research. Mainly disaster legal framework and revolutionary changers of the disaster acts, policy and other legal document for disaster risk management issued by government were thoroughly studied. Followings activities are practiced for data collection

- Official visiting of government offices responsible for DRR in Japan
- Collection of written information and data in relation to DRM in Japan.
- Collection of lows, act and circulars relating DRM issues
- Participation of International Disaster Symposiums on DRR
- Participation for the presentations delivered by government organizations

Key informant discussion was very important to acquire lot of information on disaster management system in Japan. Pre-prepared questioner forwarded to them in advanced for getting better answers and finally based on questioner, interviews and discussion carried out by meeting them.

By visiting the main historical disaster places such as Sendai (Tohuku earthquake), Hanshin Awaji Earthquake Museum, Unzen volcanic eruption places and surrounds, Unzen Geo-Park, Nagasaki atomic bomb museum, epicenter and park place etc, comprehensive knowledge was accumulated on disaster impact and disaster lesson learnt countermeasures.

Comprehensive survey was carried out for the Hyogo prefectural people to evaluate their preparedness level for natural hazards. Random sampling technique (online) was used to select the persons. Sample size was 40 people.

During research period, five International Symposiums on Disaster Risk Management conducted by various Japanese institutions were participated. Scientific discussions, ideas for development of DRM in Japan and Asia, Japanese academia's responsibility in the field of DRM were studied thoroughly.

4. Disaster Management Framework in Japan

4.1. Disaster Management Councils at National, Prefectural and Municipal level

Disaster Management System in Japan

National Government Prime Minister

Central Disaster Management Council ← Formulating and promoting implementation of basic disaster management plans

Designated Governmental Organization ← Formulating and implementation disaster management **operation** plan

Designated Public Organization

Prefectural Level Governor

Prefectural Disaster Management Council ← Formulation and promotion implementation of local disaster management plans

Designated Local government Organizations

Designated Local Public Corporations

Municipality level

Mayer of Cities, Town and Village

Municipal Disaster Management Council Formulation and promotion implementation of local disaster management plans

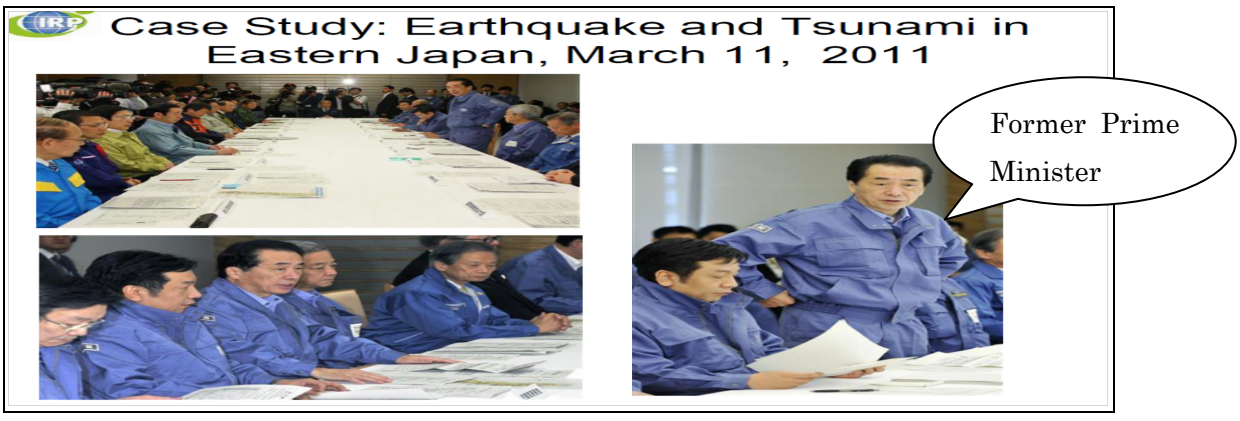


Figure. 10. Central disaster management council meeting

4.2. Disaster Prevention and Preparedness Measures

4.2.1Basic Legal Frameworks for Disaster Management in Japan

History of development of Japanese disaster management system and laws related to disasters

Year	Event	Major Act	Disaster Management Plan
1940	45 ・ Typhoon Makurazaki 46 ・ Nankai Earthquake 47 ・ Typhoon Catherine 48 ・ Fukui Earthquake	47. Fool control act 48. Disaster Relief act	
1950	1959 Typhoon Ise-wan	**1950** . Building Standard Law	
1960		**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 ・ Act on Special Measures for Heavy Snowfall Areas	**1961** Designation of Disaster Reduction Day **1962** Establishment of Central Disaster Management Council **1963** Basic Disaster Management Plan
1970	**73** ・ Mt. Sakurajima Eruption ・ Mt. Asama Eruption **76** ・ Seismological Society of Japan's report about the possibility of Tokai Earthquake **78** ・ Miyagi-ken-oki arthquake	**1973** ・ Act on Special Measures for Active Volcanoes **1978** ・ Act on Special Measures for Large-Scale Earthquakes	**1979** Tokai Earthquake Contermeasures Basic Plan
1980		**1980** ・ Act on Special Financial Measures for Urgent Earthquake Countermeasure Improvement Projects in Areas for Intensified Measures **1981** ・ Amendment of Building Standard Law	**1983** Designation of Disaster Reduction Week Campaign
1990	**1995** ・ Great Hanshin-Awaji Earthquake	**1995** ・ Act on Special Measures for Earthquake Disaster Countermeasures ・ Act on Promotion of the Earthquake-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	**1995** Amendment of Basic Disaster Management Plan Disignation of Disaster Reduction and Volunteer Day

	1999 ・Torrential Rains in Hiroshima ・JCO Nuclear Accident	Specified Disasters **1997** ・Act on Promotion of Disaster Resilience Improvement in Densely Inhabited Areas **1998** ・Act on Support for Livelihood Recovery of Disaster Victims **1999** ・Act on Special Measures for Nuclear Disasters	
2000	2000・Torrential Rains in the Tokai Region 2004・Niigata-Fukushima Torrential Rains, etc. 2004. Niigata-ken-Chuetsu Earthquake	**2000** ・Act on Promotion of Sediment Disaster Countermeasures for Sediment Disaster Prone Areas **2001** ・Amendment of Flood Control Act **2002** ・Act on Special Measures for Promotion of Tohnankai and Nankai Earthquake Disaster Management **2003** ・Specified Urban River Inundation Countermeasures Act **2004** ・Act on Special Measures for Promotion of Disaster Management for Trenchtype Earthquakes in the Vicinity of the Japan and Chishima Trenches **2005** ・Amendment of Flood Control Act ・Amendment of Act on Promotion of Sediment Disaster Countermeasures for Sediment Disaster Prone Areas ・Amendment of Act on Promotion of the Earthquake-proof Retrofit of Buildings **2006** ・Amendment of Act on the Regulation of Residential Land Development	**2005** Tokai Earthquake Disaster Reduction Strategy Tonankai and Nankai Earthquake Disaster Reduction Strategy Policy Framework for Tokyo Inland Earthquakes **2006** Policy Framework for Trench-type Earthquakes in the Vicinity of the Japan and Chishima Trenches Tokyo Inland Earthquake Disaster Reduction Strategy Basic Framework for promoting a Nationwide Movement for Disaster Reduction **2008** Disaster Management Strategy for Trench-type Earthquakes in the Vicinity of the Japan and Chishima Trenches **2009** Chubu and Kinki regions Inland Earthquake ountermeasures Basic Plan

Table.03. History of revolutionary changers and development of disaster management act

Basically after the main disasters almost all the act and legal provisions have been developed to overcome such issues with lesson learn experience.

4.2.2. The names of different act and circulars Japanese government issued time to time for various kinds of disaster issues

1. Erosion Control Act (1897)
2. Building Standard Law (1950)
3. Forest Act (1951)
4. Act on Temporary Measures for Disaster Prevention and Development of Special Land Areas (1952)
5. Meteorological Services Act (1952)
6. Seashore Act (1956)
7. Landslide Prevention Act (1958)
8. Act on Special Measures for Disaster Prevention in Typhoon-prone Areas (1958)
9. Act on Special Measures for Heavy Snowfall Areas (1962)
10. River Act (1964)
11. Act on Prevention of Steep Slope Collapse Disaster (1969)
12. Act on Special Measures for Active Volcanoes (1973)
13. Act on Special Financial Measures for Urgent Earthquake Countermeasure Improvement Projects in
    Areas for Intensified Measures (1980)
14. Act on Special Measures for Earthquake Disaster Countermeasures (1995)
15. Act on Promotion of the Earthquake-proof Retrofit of Buildings (1995)
16. Act on Promotion of Disaster Resilience Improvement in Densely Inhabited Areas (1997)
17. Act on Promotion of Sediment Disaster Countermeasures for Sediment Disaster Prone Areas (2000)
18. Specified Urban River Inundation Countermeasures Act (2003) Vicinity of the Japan and Chishima Trenches (2004)

Basic Acts

1. **Disaster Countermeasures Basic Act (1961)**
2. Act on Prevention of Marine Pollution and Maritime Disaster (1970)
3. Act on Disaster Prevention in Petroleum Industrial Complexes and other Petroleum Facilities (1975)
4. Act on Special Measures for Large-scale Earthquakes (1978)
5. Act on Special Measures for Nuclear Disasters (1999)
6. Act on Special Measures for Promotion of Tonankai and Nankai Earthquake Disaster Management (2002)
7. Act on Special Measures for Promotion of Disaster Management for Trench-type Earthquakes in the

Disaster countermeasures basic act is the strong act was created at that time considering all the issues and lesson learnt experience. In 1959 Ise-Wan typhoon was the major calamity to think on develop the disaster countermeasure basic act which is still powerful tool for disaster management activities.

4.3. Early Warning Dissemination Mechanism

Japanese Meteorological Department is the major Early Warning issuing agency in the Japan for almost all the Natural Disasters. Its head office is located in Tokyo and in all the prefectures they have sub office. The JMA consists of separate divisions and department as per assigned duties relevant to various hazards.

As of 1 October 2007, the Japan Meteorological Agency (JMA) starts the Earthquake Early Warning, a new service that advises of strong tremors before they arrive and forecasts of strong ground motion caused by earthquakes

4.3.1. Earthquake Early Warning

The Earthquake Early Warning system automatically calculates the focus and magnitude of the earthquake and estimates the seismic intensity for each location by detecting the quake (i.e. the P-wave, or the preliminary tremor) near its focus. An Earthquake Early Warning is then given a matter of seconds (i.e. a few seconds to a few tens of seconds) before the arrival of strong tremors (i.e. the S-wave, or principal motion). Earthquake Early Warnings will be provided through various media outlets such as TV and radio (JMA web).

It is reported that strong tremors may arrive at the same time as the Earthquake Early Warning (EEW) in areas that are close to the focus of the earthquake. The National Research Institutes for Earth Science and Disaster Prevention and IED Hi-net, have developed a new system for estimating the immediate epicenter, magnitude, and also mechanism solutions intended for large earthquakes relatively. AQUA system **(A accurate and QUICK A** was named analysis system

for source parameters).

On the other hand, from October 1, 2007, full-scale implementation of earthquake early warning has been initiated at the Japan Meteorological Agency. The earthquake early warning system that has been developed by NIED and NIED Hi-net data has contributed significantly. The new AQUA system can estimate the epicenter instantaneously based on the wearing arrive method of using the Hi-net continuous data to be transmitted in real time from the observation point of the national first.

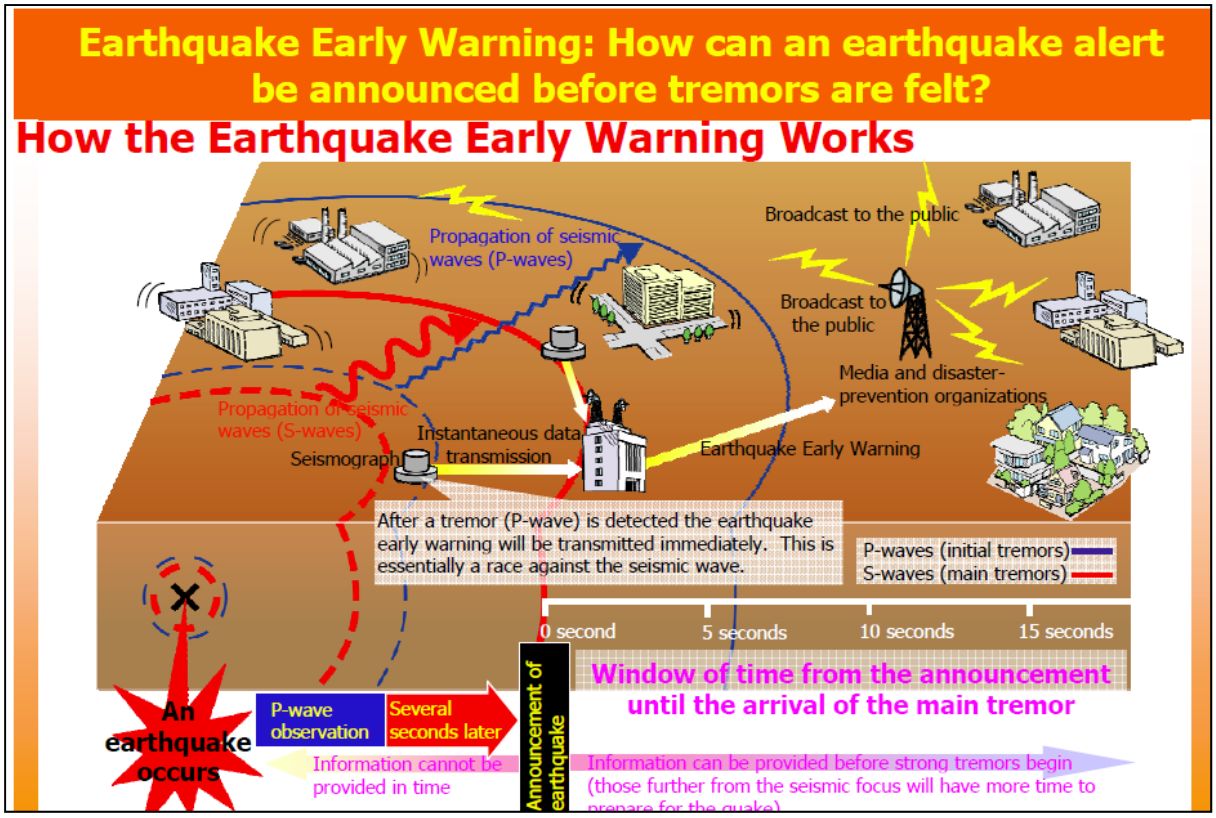


Figure.11.Early warning dissemination mechanism

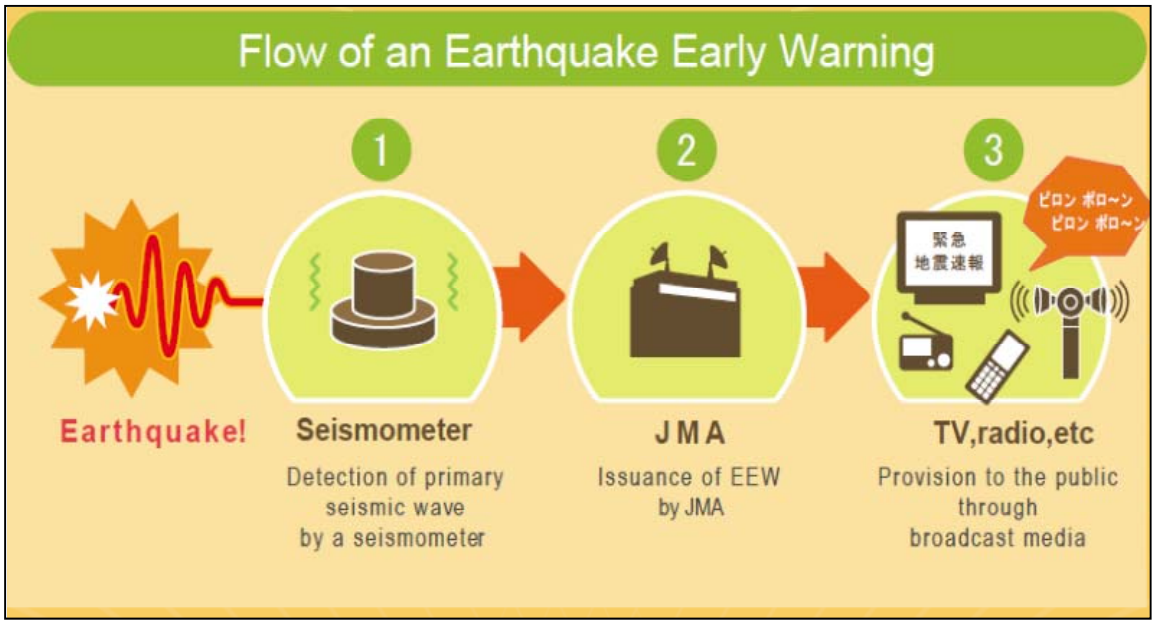


Figure.12. flow of Earthquake early warning

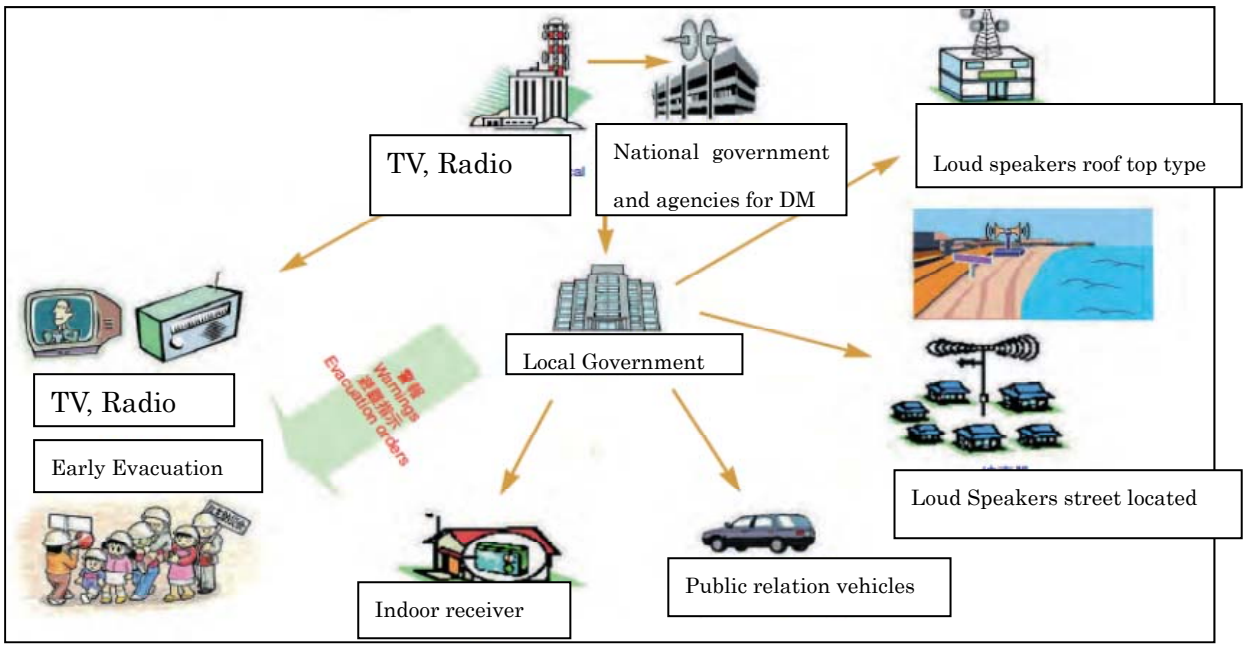


Figure .13. Early Warning mechanism in Japan

The Earthquake Early Warning system provides advance announcement of the estimated seismic intensities and expected arrival time of principal motion. These estimations are based on prompt analysis of the focus and magnitude of the earthquake using wave form data observed by seismographs near the epicenter.

The Earthquake Early Warning is aimed at mitigating earthquake-related damage by allowing countermeasures such as promptly slowing down trains, controlling elevators to avoid danger and enabling people to quickly protect themselves in various environments such as factories, offices, and houses and near cliffs.

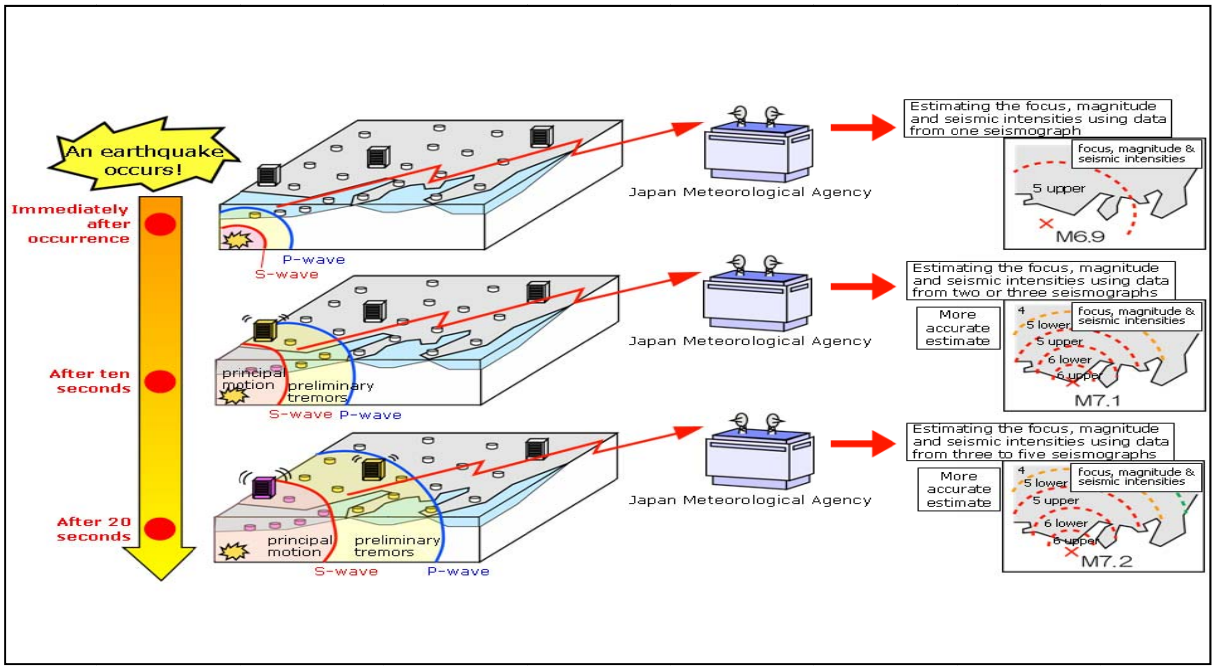


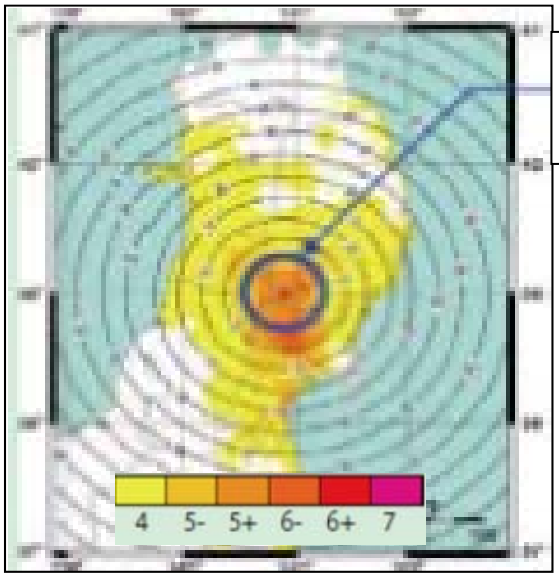
Figure.14.Semmic wave receiving and its processing procedure (source JMA websites)

Category	Details	Earthquake Early Warning dissemination methods
EEW (warning)	● **Estimated original time, Hypocenter and Magnitudes** ● **Area where seismic intensity is 4 or greater**	**Disaster management radio, TV, social media, internet.**
EEW (forecast)	● **Estimate original time, Hypocenter, Magnitudes.** ● **Area where seismic intensity is 4 or greater** ● **Estimated maximum intensity** ● **Expected arrival time of principal motion with a seismic intensity of 4 or greater**	**Through EW receiver and dedicated system**

Table.04. Earthquake early warning

EEW seismic intensity estimations have an error margin of ± 1 or so. If multiple earthquakes occur almost simultaneously or in close proximity to each other, warnings may be inaccurate because the system cannot tell them apart. For deep-focus earthquakes with a focal depth of 100 km or more, seismic intensity estimations may lack accuracy. In areas close to the focus of earthquakes, warnings may not arrive in time before strong tremors hit (see the example below).

Some areas may be hit by strong tremors before the announcement of an EEW in the event of local earthquakes occurring inland. However, EEWs provide between several and a few tens of seconds to take action before strong tremors hit for large inter-plate earthquakes far from land.



The area circled hit by strong tremor is before EEW announcement

Figure.15. EQ intensity distribution

EEWs are issued with the flow shown above. Their provision requires a dense observation system to detect earthquakes quickly, advanced technology to allow prompt estimation of seismic intensity with limited Figure.15. Earthquake intensity distribution data, and appropriate communication technology to disseminate warnings. The EEW system leverages the cteristics of seismic waves, which propagate in all directions from the focal point of an earthquake and are generally primary waves (P-waves) and secondary waves (S-waves). S-waves propagate more slowly than P-waves but move with high amplitude and cause damage. P-waves travel at about 7 km/s (25,200 km/h), while S-waves travel at about 4 km/s (14,400 km/h). This speed difference allows an EEW to be issued right after the P-wave is detected and before the S-wave arrives.

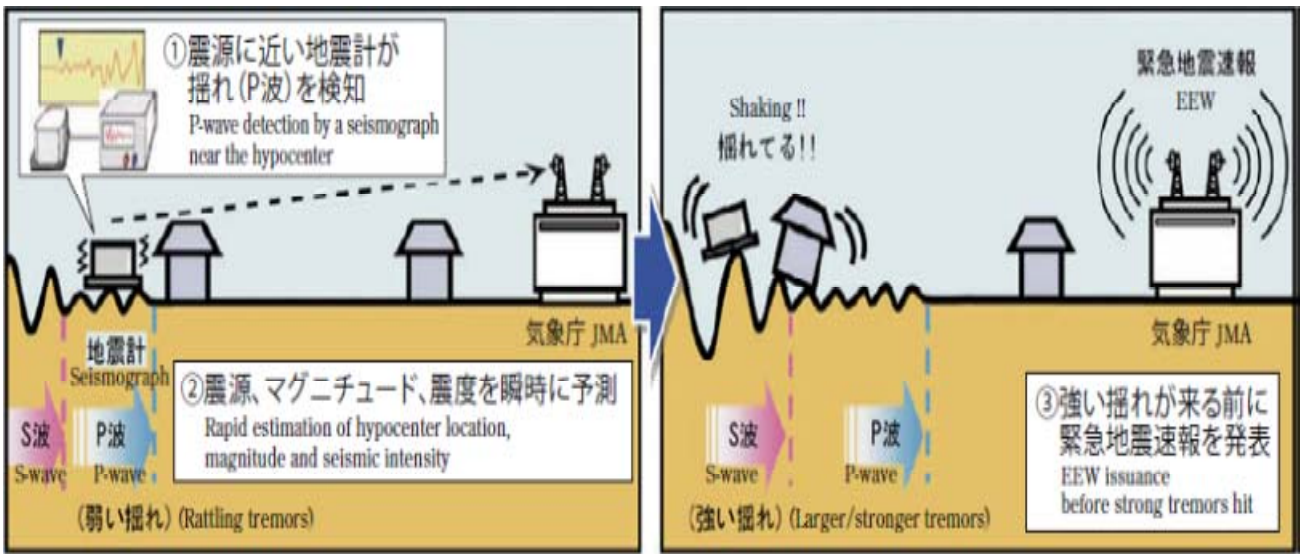


Figure.16.Earthquake wave transmission

EEWs are issued with the flow shown above. Their provision requires a dense observation system to detect earthquakes quickly, advanced technology to allow prompt estimation of seismic

intensity with limited data, and appropriate communication technology to disseminate warnings. The EEW system leverages the characteristics of seismic waves, which propagate in all directions from the focal point of an earthquake and are generally primary waves (P-waves) and secondary waves (S-waves). S-waves propagate more slowly than P-waves but move with high amplitude and cause damage. P-waves travel at about 7 km/s (25,200 km/h), while S-waves travel at about 4 km/s (14,400 km/h). This speed difference allows an EEW to be issued right after the P-wave is detected and before the S-wave arrives.

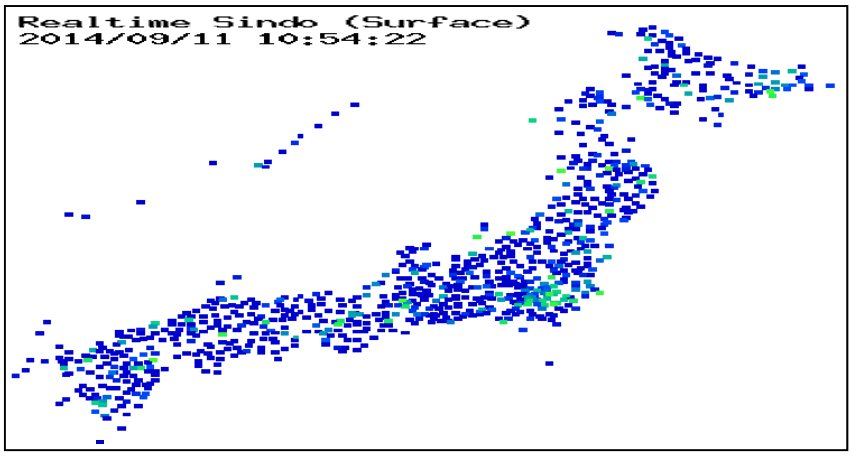


Figure.17. Real time earthquake monitoring system in Japan

4.3.2 Tsunami Warning advisory

When an earthquake occurs, the Japan Meteorological Agency (JMA) estimates the possibility of tsunami generation from seismic observation data. If disastrous waves are expected in coastal regions, JMA issues a Tsunami Warning/Advisory for each region expected to be affected based on estimated tsunami heights. JMA also issues information on tsunami details such as estimated arrival times and heights. (JMA websites)

4.3.3. Volcanic Early Warning

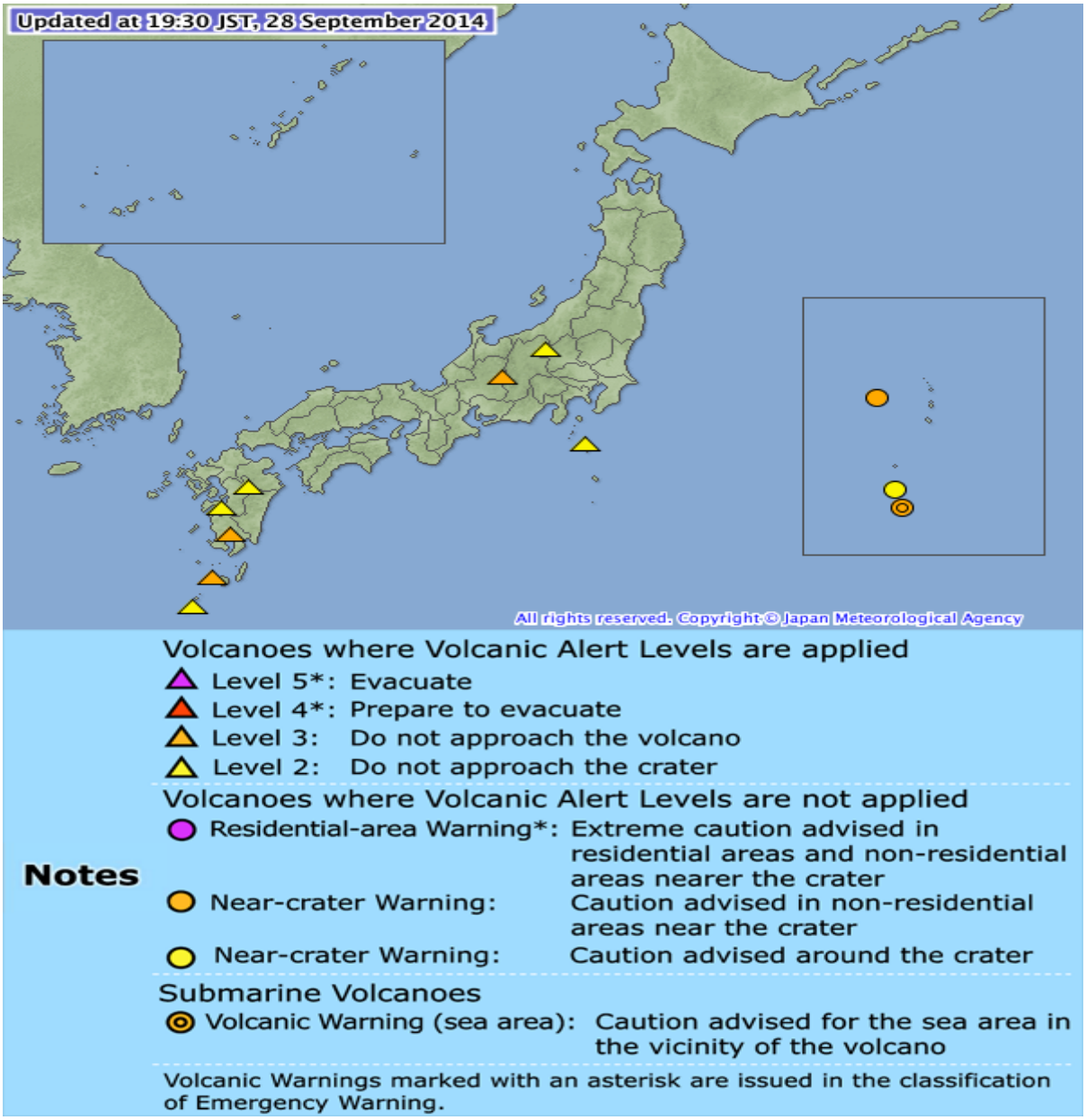
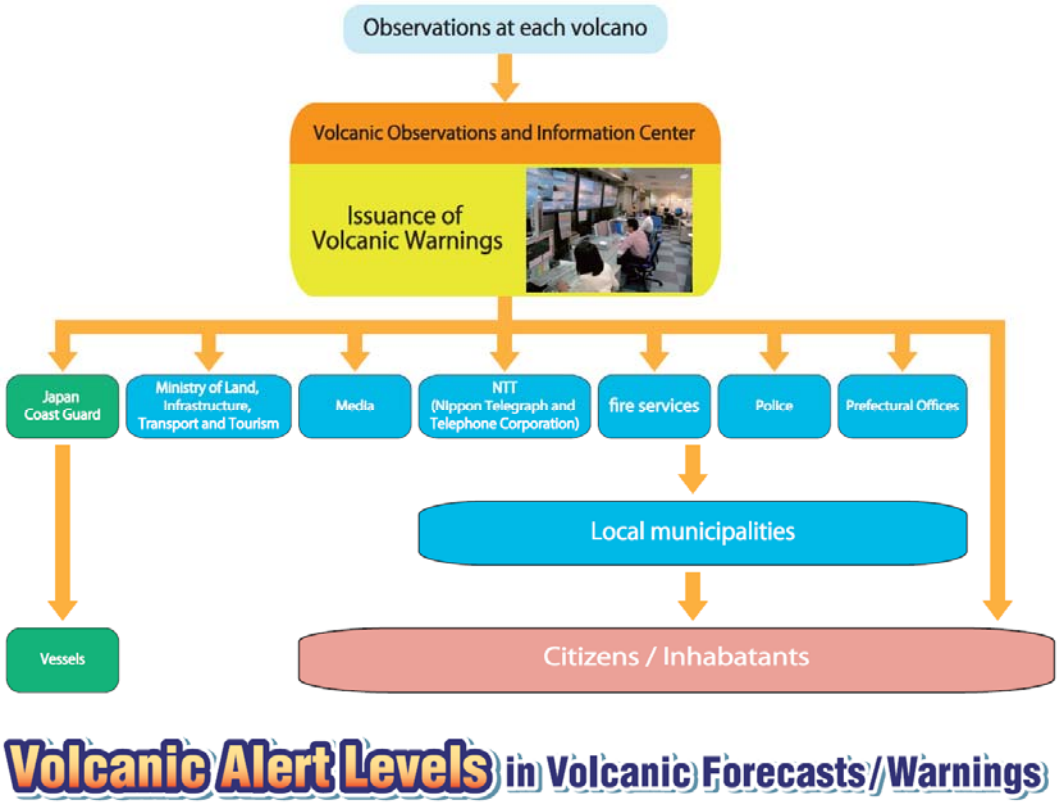


Figure 18 Major volcanic places



Volcanic alert level are classified as five section in terms of target areas and action to be taken. Only warning issues to residents if the treat comes to level four or five stage.

Classification	Abbreviated Term	Target area	Levels & Keyword	Explanation		
				Expected volcanic activity	Action to be taken by inhabitants	Action to be taken by climbers
Emergency Warning	Volcanic Warning (Residential area) (a.k.a. Residential area Warning)	Residential areas	Level 5 Evacuate	Eruption that may cause serious damage in residential areas, or imminent eruption.	Evacuate from the danger zone. (Target areas and evacuation measures are determined in line with current volcanic activity.)	
			Level 4 Prepare to evacuate	Possibility or increasing possibility of eruption that may cause serious damage in residential areas.	Prepare to evacuate from alert areas. Let disabled persons evacuate. (Target areas and evacuation measures are determined in line with current volcanic activity.)	
Warning	Volcanic Warning (Near the crater) (a.k.a. Near-crater Warning)	Non-residential areas near the crater	Level 3 Do not approach the volcano	Eruption or possibility of eruption that may severely affect places near residential areas (threat to life is possible in these areas).	Stand by, paying attention to changes in volcanic activity. Let disabled persons prepare to evacuate in line with current volcanic activity.	Refrain from entering the danger zone. (Target areas are determined in line with current volcanic activity.)
		Around the crater	Level 2 Do not approach the crater	Eruption or possibility of eruption that may affect areas near the crater (threat to life is possible in these areas).	Stay as usual.	Refrain from approaching the crater. (Target areas around the crater are determined in line with current volcanic activity.)
Forecast	Forecast	Inside the crater	Level 1 Normal	Normal: Volcanic ash emissions or other related phenomena may occur in the crater (threat to life is possible in these areas).		No restrictions. (In some cases, it may be necessary to refrain from approaching the crater.)

Figure.19. Volcanic alert early warning system(source JMA web)

4.3.4. Emergency Warning and Warning Advisories

Emergency Warnings are intended for extraordinary phenomena expected to be of a scale that will far exceed the warning criteria. Warnings and Advisories continue to be issued in their current form even after the introduction of Emergency Warnings.

Residents should not let down their guard even if no Emergency Warning is currently in effect in the area. It is important to take action early wherever possible with reference to relevant weather bulletins, Advisories and Warnings, which are updated in response to the latest phenomenon observations or predictions.

The criteria for Emergency Warning issuance were determined in response to the views of local governments in charge of disaster management for their own areas. In regard to earthquakes, tsunami and volcanic eruptions, JMA maintains the system of warning nomenclature used until 29 August, 2013 but issues messages in the new classification of Emergency Warnings for high-risk conditions. These include Major Tsunami Warnings, Volcanic Warnings (Level 4 or more) and Earthquake Early Warnings (incorporating prediction of tremors measuring 6-lower or more on JMA's seismic intensity scale).

4.3.5. Extreme weather warning

Early Warning Information on Extreme Weather is issued at 14:30 JST every Monday and Thursday when a high probability (30% or more) of very high or very low seven-day averaged temperature, or very heavy seven-day total snowfall is predicted in the week starting from five to eight days ahead of the date of announcement. If information was issued on the preceding announcement date, follow-up information is issued on the next date of announcement. The terms very high and very low refer to high or low seven-day averaged temperatures that are in the top 10% of all samples.

5. Hyogo Prefecture Disaster Management System

5.1. Overview of Hyogo Prefecture

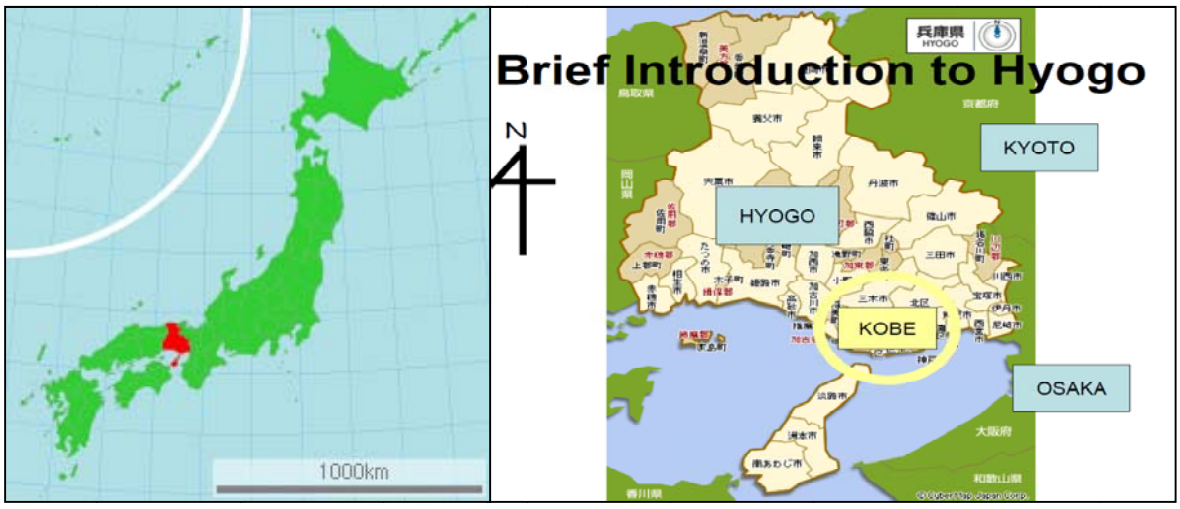


Figure.20. Hyogo prefectural map

Hyogo prefecture is located in Kansai region in Honshu Island. It the largest island the Japan. Hyogo has coastlines on two seas to the north, the Sea of Japan, to the south, the Inland Sea. Hyogo borders on Osaka Prefecture, Kyoto Prefecture, Tottori Prefecture and Okayama Prefecture. The northern portion is sparsely populated, except for the city of Toyooka, and the central highlands are only populated by tiny villages. Most of Hyogo's population lives on the southern coast, which is part of

the Osaka-Kobe-Kyoto metropolitan area. Awaji Island is an island in the inland sea, lying between Honshu and Shikoku islands. Rokko island and Port island are the islands made by Japanese government where are located in Hyogo prefecture.

As of March 31, 2008, 20% of the total land area of the prefecture was designated as Natural Parks which are very important to use as the earthquake evacuation places or first gathering point. About 29 cities are included in Hyogo prefecture (Namely Aioi, Akashi, Akō, Amagasaki, Asago, Ashiya, Awaji, Himeji, Itami, Kakogawa, Kasai, Katō, Kawanishi, Kobe (capital), Miki, Minamiawaji, Nishinomiya, Nishiwaki, Ono, Sanda, Sasayama, Shisō, Sumoto, Takarazuka, Takasago, Tamba, Tatsuno, Toyooka Yabu) (Wikipedia).

Hyogo is the industrial part of the Hanshin industrial region in Japan. Kobe port is the main port support to their economi with huge industries such as metal, beverage, and medial etc.

Figure.21. Kobe port and city view

5.2. Different Hazard threatened to Hyogo Prefecture

1. Typhoons

Typhoons occur between July and October, bringing torrential rain and extremely strong winds. Landslides and flooding can occur due to typhoons. There is also a risk of injuries due to fragments that have been blown about, and flood tides.

Tropical cyclones occurring at a longitude of 100-180 degrees east in the Pacific Ocean or East China Sea with minimum wind speed of 17.2m/s near the center are called "typhoons." They are the same as hurricanes and cyclones. Caution is necessary, because typhoons can cause a great deal of damage. The mean pressure of the surrounds of Japan is 1013hPa (Hectopascal); when a typhoon approaches, the air pressure goes down. The lower the air pressure, the stronger the wind and rain tend to become. The winds of a typhoon in Japan blow in an anticlockwise direction. Moving towards the right-hand side in the direction of the typhoon, this side is even stronger than the left-hand side because the wind which is enerated by the typhoon itself blows in the same direction as the wind which is moving the typhoon. The extent of the damage varies considerably depending on the path which the typhoon takes, so you should prepare for typhoons by measures such as watching the weather forecast. It is essential to be careful of high tides around the coastline due to rises in sea levels and strength of the wind caused by the low air pressure. Sea levels go up 1cm for every 1hPa that air pressure drops, and grows higher by square in proportion to the power of the wind speed. When the effect of the high water levels is added to high tide, this can result in serious damage; you should avoid going near the sea at such times.

2. Earthquake

Japan is one of countries most frequently affected by earthquakes in the world. Hyogo prefecture is highly vulnerable to earthquake disaster may occur 9M nearly 100 year return period. Great Hanshin Awaji earthquake was major disaster ever impacted huge damage Hyogo prefecture and Japan as well. In the Prefecture level history many severer earthquakes were happed with large scale impact on human lives as well as property damages.

3. Tsunami

Based on Earthquake occurrence intensity, there are considerable threats of occurrence of tsunami hazards to the Hyogo prefecture. As per the tsunami hazard map developed by prefecture, 3-2 meters height waves are expected in high hazard areas.

4. Sediment Disaster

Rokko mount located along the prefecture has created the treat of landslide, sediment and rock failures. Lower areas are highly vulnerable for the sediment disasters, high probability of creating huge impact on people lives and property in the prefecture

5.3. Legal Provision for Disaster Management activities for Prefecture

By Disaster Countermeasures basic act, Act no 223, 1997, has given the authority to Prefecture government for disaster management activities within their premises. Act says

Art. 4. In the interest of protecting the area of a prefecture, the life and limb of its residents and their property from disaster, the prefecture shall have the responsibility to formulate and implement, with the cooperation of agencies concerned and other local governments, a disaster prevention plan relating to its area, as prescribed by law, and at the same time, shall assist in the performance of business or operations related to disaster prevention of a city, town or village, and designated local administrative organs within the area, and shall exercise responsibility for overall coordination of such business or operations. 2. Agencies of a prefecture shall, in performing their business or operations, act in concert in order that responsibilities of the prefecture as provided under the preceding paragraph may be fulfilled.

5.4. Disaster Preparedness in Hyogo Prefecture

5.4.1. Hazard and Risk Map Prepared by Hyogo Prefecture government

Preparation of Hazard and risk map is mandated task of particular municipality. National government has introduced the major plan as a guideline. Based on that guide line each municipality should prepare the hazard map. Almost all municipalities have displayed them in the websites where people are much familiar and easily accessible. Some municipality has put the live monitoring system using web camera which is general public can access. Specially river and water level fluctuation and vulnerable areas those camera can be seen.

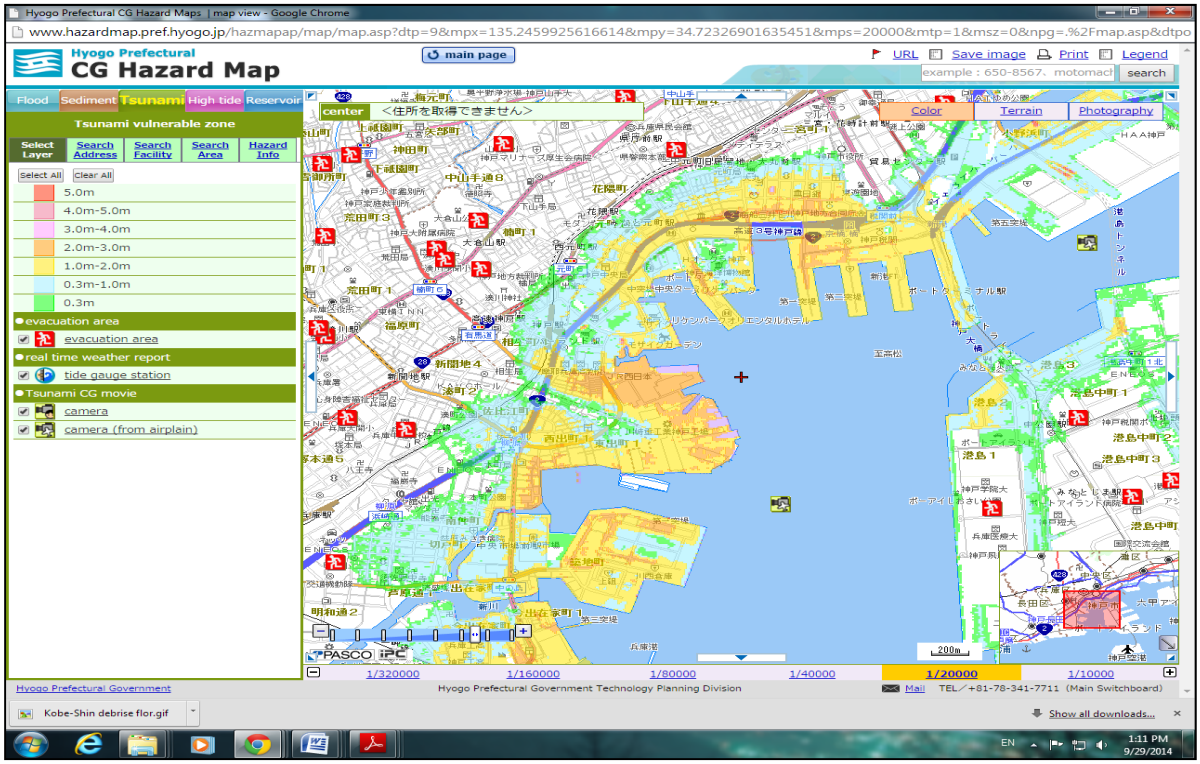


Figure.22. Tsunami Hazard Map of Kobe

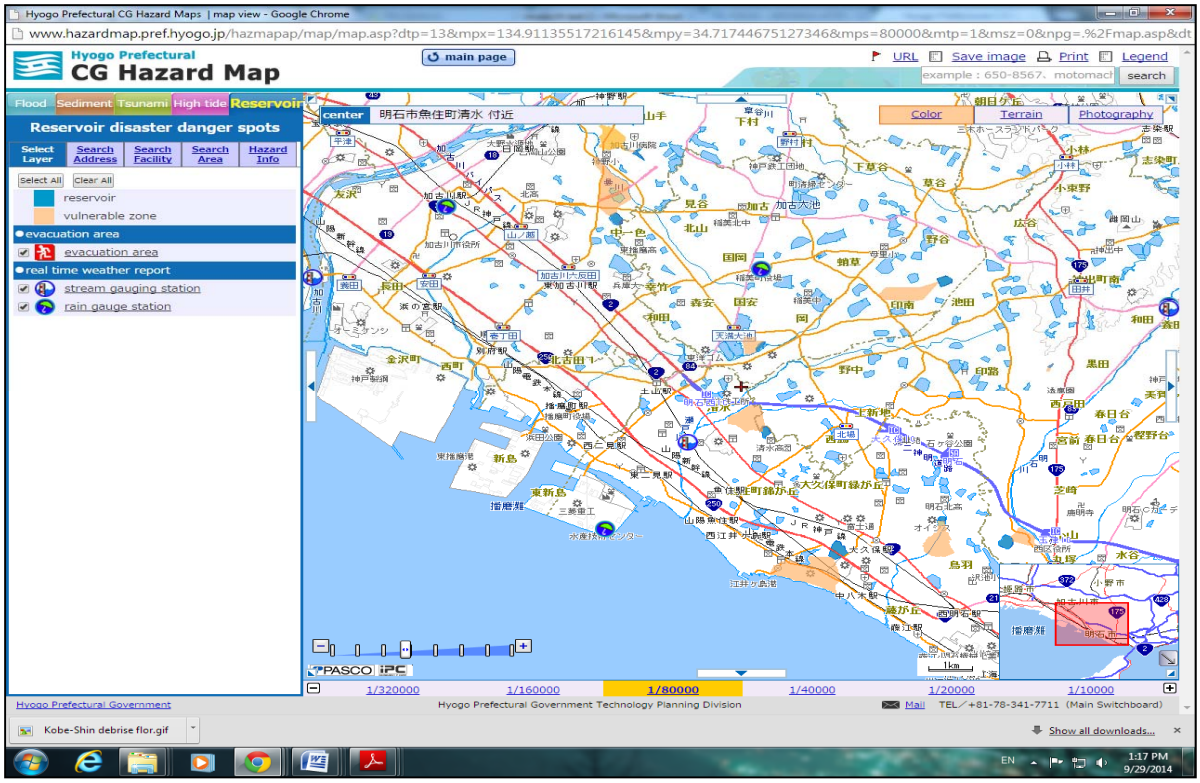


Figure. 23. Reservoir Disaster Danger spots

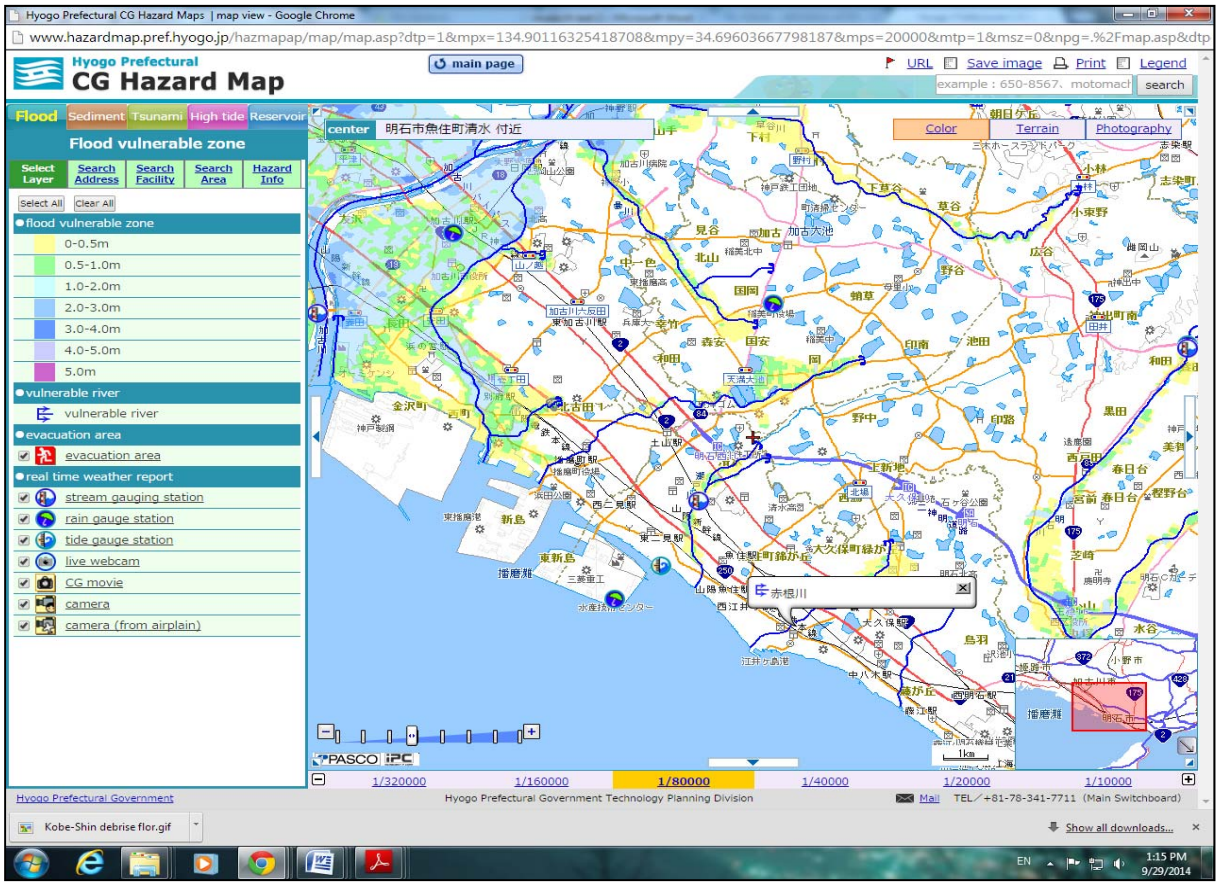


Figure.24. Flood Hazard map

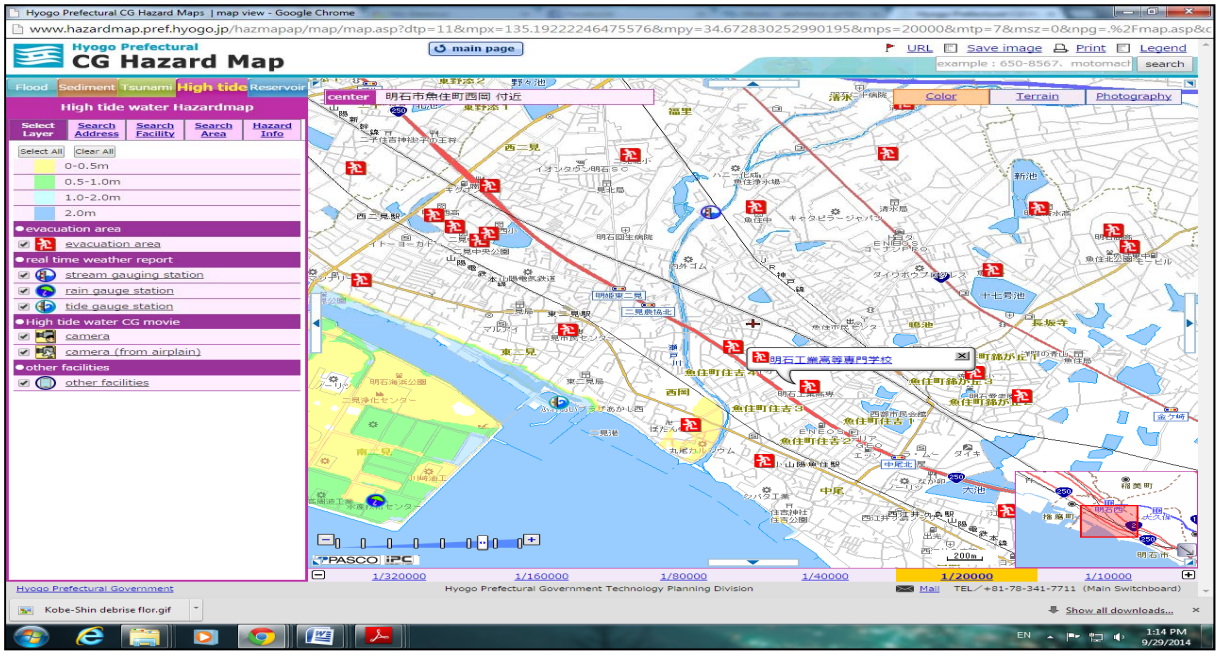


Figure.25. High tide risk area map

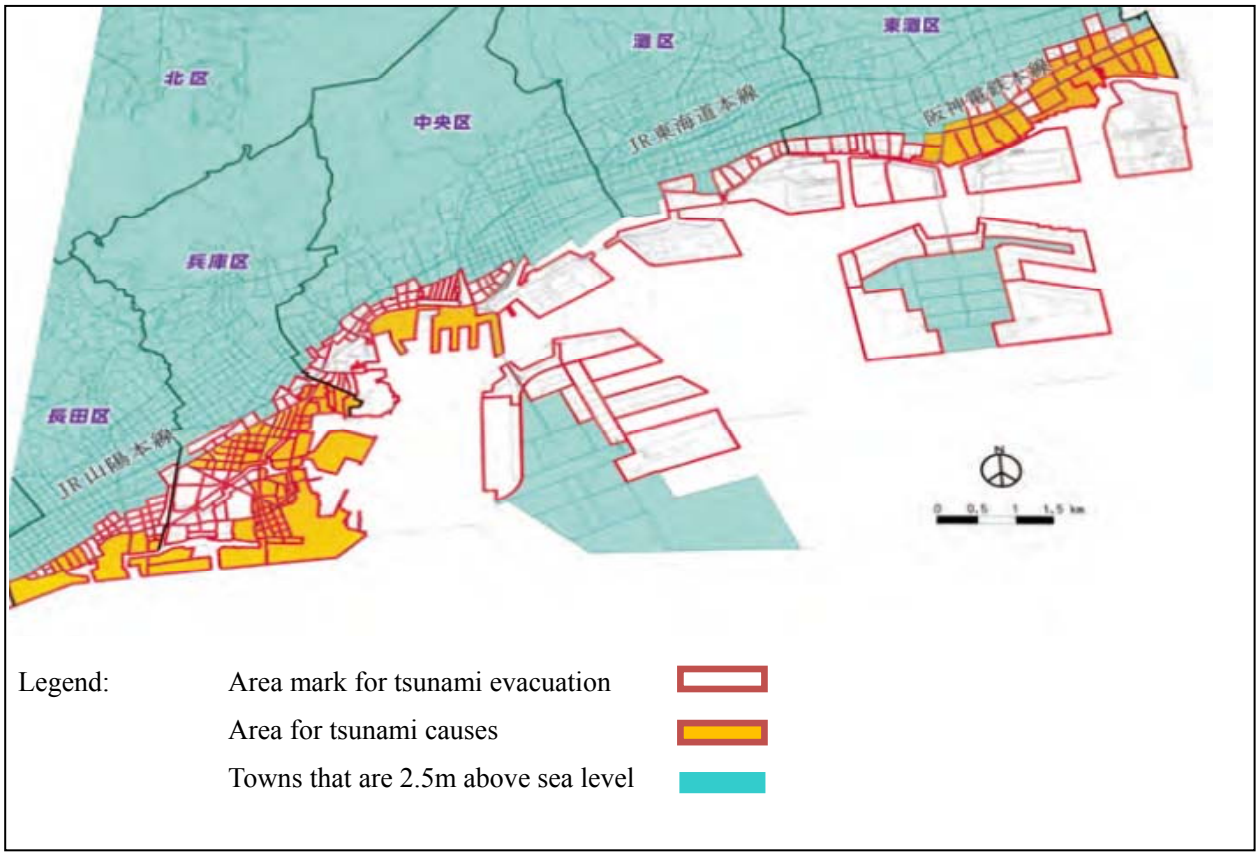


Figure.26. Kobe city tsunami hazard map

5.4.2. The Importance of Preparedness

In a survey conducted by the Prime Minister's Office in 1991, the proportion of people who thought a big earthquake could occur in their area was 43.3% in the Tokai region, 22.9% throughout the country as a whole, and only 8.4% in the Kinki (Western Japan) region. This revealed the fact that the residents and governments of Hyogo Prefecture and the damaged municipalities, all of which were located in the Kinki region, did not think that a serious earthquake could occur in the region. In general, we were not sufficiently prepared for such a sudden disaster. This catastrophe was a sharp reminder of the need to build a disaster management system that could respond to any kind of disaster (Disaster Management Hyogo prefecture report)

5.5. Identified Best Practices in the Hyogo Prefectural DM system

- **Establishment and Operation of 24-hour** Monitoring and Quick-Response System is maintained by rotation system giving smooth working environment for the officials
- **Hyogo Satellite Communication**: In the event of a disaster, emergency contacts, meteorological information, disaster information, and other information is collected and transmitted by means of a disaster administration wireless system that connects the prefectural office, district administration offices, municipalities, fire headquarters, and other points using satellite communications, which are less vulnerable to disasters.
- **Video Phone System:** In the event of a disaster, information is exchanged between the prefectural and municipal disaster management headquarters by video telephone.
- **Helicopter video transmission system:** Through this system Hyogo prefectural DMC take the real-time pictures in addition to Police Department photographic information. This has given the advantage to minimize the gap to government officials to be easy their task. This system has been implementing since 2007.
- **Continues Practice of drills:** Hyogo prefecture is conducting the drills combining with Bokumi to various groups such as school students, communities at municipality level and prefectural level, emergency management drills.

Figure.27.Hyogo prefecture drill

- **Standby accommodation:** for the officer who are involving in emergency management activities are provided accommodation
- **Developing the websites** for Hyogo prefecture DM institutions

- **Preparation of multi-purpose structures such as Miki Disaster Management Park**

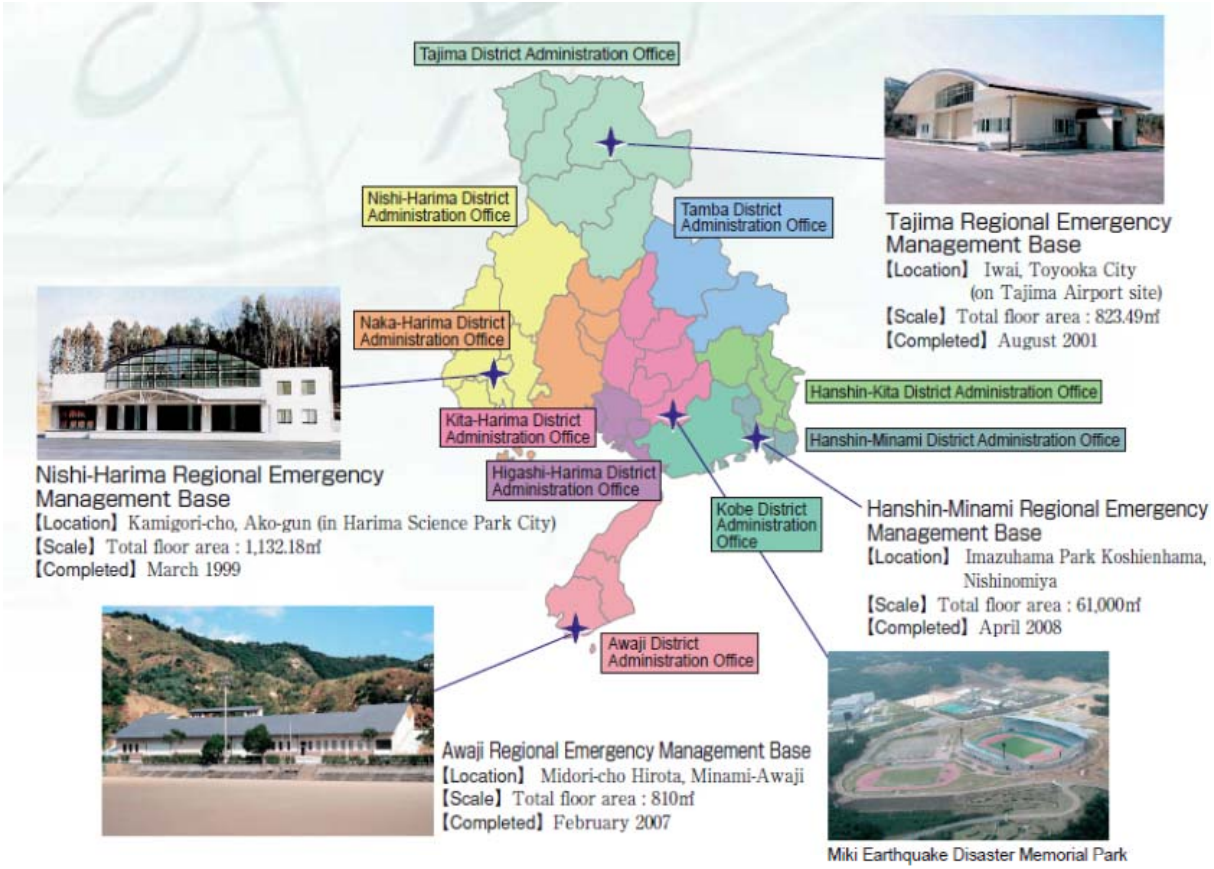


Figure.28. Disaster Management institutions' location

In the Miki Disaster Management Park all the structure has been developed to additional usage of emergency situation. All the places in park, stadium and other places also use as the storage, people gathering places, temporary accommodation for victims with all the basic facilities for victims.

Interconnecting all the institutions relating disaster management, prefecture government has made better system for coordinating all institutions at the emergency situation. They have maintained large quantity of reserved food and other emergency required items a few bigger stores. Miki stadium is also one of places which large scale foods and emergency items have been stored.

Figure.29.Under Miki stadium emergency store

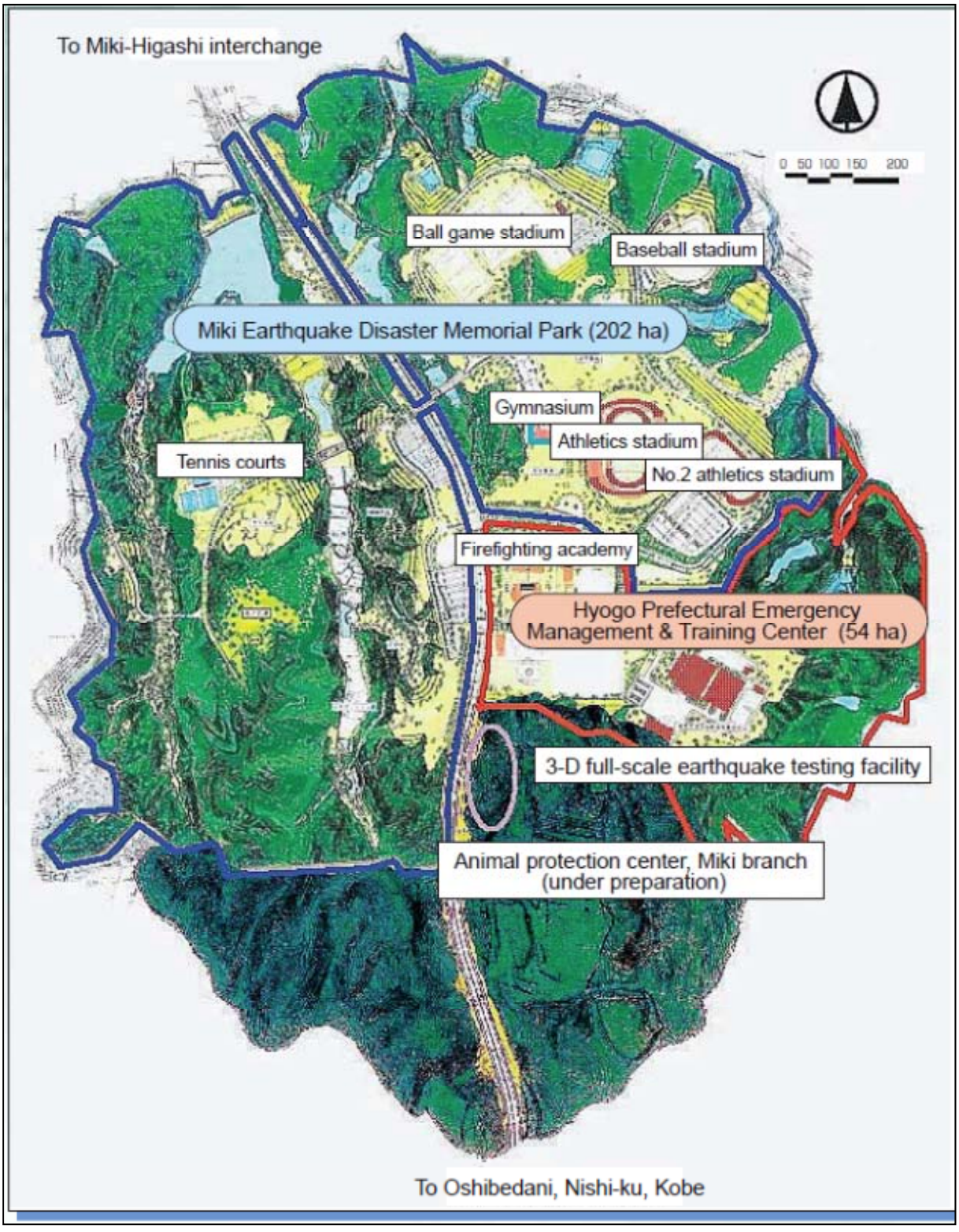


Figure.30.Mikli Earthquake Disaster memorial park

This is very good practical intervention Hyogo Prefecture government has been practicing to utilize resources successfully and preparedness for the future disasters.

- **Introduction of building codes** as preparedness measures to protect civilians home for

earthquake

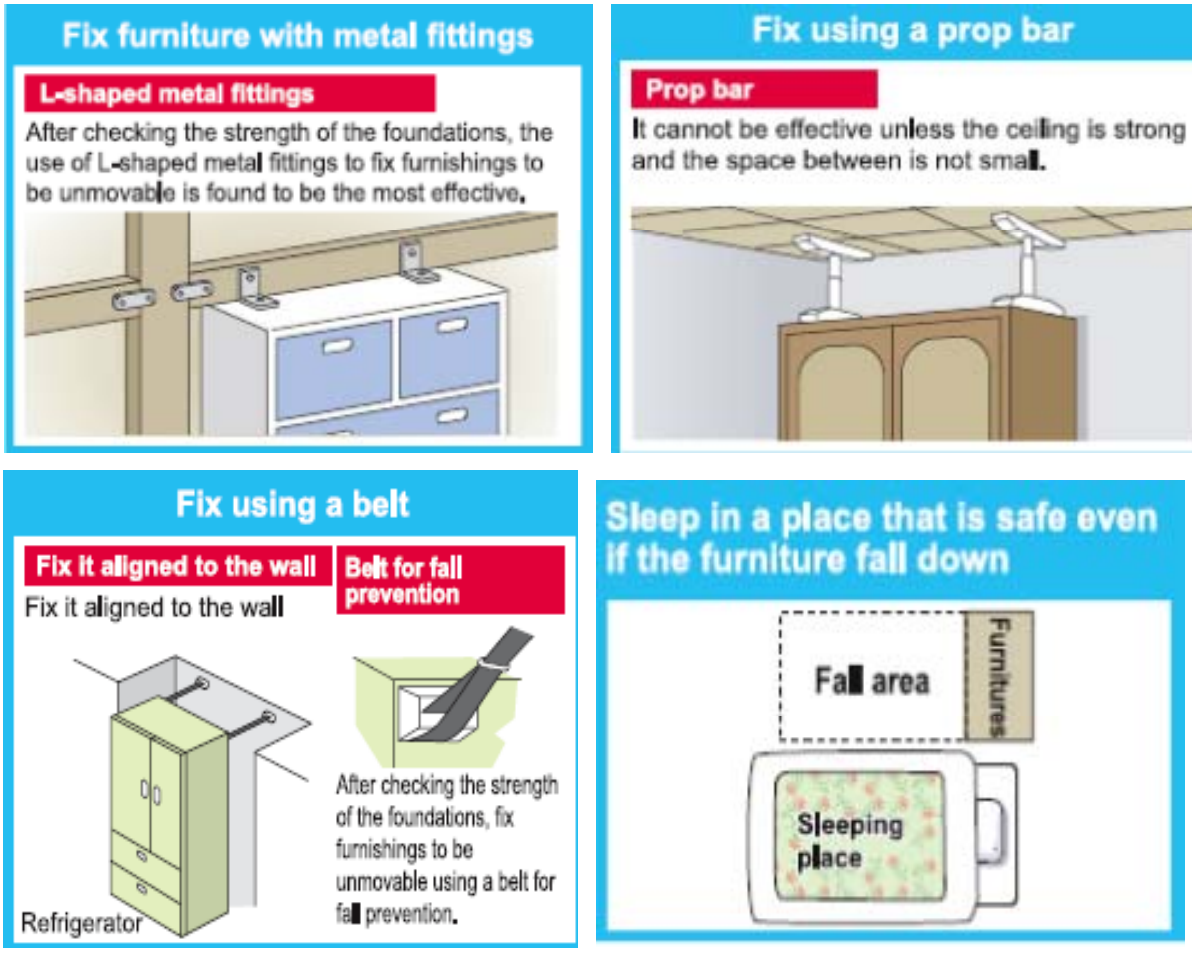


Figure.31. Some safty measures Hyogo prefectural govenement has been introduced for minimize the earthquake hazards

- **Introduction of Phoenix Mutual Aid Funds** for Housing Reconstruction
  The hyogo prefecture government has introduced this system for assisting the people who damaged their houses by disasters. Firstly dwellers should join this program in advance for getting the benefit from this fund. Up to 6 million yes can be obtained for reconstruction or repair the houses damaged by disasters with some conditions. This is better practices for the benevolence of victims as lesson learn practices

- Contribution of Hyogo prefecture for the international important action plan such as HFA (**Hyogo Framework for Action**). The Hyogo Framework for Action was an outcome of the 2005 conference held in Kobe, Japan. The HFA suggests five specific priorities for action:

  1. Making disaster risk reduction a priority;
  2. Improving risk information and early warning;
  3. Building a culture of safety and resilience;
  4. Reducing the risks in key sectors;

5. Strengthening preparedness for response.

- **Preparation of Disaster Information documents**

  For the be benefit of civilians disaster information leaflets and poster documents has been prepared for giving the better information an emergency situations.

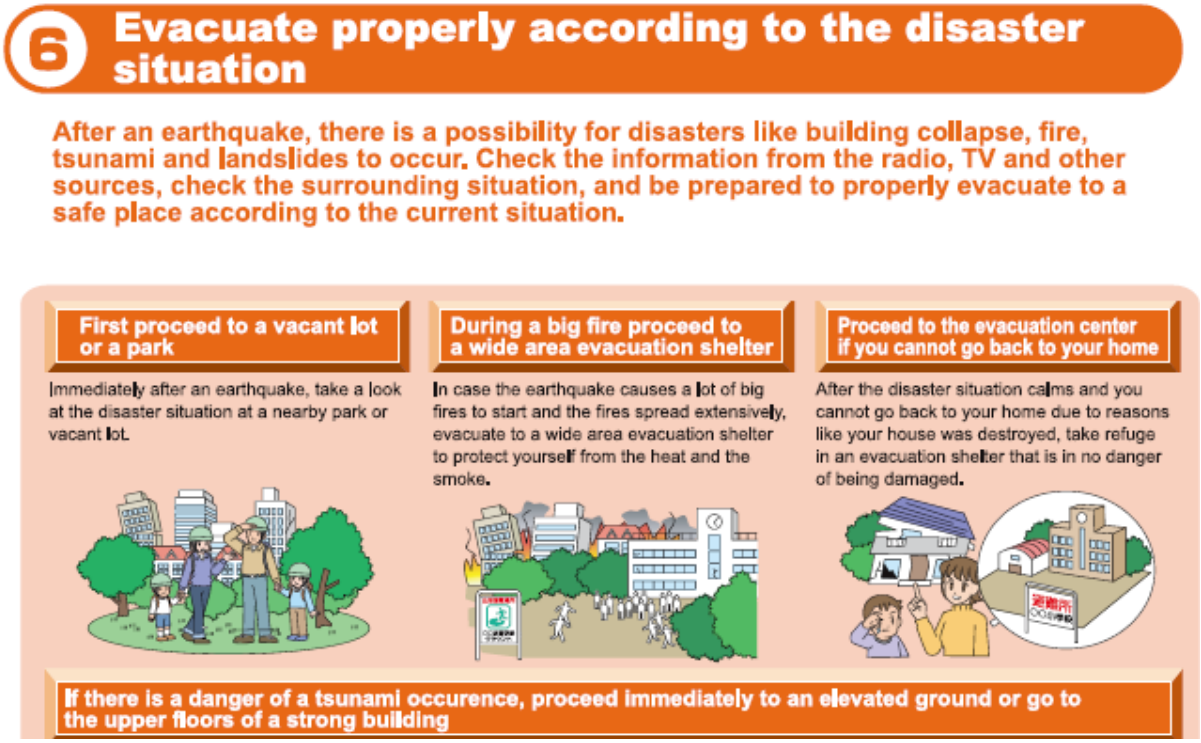


Figure.32.safety guide document made by Hyogo prefecture DM authorities

This information is very important to civilians to make sure their safety in an emergency situation.

- **Kobe city Education support program**

Kobe city Board of Education and KCFB (Which supports Bokumi) jointly developed a series of disaster prevention education program which can be used at schools and other educational situations. These programs were then compiled in a booklet. These guide book are very useful to students as well as volunteers and civilians for disaster management practices.

Figure.33. sample guide book and other materials

- **Town Watching**: This method gives a better understanding of the surrounding environment and prevents adverse effect of the disasters. Town watching is done two times in a month and students move to the town area and find all the possibilities for the disasters. At the class room they have to discuss about the findings and finally drawn on a Digital Hazard Map. That would be more important to the children to gain more knowledge on disaster management.

- At the Great Hanjin Awaji Earth Quake in the Kobe in 1995, 85% of the victims were rescued by the people. Past experience must be transferred to the younger generation through the **school disaster management programs**. Not only the students but also all many parents, village disaster management committee members, University students and various organizations are combined with this event.

- Japanese Government has created very knowledgeable **museum to memorize** large scale disaster happened in the past to educate the people and students. For ex.. Geate Hanshing Awaji Earthquake Museum, Unzen Volcanic Memorable Museum, Atomic bomb Museum...etc using high technology easy to understand spending millions of money.

- **Community Emergency Drill program**: with guidance of Bokumi and other organization periodically emergency preparedness drill are practiced with general public for giving better practical experience on prevention strategies. For the drills, local communities, women organization, religious institutions and mutual support groups are playing major role at the drill time.

5.6. Community based disaster management activities in Hyogo prefecture

Appreciable services have been fulfilling for few years by BOKUMI volunteers who is specific for Hyogo prefecture. They have well trained volunteers for specific subjects. In the normal time, those volunteers are doing other business and they have liaised (commitment) with local government that they would report anytime in advance with calling in. Those volunteers are highly qualified and well trained people able to handle any disasters.

Volunteer for the Promotion of Community Early Warning (VCEW) is a group of person who wish to wish to work voluntarily for the improvement of hydrological equipment suitable for community level early warning. They have voluntarily produced the simple technique automated rain gauge and water level gauges which is more convenient vulnerable community for self evacuation. VCEW assembles equipment and donates equipment for the developing countries.

5.7. The important issues of initial response system

- **Lack of disaster-management personnel**

The earthquake also affected those responsible for carrying out disaster management measures. Consequently, out of a total of twenty-one members who were supposed to attend the first Prefectural Emergency Relief Headquarters Meeting, (PERH) only five, including the Governor, were able to attend. In the administrative office, only two members were present. Under these circumstances, with so few staff members and with so much to do, we were not able to provide an adequate response. (Disaster Management Hyogo prefecture report)

- **Paralyzed telecommunications**

Due to our inability to collect information, we had trouble comprehending the full extent of the damage. As a result, we were unable to avoid taking emergency measures based on insufficient information. Importance of Cooperation among Disaster Management Organizations Communications networks connecting organizations such as administrative offices, fire stations, police stations, the self-defense forces, and medical organizations had not been effectively established at the time of the earthquake, and setting up cooperative systems required too much time. Moreover, since a single municipality or prefecture is unable to deal with such a large-scale disaster, a widespread, comprehensive disaster management network was urgently required to effectively aid the damaged areas across city or prefectural lines. Importance of Community and Regional Disaster-Response Capability

Many people who were buried under buildings during the quake were rescued by their families or neighbors. One researcher estimated that 80% of victims were rescued in this way. These local-level lifesaving activities played a very significant role in highlighting the importance of community-based disaster response. Importance of Making Cities Disaster-Resistant Contrary to their sturdy appearance, modern cities have a number of weak points in terms of disasters. Modern structures, facilities, and highways collapsed, elevated bullet train tracks fell, and ports were damaged. This made us keenly aware of the need for urban planning that takes space and safety

into careful consideration, and for disaster management bases that cover a wider area (Disaster Management Hyogo prefecture report)

Figure.34. Build back better

6. Results and discussion on conducted survey

A survey was carried out to measure the people's preparedness natural hazard in Hyogo prefecture. It was random selected sample using internet. Online questioner was prepared for collecting the feedbacks of Hyogo people.

6.1. General disaster education and disaster experience

6.1.1. People's age and disaster experience

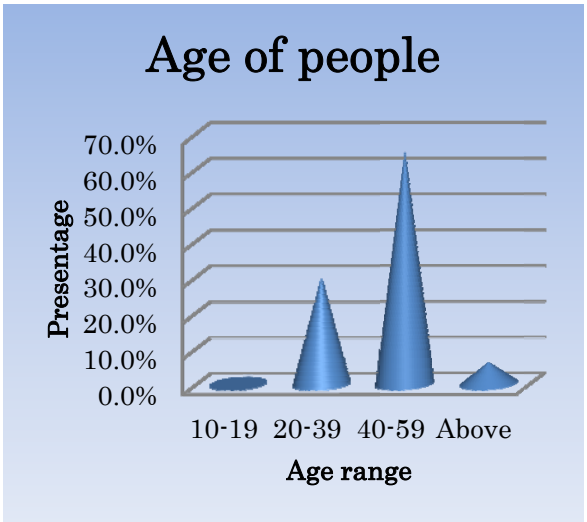


Figure.35. Age of people who answered

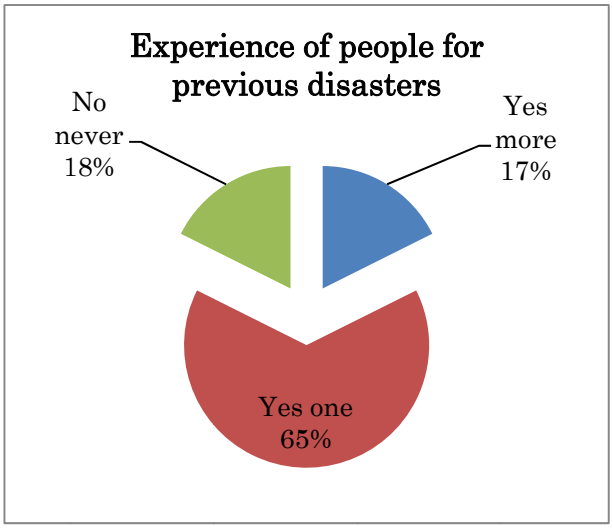


Figure.36.Experience of people for previous disasters

As per the above two graft, approximately 60% people were age range 40-59. However, 18% of people are not much experience on impact of disasters occurred in past and they may not be interesting in getting education or preparedness measures than the people who have experienced (82%) on disasters.

6.1.2. People's experience on Hanshin Awaji Earthquake

People's experience on Hanshin Awaji Earthquake	
Yes, I have an experience on Hyogo Prefecture's impact	82.4%
I have heard about that EQ (because I was not born or I lived in other prefecture)	14.7%
No	2.9%
Severity of impact experienced disasters	
Yes, extremely terrible	20.7%
Yes severely affected	20.7%
Yes some effect	48.3%
Yes, but it was not reported any significant impact	10.3%

Table.05.People's idea on disaster

Numbers of people have some experience on disasters affected to Hyogo Prefecture. 82% of people have replied as they had the experience of Great Hanshin Awaji Earthquake. 41% people had felt those impacts severely or extremely severely.

6.1.3. People's idea on possibility of occurrence large scale earthquake

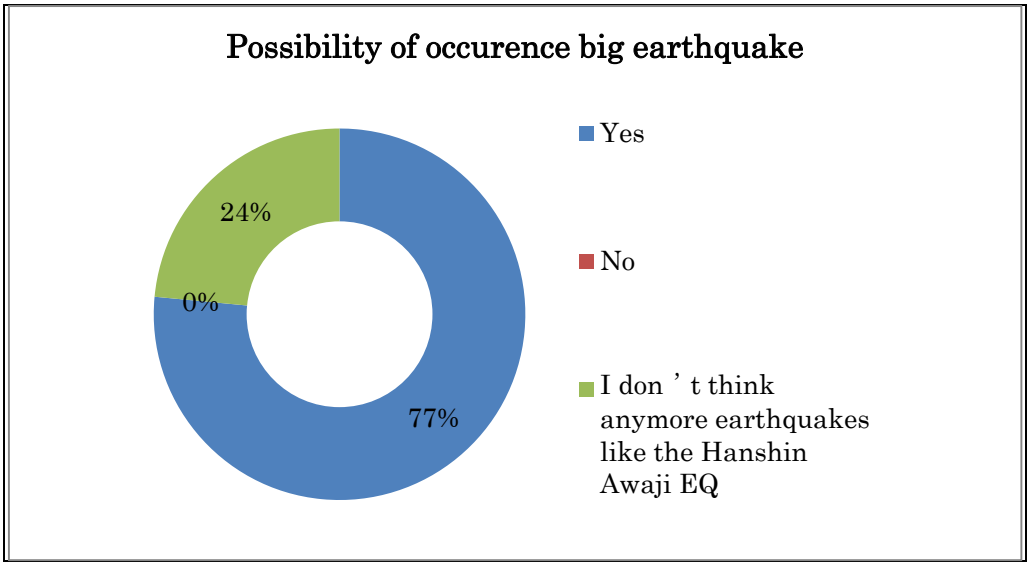


Figure.37. people's awareness on possibility of occurrence large scale earthquake

People's idea on possibility of occurrence large scale earthquake near Kansu region was questioned to understand the attitudes and awareness on earthquake preparedness. 77% of people have mentioned that they are expecting the next biggest earthquake in this region. However considerable numbers of people have mentioned that they don't expect same scale earthquake furthermore. Although the return period of large scales EQ around 100 years, there are possibilities of occurrence massive EQ any time.

6.1.4. Experience on Evacuation Warning

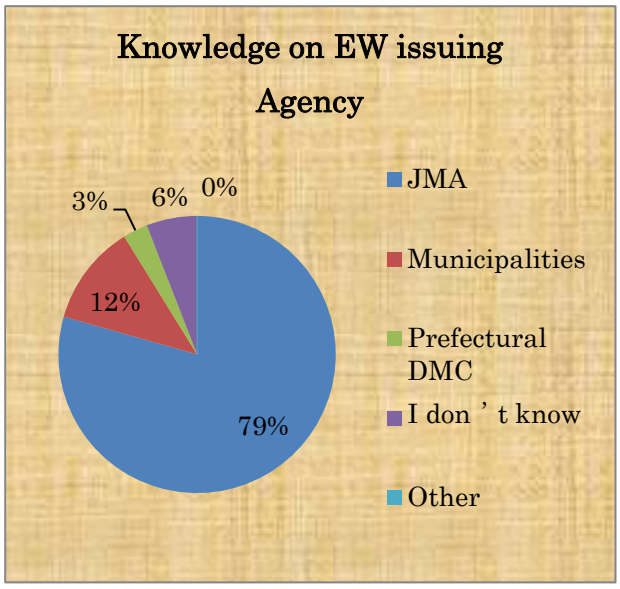
Answer Options		Response Percent
A)	Yes	26.5%
B)	No	73.5%

Table.6. experience on evacuation warning

As per the answer, 74% people have mentioned that they have never received any warning related to natural disasters during their lifetime. However government has issued several warning within last 20 years period (for natural hazard). It convinces that some people have no access for getting warnings or they are not care on that matter.

6.2. Early Warning and Evacuation behaviors

6.2.1. People's knowing on EW issuing agency



The knowledge of the people's on Early Warning issuing agency was admirable level. It was 80% and only 15% people are thinking it is by municipality or Prefectural DMC. And 6% people don't have an idea on EW issuing agency. This situation represents the people's preparedness and reaction for warnings and alerts. Further, JMA has been fulfilling very advance and appreciable service to the country.

Figure.38.knowledge on EW issuing agency

6.2.2. Usefulness of Earthquake Early Warning

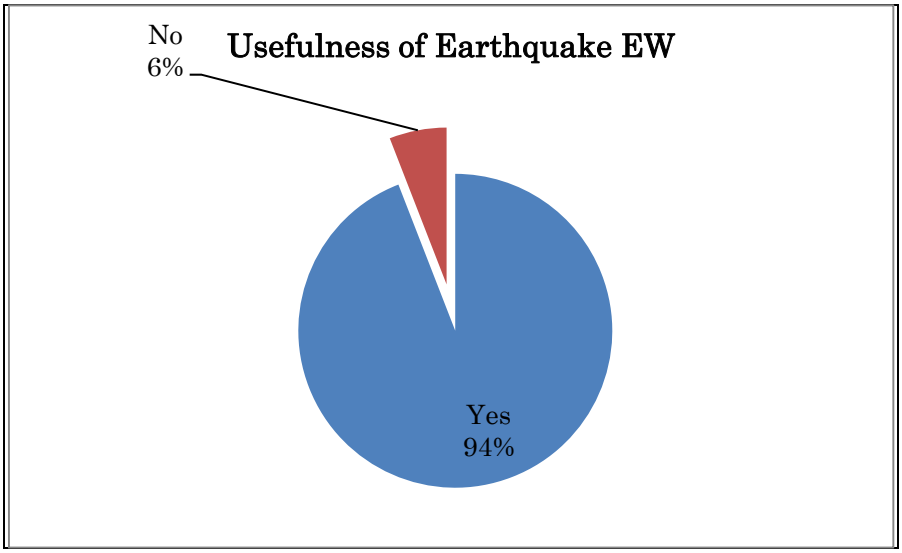


Figure.39.Usfulness of earthquake early warning

Japan is the only one country issuing the Early Warning for earthquake. Although it is very limited time before occurrence the earthquake, people have given the good response on it. As per the result, 94% of people say it is useful; it seems that earthquake early warning is very useful for people for immediate action for saving their lives although it is very short period.

6.2.3. People's preference for disaster warning information dissemination

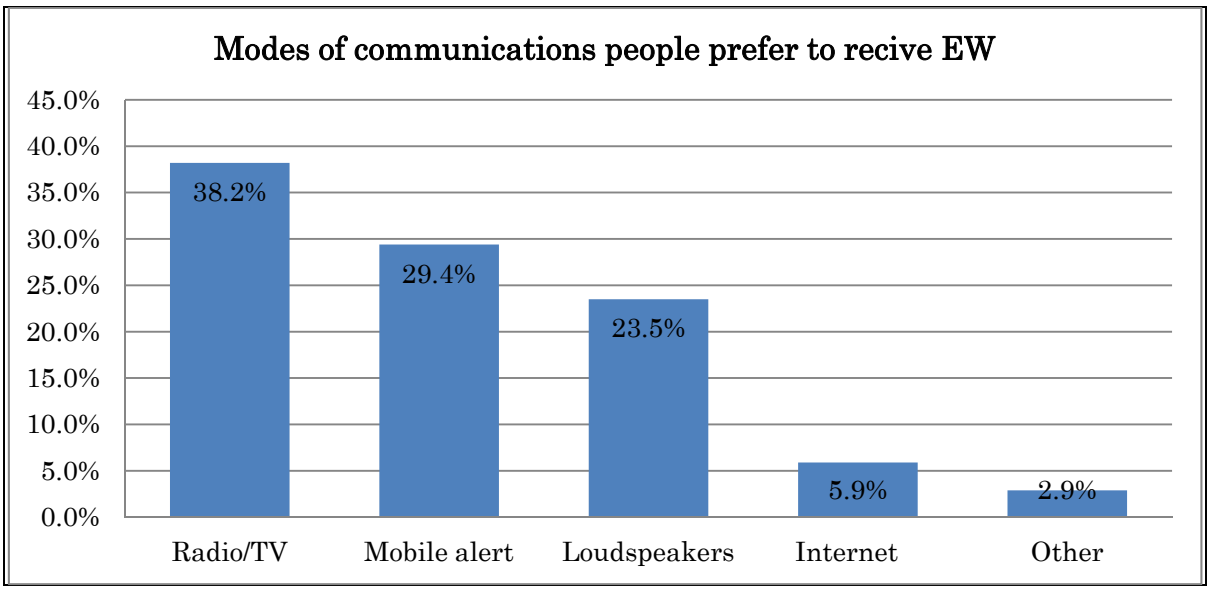


Figure.40. People's preference for disaster warning information

Based on results, TV/Radio communication, mobile alert and loudspeaker have taken approximately equal portion on people's preference for early warning information dissemination. Through internet, 6% people only have expressed their willingness. All the other countries as well as Japan people are willing to watch the TV for disaster information sharing. However loudspeaker is also very popular in Japan for disaster information sharing.

6.2.4. People's decision on evacuation

Answer Options		Response Percent
A)	Yes	61.8%
B)	No	38.2%

Table.7. People's prompt action on evacuation

This question asked to understand the people's behavior after an earthquake that lasted within a minute or during which it was hard to stand up. 62 % people mentioned that they evacuate from the premises with EW message and rest said that they don't evacuate just after hearing EW. As the prompt action, those people mentioned that they immediately run to safer place. However rest has different ideas as below figure shows.

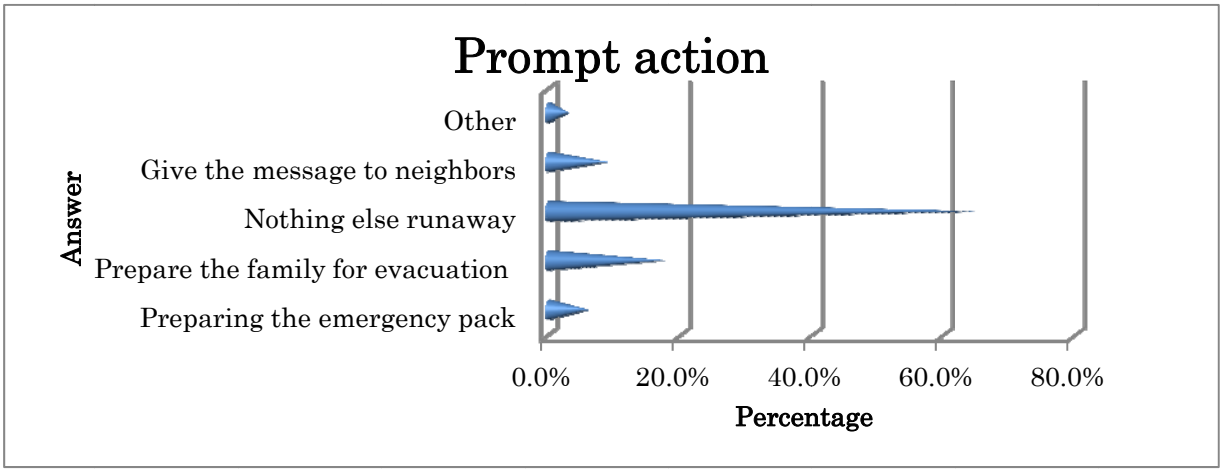


Figure.41. actions people taken after EEWs

Among replies, around 65% ideas are to runaway after receiving the message. And other ideas were on family safety; passing massage to others; preparing emergency pack and other. Family preparation and emergency pack preparation replies give the indirect idea on lack of people's preparedness immediate response.

6.2.5. Identification of evacuation route and center

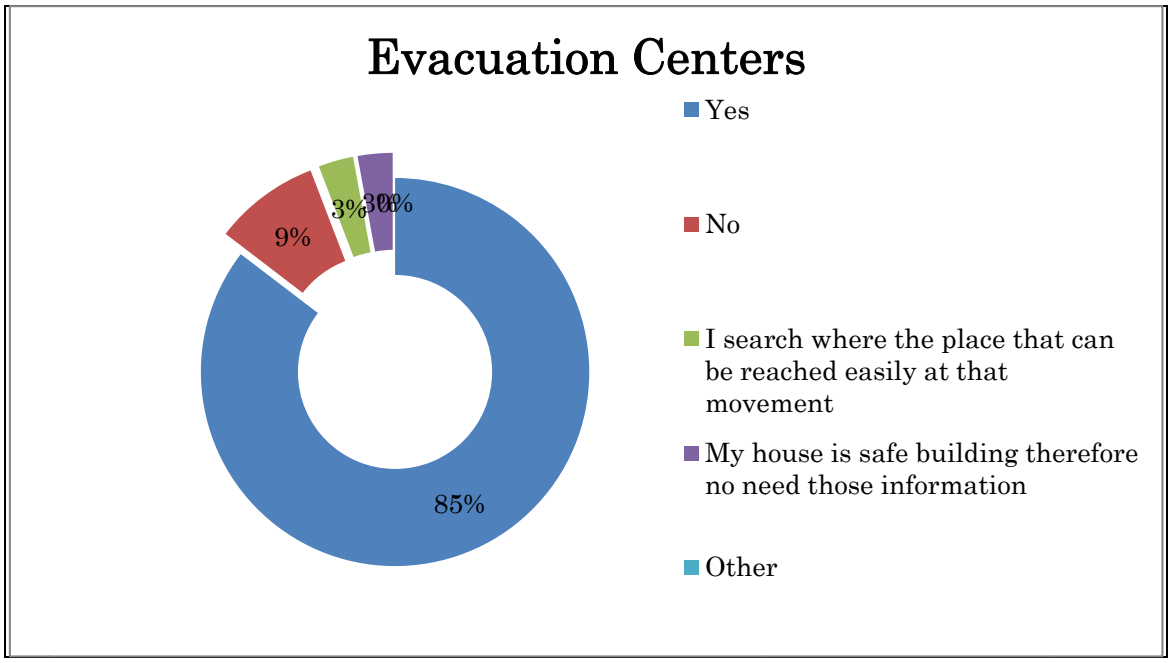


Figure.42. identification of evacuation route and place

This was forwarded to measure the Hyogo people's knowledge on location of their evacuation centers and routes. As per the results 85% people have an idea on where there evacuation center is located. However considerable number of people doesn't have idea on where the evacuation centers and what are the routes they should use. Thus, 3% people only have decided not to

evacuate just because they think that their houses are highly resistance for withstanding any kind level of natural hazard. 83% people out of evacuation center known community have an idea on evacuation routes to reach that place.

6.3. School education and community based DRM

6.3.1. Children's Awareness on Disaster Preparedness

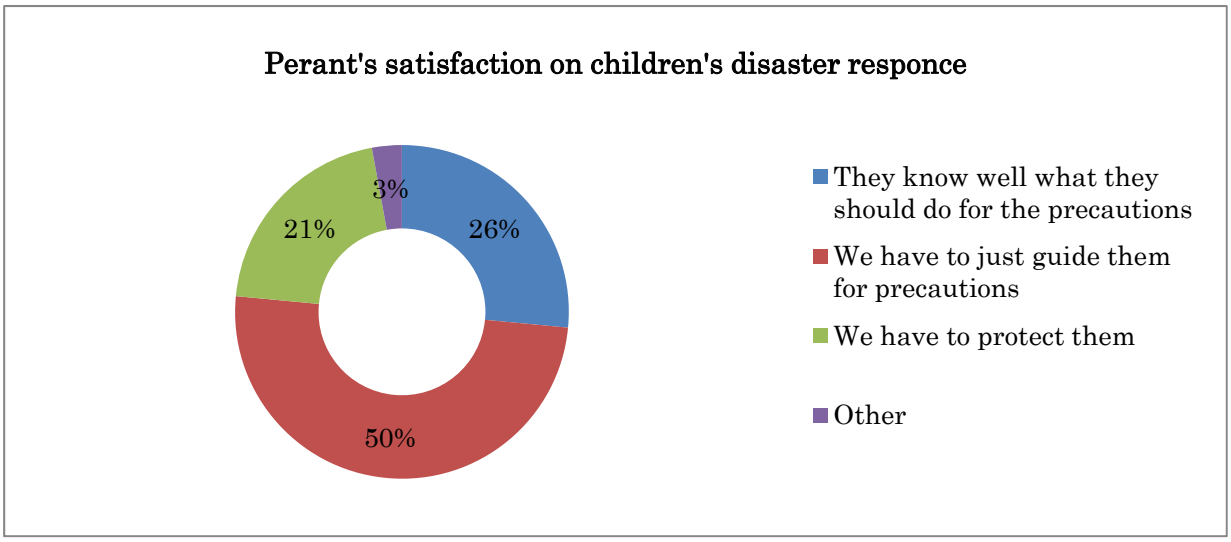


Figure.43. parents' idea on school disaster education

According to results 76% parents have sound idea on their children's education on disasters response. However 24% people think that it is not enough.

6.3.2. Children's education

Based on results, 75% people have sound idea on their children's education on disaster management. And the rest do totally not believe that children have practiced well for face to emergency situation. Therefore most of times, when EEWs issued, parents are unnecessarily afraid for their children and they created unexpected fear and excited situation whether disasters would be happened. Therefore joint DRM program combining with children and parents are very important to understand each other and then parents are able to suggest some ideas for the improvement.

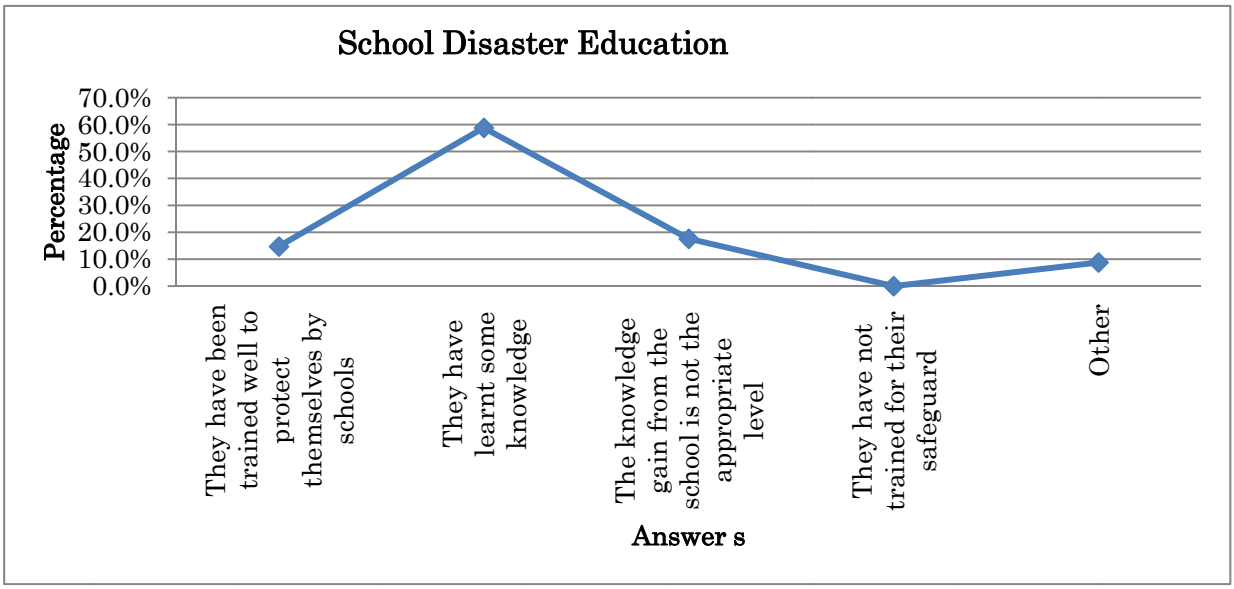


Figure.44.Parents ideas on children's disaster education

6.3.3. Hyogo prefectural people's communication preference

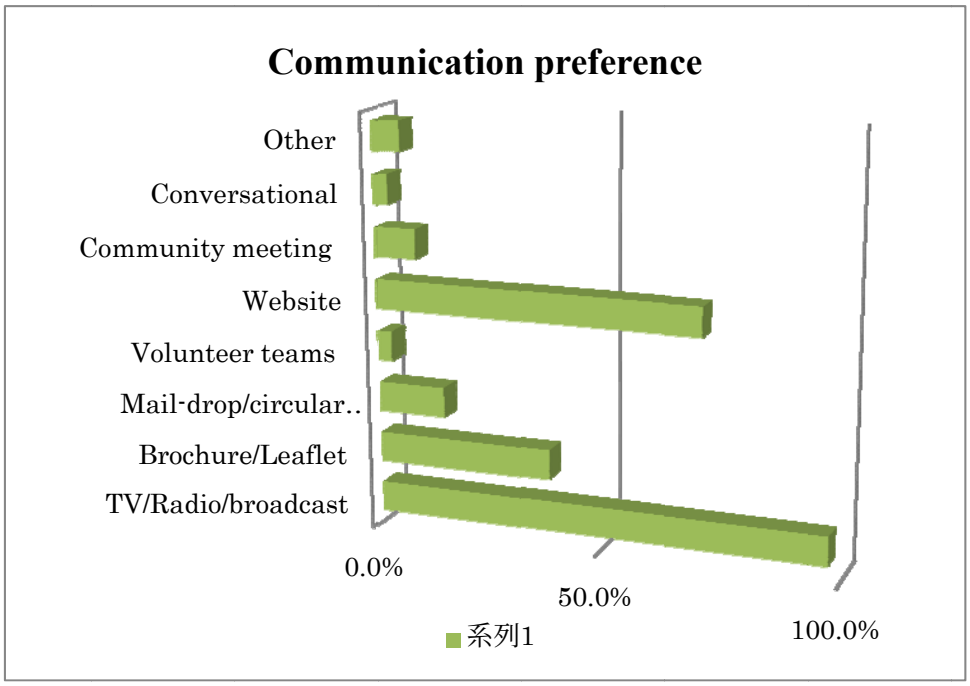


Figure.45. People's communication preference

This question was focused on evaluate the people's preference of modes communication and information receiving methods in pre-disaster time. As per the results, TV/Radio related broadcast is the most popular method among civilians for disaster information receiving at the pre-disaster time. It is more than 97% present. Second preference is through websites and it reserve 70%. This figure indicates the technological advancement and modern societal behavior with mobile technology. Further, the people used to daily reference on some websites; social media such as

face book, twitter and Japanese Meteorological websites for information sharing on disaster management.

6.3.4. People's participation of CBDRM program

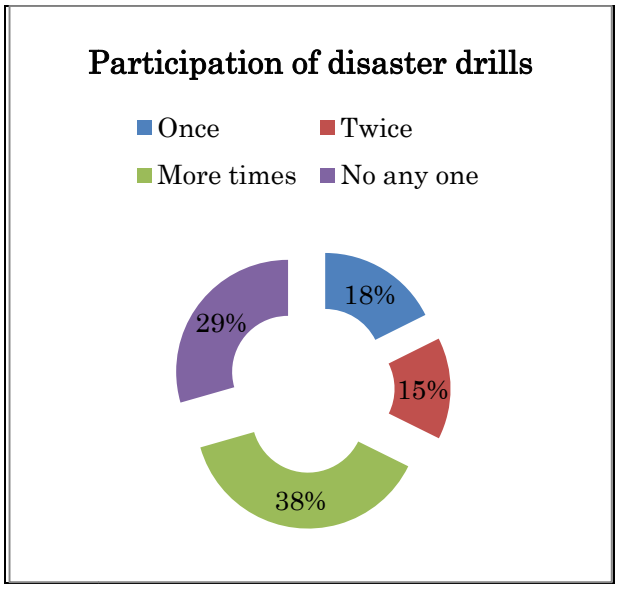


Figure.46. People's participation of CBDRM program

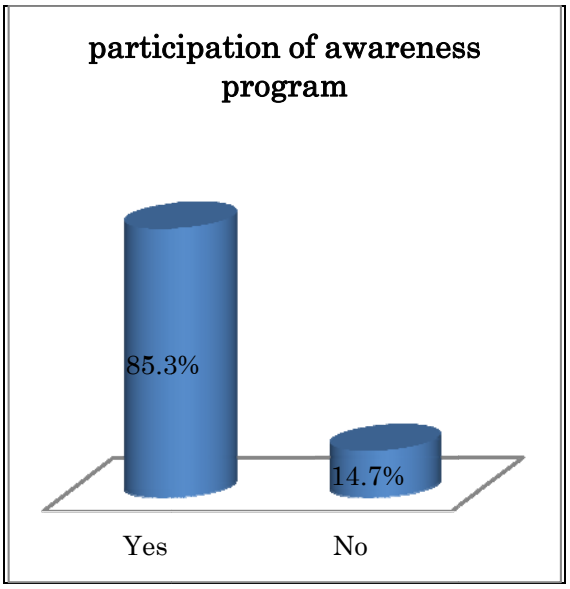


Figure.47. Awareness program participation

Participation of disaster training program		
Answer Options		Response Percent
A)	Yes	61.8%
B)	No	38.2%

Table.08.Hyogo people's participation for training program

As per the results, 38% people have participated for more times for simulation exercises and 15% people have never participated for any drills within the prefecture. Participation of disaster awareness program was 86%. It shows the dedication of community and disaster management officers on this matter. Getting disaster management training such as First Aid, Camp Management, Search and Rescue also are appropriate level among Hyogo People.

6.4. Pre-disaster phase preparedness activities

6.4.1. Preparedness planning activities civilian practiced

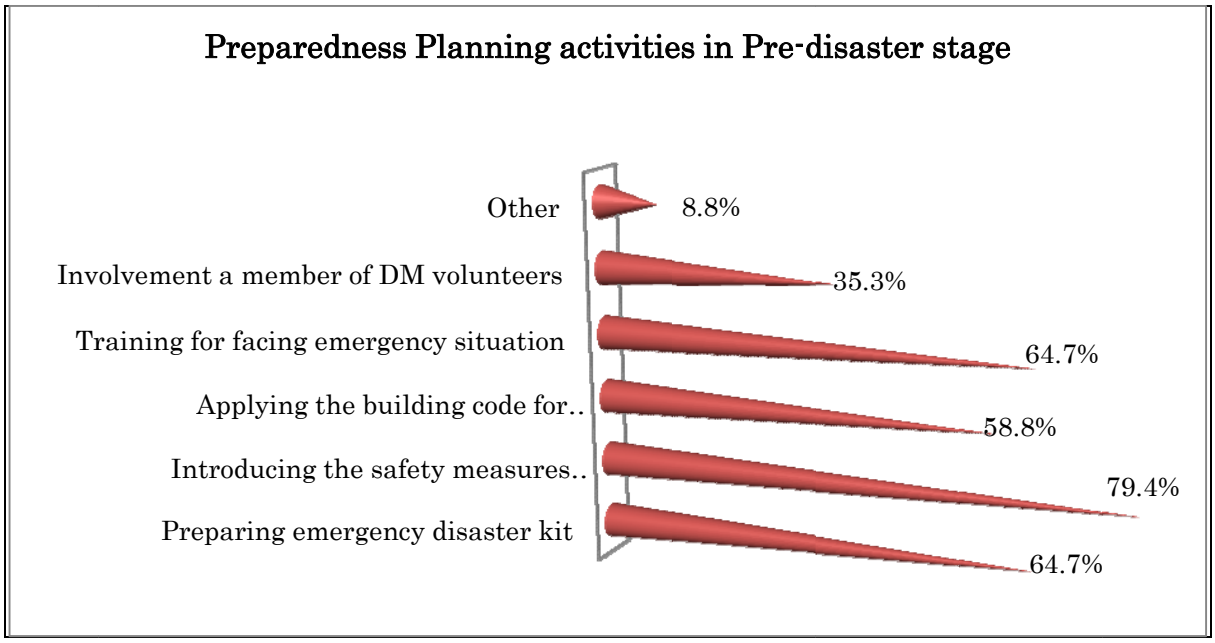


Figure.48. preparedness planning activities during the pre-disaster time

Hyogo prefecture is considered as well prepared exemplary city for natural disasters in the world. In the pre-disaster phase the activities such as preparing emergency disaster kit for emergency evacuation, introducing the safety measures among householders, applying the building code for earthquake safety, participating the disaster training program, involvement as a member of DM volunteers and other practices have been forwarded for people to understand their behavior. Introducing the safety measures among family members was highest (80%) concern among dwellers. And preparing emergency disaster kit, applying building codes and gaining disaster management training are other main practices which Hyogo people practiced.

Based on results, this figure indicates the modern well prepared societal behavior for natural hazards.

6.4.2. Ways of gaining disaster education on response

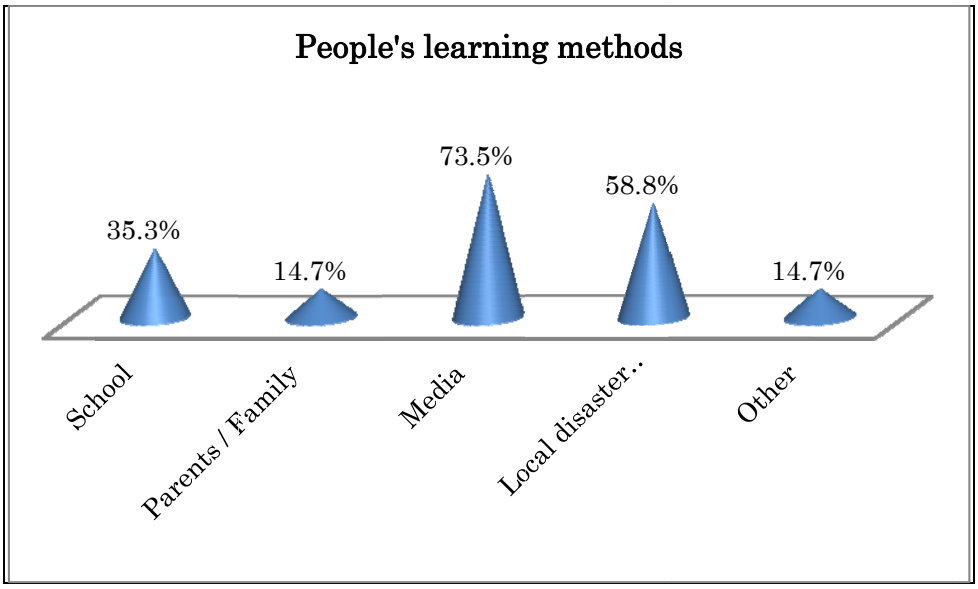
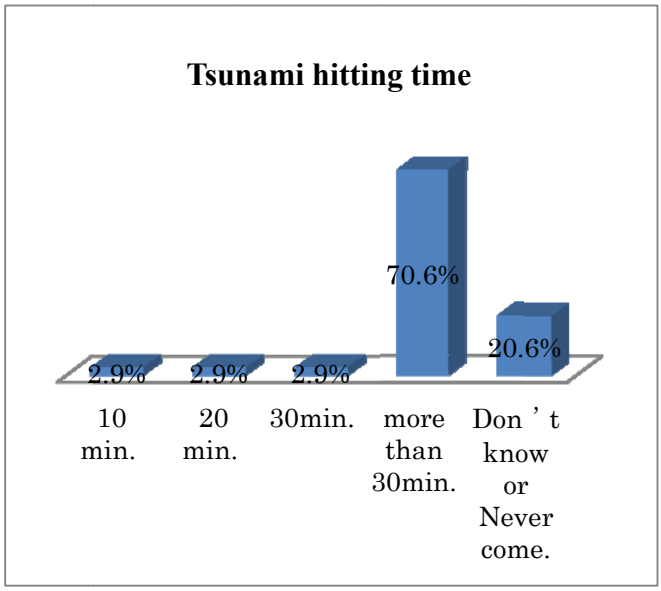


Figure.49. People's disaster response learning methods

In the preparedness stage, uplifting the knowledge of people's education on disaster response for impending disaster is very important. According to results of surveying, media have done better service to be educated the people on immediate response action. In addition to that local level disaster management authorities also have fulfilled clear and appropriate service increasing the awareness of the people live in Hyogo.

6.4.3. People's awareness on time in between earthquake and tsunami hit (in case of Tounankai/Nankai EQ)



Scientists believe that time in between EQ and tsunami wave hit around 30 minutes to Hyogo prefecture with natural obstacle such as Awaji Island. Around 70% people think that it takes more than 30munites and it is reasonable measurement without experience on tsunami. However 21% people have no idea on tsunami hitting time and this group should be educated on this matter for better preparedness

Figure.50. people's awareness on tsunami reaching time

6.4.4. Resistant level of People's house for seismic intensity

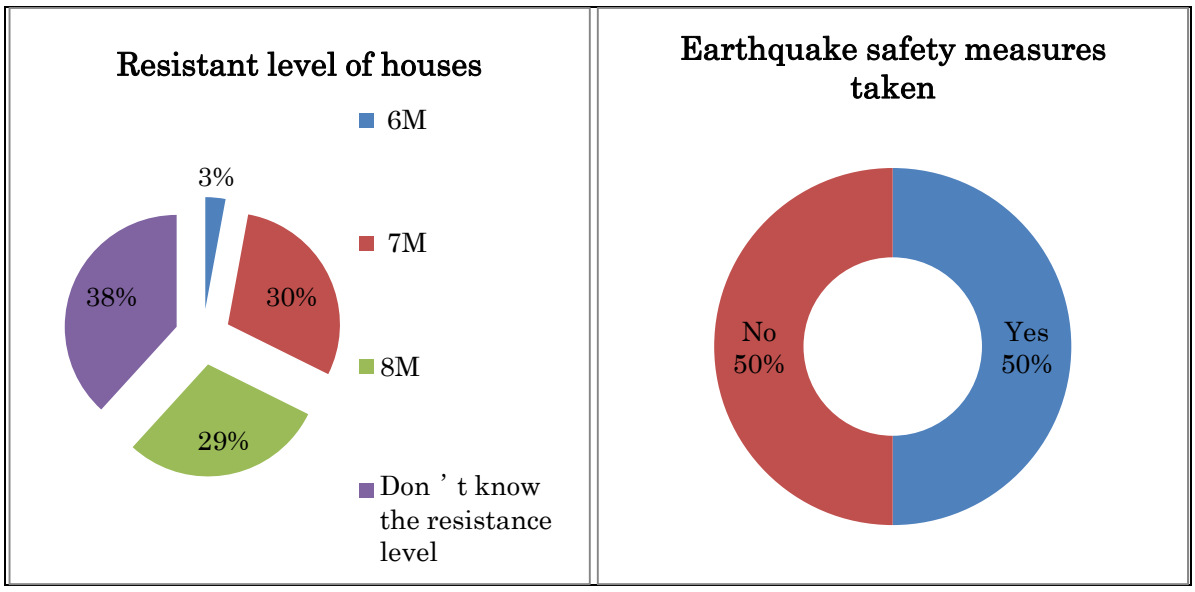


Figure.51. Safety measures taken to minimize the earthquake risk at their houses

Based on results, only 50% people have taken in to consideration the safety measures of their houses or they were aware on that. Rest of the houses might not be strong enough for some strong earthquake. However, 38% people don't have idea on their houses' resistance for earthquake magnitudes. This shows the people's lack of awareness on earthquake or their highly adherence and surety on government interference. Further, as per the answers, it shows that the people strongly believe the provided houses by local government are strong enough to survive any strong earthquake.

6.4.5. Investment willing to the safety of their houses and expected incentives for retrofitting the houses

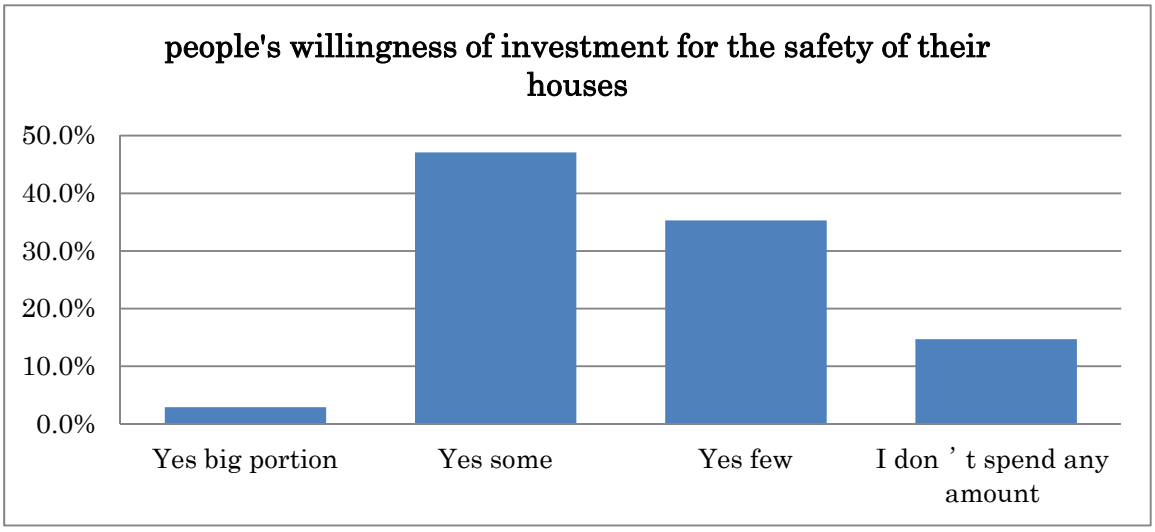


Figure.52. people's willingness of investment for the safety of their houses

Approximately 85% people like to spend a few amount of money for the safety of their houses. It gives a good message that they have an idea on consequences of natural hazards. But rest may have sufficient confident on their houses' safety or any other reasons.

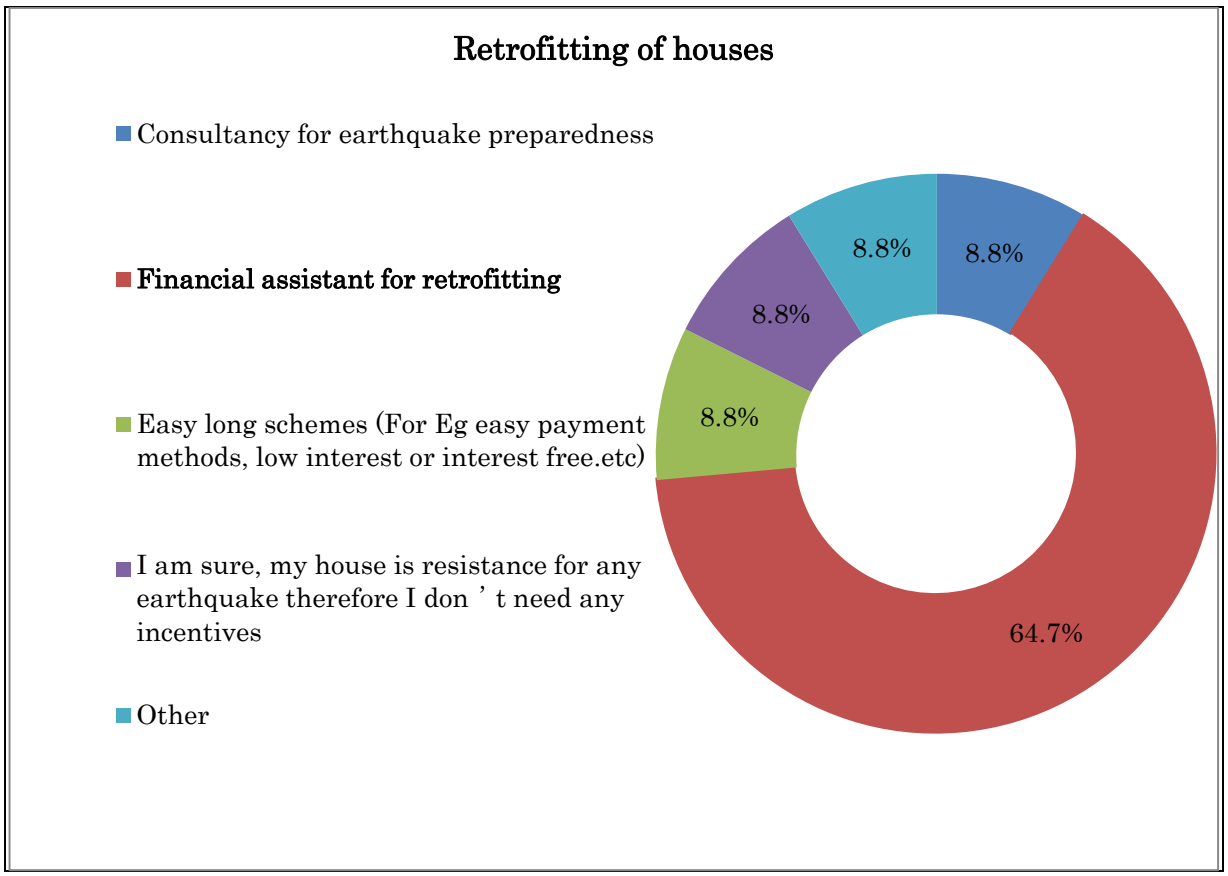


Figure.53. Expected incentives for retrofitting of houses

Based on people's willingness, 65% people are willing to getting financial assistance from government for retrofit their houses. It shows that people are still living without 100% confident on EQ resistance of their houses. Among Hyogo people, some are lacking the knowledge on technical matters on EQ and they prefer getting consultancy from proper authorities. Equal portion of people are fully confident about their houses and safety.

6.4.6. Insurance strategies for risk transferring methods

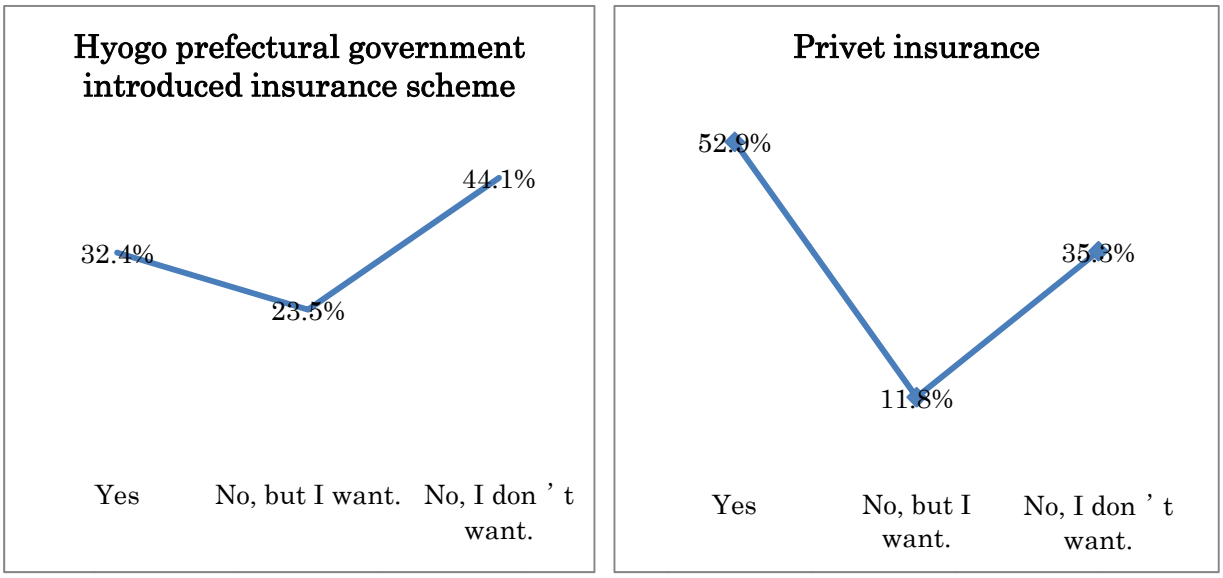


Figure.54. people's preference Govt insurance and privet insurance for risk transferring

Hyogo prefectural government has introduced the insurance scheme for Hyogo people. However, numbers of members who have taken the membership are currently very limited. Prefectural Disaster Management Center has been applying various strategies to increase the no of members. Based on these results 32% people have taken the membership of government insurance scheme. Approximately 24% people were not aware on the government insurance and rest (44%) either they have another insurance or don't have; they are not willing to become member of Hyogo insurance scheme. However 52% people said that they have the privet insurance for natural hazards but still close to 50% people don't have privet sector insurance for natural hazard.

6.4.7. The time people prefer to spend for the disaster preparedness works

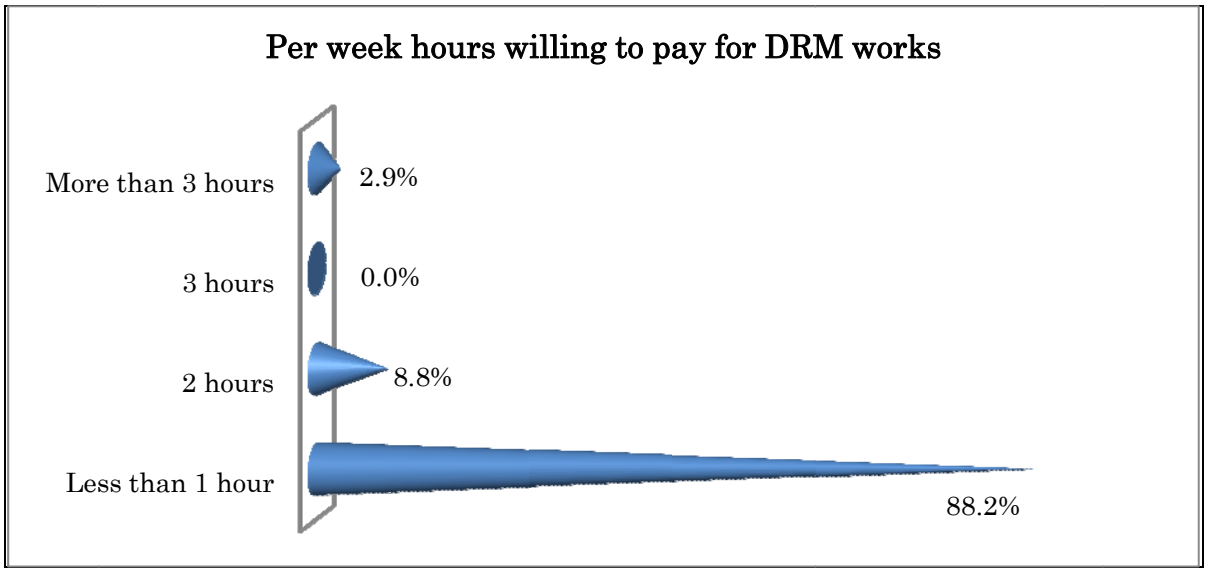


Figure.55. weekly hours Hyogo people prefer to DRM activities

According to answers people given, they are not willing to spend more time for disaster management activities. As per the various reasons, people are not willing to spend much time for CBDM activities. It shows that specially aged people only lead community based activities because of many reasons such as youths' attitudes, no leisure time for participation, labor force have to do works hardly and the leisure time they prefer to be with their family etc. Therefore for attraction of youth and others, DM officers have to come with various aspects.

6.4.8. Usage of social media for information sharing

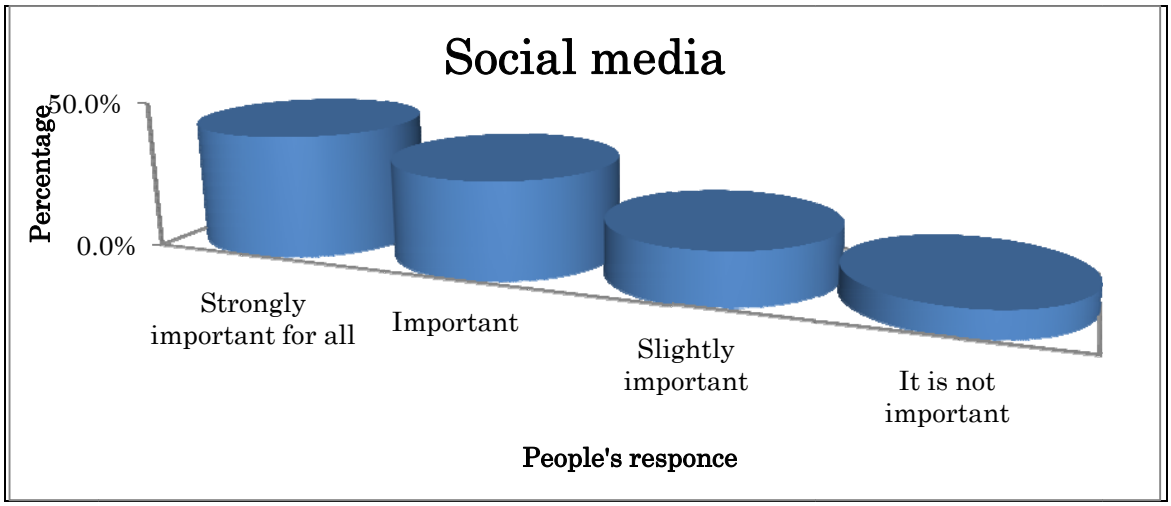


Figure.56.Social media and information sharing

In 2011, Thailand floods severely attacked Bangkok metropolitan and suburb inundating the whole cities roughly 6 month period. During this period, a research which was conducted by one of their national responsible agencies disclosed the usage of social media during that time. The information on flood affected areas; possible access, weather forecast; on affected people and so on had been sharing through social media such as twitter, face book and locally popular SM. It was recorded roughly 50% of people in Bangkok and suburbs. This gives the interesting hints to disaster management authorities to promote social media for disaster information sharing, EW and response. In Hyogo prefecture, approximately 74% people have mentioned that it is important for disaster information sharing.

7. Recommendation

Building resilience, communication, infrastructure and restoring connectivity should be the heart of disaster management planning. Public education on limitation of disaster management technology in the disaster time and risk awareness and continued disaster preparedness is needed for a better disaster risk management system in a country.

At the international conference held in Kyoto University Dr. Tetsuo Tobita suggested that all most all the building are vulnerable to liquefaction hazard because he reveled scientifically the courses for damaging the building at the earthquake time. He further emphasized that engineers only consider about the earthquake condition and it should be considered the effect of liquefaction too. Almost all the buildings in vulnerable areas are vulnerable to liquefaction hazards he further said. Therefore considering these factors reinvestigation is needed for identifying its strengths and scientific solution.

Based on the results of earthquake close 40% people don't have appropriate insurance for the protection of their property from potential disasters. Therefore, those people can be considered as very vulnerable people live in Hyogo prefecture. Prefectural disaster management center said that current percentage of membership of their insurance scheme is also very lower rate. Therefore sounds insurance scheme as well as achievable methods should be created for Hyogo people by Hyogo officials.

Local media are needed to be adequately supported technically and financially. Local responders need to work with them closely before during and after the disaster. Although government handled specific disaster management media which are popular among people, all the other media are suggested to be used for disaster awareness and education in the pre-disaster stage.

Chutsu Earthquake (6.8M) occurred after Hanshin Awaji Earthquake, on 23/10/2004 in Niigata prefecture, Japan. Although the number of death were limited (65) wide range of topography and infrastructure were severely damaged. 4805 people injured and 16,000 houses collapsed (Source Asian Study symposium, Kanagawa University). After introducing the many lows and orders with the lesson learnt from Hanshin Awaji EQ, Chutsu EQ damage are subsequently gigantic with introduced lows and regulations. Therefore revision on retrofitting and building codes in Hyogo prefecture is recommended

Specially, Japan is considered the highly aged population lived country in the world. Based on the Health and Welfare Ministry estimation, 25% of current population is elderly people. By 2060, aged population will be 40% because Japan's population growth will keep declining by about one million people every year and also life expectation is the highest in the world the ministry predicts. Thus, past large scale calamities in the Japan have shown the figures of number of aged people who were victims with unprotected environment. Therefore they are very vulnerable to disasters

and existing system might not be enough for ensure the all aged people's safety. Therefore, it should be paid proper attention and specific program for the aged people on disaster preparedness and emergency evacuation to minimize the damage by future calamities.
Based on surveying results, numbers of people are not aware on the evacuation centers and evacuation routes assigned for them by municipality. This situation may create unnecessary difficulties for dwellers when emergency evacuation announce. One is an unexpected crowd which would not be manageable would concentrate to the particular place at the same time. Perhaps, some will be walking unnecessarily searching evacuation center until disaster happen. Therefore, appropriate awareness programs are needed to be aware the people on this matter.

75% people had no any experience on EW as per the answers given. It indirectly says that those are not in a position to access EW or any other disaster information. Frequently practices are needed them for learn how to behave the time an EW is issued by proper authority.
Community base disaster management activities such as emergency management drills, awareness program and educational program on disasters, training program for emergency response such as first aid, camp management are main preparedness parameters government has been practicing in Hyogo prefecture. However it seems that community participation for these programs is very limited and almost all the participants are aged people in the surrounding area. Although government and DM agencies have applied several strategies to overcome such issues, currently, it seems some declining on participation of community. As such, it is recommended that new ways and practices should be applied for attracting the people for CBDRM.
Considerable numbers of people do not believe on their children's education on DRM by schools. Therefore most of times, when EEWs issued, parents are unnecessarily afraid for their children and they created unexpected fear and excited situation whether disasters would be happened. Therefore join DRM program combining with children and parents are very important to understand each other and then parents are able to suggest some ideas for the improvement DRM program. Further it gives an opportunity to educate the parents by their children.

BOKUMI volunteers and other community leaders are doing a wonderful dedicated service collaborating with government officers. This is exemplary action to the world that volunteers' dedication for the community based DRM. However, almost all the members and leaders seem aged people and second generation (youth) are not being practiced for those activities. Therefore participation of young leaders is very important to CBDM programs.

Figure.57. Bokumi aged volunteer organized emergency drill in Kobe

Large amount of money has been invested for the landslide mitigation project which is very important to mitigate the landslide threats by Japanese government. However, the practices such as community bases preparedness, living with disaster concepts (adaptation) are not in practicing properly, and people used to rely on government and other agencies for all the warning and advice. Therefore simultaneously community level disaster preparedness and two way communication methods should be activated for proper preparedness for Landslides.

Based on research finding, more than 80% of people were rescued by neighbors when Awaji earthquake time. Rest by government search and rescue trained people. It shows the importance of giving training for civilians forming search and rescue committees. Therefore creation of volunteer search and rescue special teams are important to cope with disaster at the time of emergency rescue needs.

Estimation of damage when Tokai, Tonankai and Nankai earthquake occur simultaneously about **21,000 casualties** and **81 trillion yen** economic losses (worst case), and probability of the occurrence within 30 years is Tonankai earthquake around 60% (about 8.1), Nankai earthquake around 50% (about M8.4). Therefore National level gigantic scientific discussion and strategic plan should be taken in to consideration on earthquake preparedness and minimize the impact.

Near Osaka, Kyoto and Hyogo area magnitude 6M earthquake occurrence possibility within 30 years starting from 2006 is 26%. Therefore it is recommended that reinvestigation of building codes and other parameter for the safe guard of property and lives on earthquake is timely important.

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9. Appendix

1. Questioner

Survey on Studying Hyogo Prefectural People's Preparedness for Natural Hazards

1. Your age

A) 10-19

B) 20-39

C) 40-59

D) Above

2. Have you ever experienced any disaster incident happened during your life time?

A) Yes more

B) Yes one

C) No never

3. If yes what was that and how did you feel those?

A) Yes, extremely terrible

B) Yes severely affected

C) Yes some effect

D) Yes, but it was not reported any significant impact

4. Do you know which is the proper authority issuing Earthquake and Other Hazard EW?

A) JMA

B) Municipalities

C) Prefectural DMC

D) I don't know

E) Other

5. If you receive Earthquake Early Warning what do you think of your children's awareness for response it?

A) They know well what they should do for the precautions

B) We have to just guide them for precautions

C) We have to protect them

D) Other

6. What do you think on your children's education on disaster safety measures learnt from their school?

A) They have been trained well to protect themselves by schools
B) They have learnt some knowledge
C) The knowledge gain from the school is not the appropriate level
D) They have not trained for their safeguard
E) Other

7. Have you ever received tsunami or any other evacuation waning in Hyogo Prefecture

A) Yes
B) No

8. What would you do after an earthquake that lasted for more than a minute or during which it was hard to stand up? Then prompt: "Would you evacuate?"

A) Yes
B) No

9. What is appropriate prompt action right before evacuation?

A) Preparing the emergency pack
B) Prepare the family for evacuation
C) Nothing else runaway
D) Give the message to neighbors
E) Other

10. Do you know evacuation center around your house where municipality have identified in advance

A) Yes
B) No
C) I search where the place that can be reached easily at that movement
D) My house is safe building therefore no need those information
E) Other

11. Do you know appropriate evacuation route to reach evacuation center?

A) Yes
B) No

12. How do you receive the information on disaster in pre-disaster phase?

(tick all that apply)?

A) TV/Radio/broadcast
B) Brochure/Leaflet
C) Mail-drop/circular bulletin
D) Volunteer teams
E) Website
F) Community meeting
G) Conversational
H) Other

13. What is the best way you prefer for disaster warning information dissemination?

A) Radio/TV
B) Mobile alert
C) Loudspeakers
D) Internet
E) Other

14. Have you participated any public disaster drills

A) Once
B) Twice
A) More times
B) No any one

15. What are the steps that you or family member taken to prepare for a natural disaster in pre-disaster phase? (If you think more than one please tick all)

A) Preparing emergency disaster kit
B) Introducing the safety measures among householders
C) Applying the building code for earthquake safety
D) Training for facing emergency situation
E) Involvement a member of DM volunteers
F) Other

16. How do you learn appropriate immediate response actions to response, (e.g., evacuation information), for earthquake/tsunami hazard (If you think more than one please tick all)

A) School
B) Parents / Family
C) Media
D) Local disaster management authorities

E) Other

17. Have you ever been participated a disaster awareness program conducted by any organization?

A) Yes

B) No

18. Have you ever been participated for the training program? (e.g., camp management, emergency bed preparation, emergency toilet preparation, any cooking pan preparation)

A) Yes

B) No

19. Do you have any idea on return period of massive earthquake would be hit in Hyogo

A) Yes

B) No

C) I don't think anymore earthquakes like the Hanshin Awaji EQ

20. Have you experienced or heard any information about the Hanshin Awaji EQ?

A) Yes I have an experience in Hyogo Prefecture

B) I have heard about this EQ (because I was not born or lived other prefecture)

C) No

21. Do you know time in between earthquake occur to hit first tsunami wave to your coastal area (in case of Tounankai/Nankai EQ)

A) Yes. It is within 10 min.

B) Yes. It is within 20 min.

C) Yes. It is within 30min.

D) Don't know

22. Do you know the resistant level of your house for seismic intensity?

A) Seismic intensity 6M

B) Seismic intensity 7M

C) Seismic intensity 8M

D) Don't know the resistance level

23. Have you taken any safety measures to minimize the earthquake risk at you house

A) Yes

B) No

24. Are you willing to spend to better protection of your home against disasters?

A) Yes big portion

B) Yes some

C) I don't spend any penny

25. Have you taken an insurance membership of Hyogo prefectural government?

A) Yes

B) No, but I want.

C) No, I don't want.

26. Have you taken an insurance membership of private company?

A) Yes

B) No, but I want.

C) No, I don't want.

27. Do you think early warning of EQ is useful to take precautionary action?

A) Yes

B) No

28. How much are you willing to spend time (per week) for preparation of disaster response?

A) Less than 1 hour

B) Less than 2 hours

C) Less than 3 hours

D) More than 3 hours

29. Which of the following incentives that you would motivate to take next step for the better protection of your house?

A) Consultancy for earthquake preparedness

B) Financial assistant for retrofitting

C) Easy long schemes (For Eg easy payment methods, low interest or interest free.etc)

D) I am sure, my house is resistance for any earthquake

E) Other

30. How do you feel the importance of social media for information sharing?

A) Strongly important for all

B) Important

C) Slightly important

D) It is not important

Thank you for taking time to fill this form.

Nuwan Madawan Arachchi,
Visiting Researcher,
Asian Disaster Reduction Center

2. Evacuation Centers of Hyogo Prefecture

Area	Evacuation Site	Address
Honjo	Honjo Elementary School Playground	4-4-1 Ougi Higashinada-ku
	Honjo Junior High School Playground	4-4-2 Ougi Higashinada-ku
	Honjo Central Park	5-18 Ougi Higashinada-ku
	Tennis Courts of Kobe University	4-1 Ougi Higashinada-ku
Kotsu Koen	Fukuike Elementary School Playground	4-4-28 Motoyamaminami-machi Higashinada-ku
	Koyori Park (the previous "Motoyama Kotsu Park")	4-4 Motoyamaminami-machi Higashinada-ku
Motoyama	Motoyama Junior High School Playground	3-3-1 Okamoto Higashinada-ku
	Motoyama Daini Elementary School Playground	1-3-1 Nishi-Okamoto Higashinada-ku
	Motoyama Minami Junior High School Playground	4-12-1 Tanaka-cho Higashinada-ku
	Temizu Park	3-16 Tanaka-cho Higashinada-ku
Uozaki	Seto Park	1-2 Uozakiminami-cho Higashinada-ku
	Uozaki Junior High School Playground	1-2-1 Uozakiminami-cho Higashinada-ku
Sumiyoshi	Sumiyoshi Elementary School Playground	4-1-31Sumiyoshihigashi-machi Higashinada-ku
	Sumiyoshi Miyamachi Park	3-2 Sumiyoshimiya-machi Higashinada-ku
	Sumiyoshi Park	3-3 Sumiyoshimiya-machi Higashinada-ku
Mikage	Mikage Elementary School Playground	3-1-1 Mikageishi-machi Higashinada-ku
	Mikage Junior High School Playground	5-1-1 Mikagenaka-machi Higashinada-ku
	Mikage Kindergarten Playground	3-13-1 Mikageishi-machi Higashinada-ku
	Mikage Park	5-1 Mikagenaka-machi Higashinada-ku
Yamato	Seitoku Elementary School Playground	1-3-1 Bingo-cho Nada-ku
	Yamato Park	5-1 Nakago-cho Nada-ku
	Seitoku Park	1-3 Bingo-cho Nada-ku
Uzugamori	Kobe University Attached Sumiyoshi Elementary School Playground	5-11-1 Sumiyoshi Yamate Higashinada-ku
	Kobe University Attached Sumiyoshi Junior High School Playground	5-11-1 Sumiyoshi Yamate Higashinada-ku
	Uzugamori Elementary School Playground	1-12-1 Uzumoridai Higashinada-ku
Rokkodai	Kobe University	1-1 Rokkodai Nada-ku
Oji	Ouji Park	2-1 Ouji-cho Nada-ku
	Kamitsutsui Elementary School Playground	1-1-2 Nozaki-dori Chuo-ku
	Tsutsuidai Junior High School Playground	1-1-3 Nozaki-dori Chuo-ku
	Fukiai High School Playground	1-1-1 Nozaki-dori Chuo-ku
HAT Kobe	Nagisa Park	1-2 Wakihama Kaigan-dori Chuo-ku
	Maya Kaigan-dori Park	1-2 Maya Kaigan-dori Nada-ku
	Wakihana Kaigan-dori Park	4-2 Wakihama Kaigan-dori Chuo-ku
	Saigo-gawa Kako Park	2-1 Maya Kaigan-dori Nada-ku
	Ikuta-gawa Park (HAT Yume Park)	3 Wakihama Kaigan-dori Chuo-ku
	Nagisa Elementary School Playground	2-4-1 Wakihama Kaigan-dori Chuo-ku
	Nagisa Junior High School Playground	2-1-1 Wakihama Kaigan-dori Chuo-ku
Sannomiya	Higashi Yuenchi Park	6-4 Kano-cho Chuo-ku
	Isogami Park	2-1 Yahata-cho Chuo-ku
	Minatonomori Park	3 Onohama-cho Chuo-ku
Meriken Park	Meriken Park	2 Hatoba-cho Chuo-ku

Okura Yama (Mt. Okura)	Okura-yama Park	7-4 Kusunoki-cho Chuo-ku
	Kusunoki Junior High School Playground	4-2-5 Kusunoki-cho Chuo-ku
	Minatogawa Tamon Elementary School Playground	4-2-4 Kusunoki-cho Chuo-ku
Minatogawa/ Arata	Minatogawa Park	1-20 Arata-cho Hyogo-ku
	Arata Park	2-19 Arata-cho Hyogo-ku
Yumeno/ Egeyama	Yumenono-oka Elementary School Playground	10-1 Kikusui-cho Hyogo-ku
	Yumenodai Park	Takiyama-cho Hyogo-ku
	Egeyama Park	3 Egeyama-cho Hyogo-ku
	Egeyama Haisuijou (Water Distribution Facility)	10 Minatogawa-cho Hyogo-ku
	Kikusui Park	3 Kikusui-cho Hyogo-ku
Hyogo	Canal Town Square (Hyogo Station Front)	5-1 Ekiminami-dori Hyogo-ku
	Hyogo Ekiminami Park	5-2 Ekiminami-dori Hyogo-ku
	Shouken-cho Park	4-1 Ekiminami-dori Hyogo-ku
	Canal Town Square (West)	5-2 Ekiminami-dori Hyogo-ku
Misaki	Misaki Park	1-2 Misaki-cho Hyogo-ku
Kagura	Shin Minatogawa Park	1 Hosoda-cho Hyogo-ku
	Nagata Minami Elementary School Playground	1-4 Kagura-cho Nagata-ku
	Kagura Park	1-2 Hosoda-cho Nagata-ku
Hasuike/ Nishishiro	Hasuike Elementary School Playground	1-1-10 Oya-cho Nagata-ku
	Nishidai Hasuike Park	Hasuike-cho Nagata-ku
Shin Nagata	Wakamatsu Park	6-3 Wakamatsu-cho Nagata-ku
	Komagabayashi Junior High School Playground	7-1-23 Wakamatsu-cho Nagata-ku
	Shin Nagata Station Square	4-2 Wakamatsu-cho Nagata-ku
Takatori/ Myohoji River	Myohoji River Park	1 Tomasa-cho Suma-ku
	Myohoji River West Bank Park	5 Ooike-cho Suma-ku
	Daichi Elementary School Playground	5-15-52 Ooike-cho Suma-ku
	Takatori Ekikita Park	5 Ooike-cho Suma-ku
	Shimo Nakajima Park	1 Nakajima-cho Suma-ku
Kaihin Kouen	Suma Kaihin Park	1 Wakamiya-cho Suma-ku
Rikyu Kouen	Rikyu Park	1 Mizuno-cho Suma-ku
Sumaura Kouen	Sumaura Park	5 Ichinotani-cho Suma-ku
Shioya/ Aoyamadai	Shioya Junior High School Playground	Ootani Shioya-cho Tarumi-ku
	Aoyamadai Higashi Park	4-1 Aoyama-dai Tarumi-ku
Tarumi Kaihin Center	Shibahu Park	1 Hiraiso Tarumi-ku
	Hiraiso Ryokuchi	1 Hiraiso Tarumi-ku
Marine Pia Kobe	Marine Pia Kobe	12-2 Kaigan-dori Tarumi-ku
Azur Maiko	Azur Maiko	11 Kaigan-dori Tarumi-ku
Maiko Boen	Maiko Cemetery Park	Maikoryo Tarumi-ku
Maiko	Maiko Junior High School Playground	3-1-1 Kariguchi-dai Tarumi-ku
	Nishi Maiko Elementary School Playground	3-1-2 Kariguchi-dai Tarumi-ku
	Yamotodai Park	2-7 Kariguchi-dai Tarumi-ku
Suzurandai	Suzuran Park	5-1 Minamigoyou Kita-ku
	Minamigoyou Elementary School Playground	3-1-1 Minamigoyou Kita-ku
Hiyodorigoe Boen	Hiyodorigoe Cemetery Park	12-1 Nakaichiriyama Shimotanigami-aza Yamada-cho Kita-ku