RESEARCH REPORT

STUDY ON EARTHQUAKE RISK AND VULNERABILITY MANAGEMENT and LESSONS LEARNED

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Foreword

Objective of the Research:

- Enhance legal framework and institutional capacity for disaster risk reduction and management
- Strengthen community capacity and knowledge on disaster risk reduction and management

III. General Information:

A. Republic of the Philippines

The Republic of the Philippines (RP) is an archipelagic nation located in Southeast Asia. Three prominent bodies of water surround the archipelago: the Pacific Ocean on the east, the South China Sea on the west and north, and the Celebes Sea and the coastal waters of Borneo on the south. The Philippines constitutes an archipelago of 7,107 islands and has a total land area of approximately 300,000 square kilometers. Large mountainous terrain, narrow coastal plains and interior valleys and plains make up the country's topography.

The country's capital is Manila. The population estimated is 94.01 million as of July 2009 with a growth rate of 1.96%. Ninety percent (90%) of the Filipino population is Christians. Eighty-three percent (83%) is predominantly Roman Catholics. It has a democratic form of government.

The country is divided into three major island groups. Luzon is the largest island group with an area of 141,000 square kilometers, followed by Mindanao covering 102,000 square kilometers, and the Visayas with 57,000 square kilometers. The rest are small islets that emerge and disappear with ebbing and rising of tides.

The Philippines has a tropical and maritime climate. Using temperature and rainfall as bases, its climate can be divided into two major seasons: (1) the rainy season, from June to November; and (2) the dry season, from December to May. The dry season may be subdivided further into (a) the cool dry season, from December to February; and (b) the hot dry season, from March to May.

The Philippines is a newly industrialized country, with an economy anchored on agriculture but with substantial contributions from manufacturing, mining, remittances from overseas Filipinos, and service industries such as tourism, and business process outsourcing.

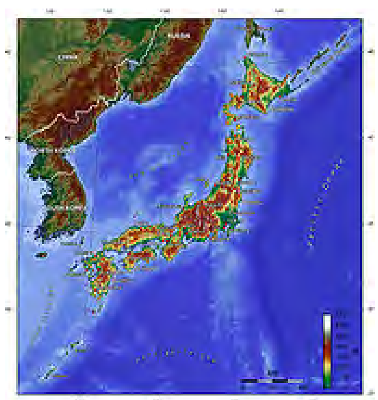
B. JAPAN

Japan is an island nation in East Asia. Located in the Pacific Ocean, it lies to the east of the Sea of Japan, People's Republic of 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. The characters that make up Japan's name mean "sun-origin", which is why Japan is sometimes referred to as the "Land of the Rising Sun".

A major economic power, Japan has the world's third-largest economy by nominal GDP and by purchasing power parity. It is also the world's fourth largest exporter and fourth largest importer. After Singapore, Japan has the lowest homicide (including attempted homicide) rate in the world. According to both UN and WHO estimates, Japan has the longest life expectancy of any country in the world. According to the UN, it has the third lowest infant mortality rate.

Japan consists of forty-seven prefectures, each overseen by an elected governor, legislature and administrative bureaucracy. Each prefecture is further divided into cities, towns and villages.

Japan has a total of 6,852 islands extending along the Pacific coast of Asia. The main islands, from north to south, are Hokkaidō, Honshū, Shikoku and Kyūshū. The Ryūkyū Islands, including Okinawa, are a chain to the south of Kyūshū. Together they are often known as the Japanese Archipelago. About 73 percent of Japan is forested, mountainous, and unsuitable for agricultural, industrial, or residential use. As a result, the habitable zones, mainly located in coastal areas, have extremely high population densities. Japan is one of the most densely populated countries in the world.



The islands of Japan are located in a volcanic zone on the Pacific Ring of Fire. They are primarily the result of large oceanic movements occurring over hundreds of millions of years from the mid-Silurian to the Pleistocene as a result of the subduction of the Philippine Sea Plate beneath the continental Amurian Plate and Okinawa Plate to the south, and subduction of the Pacific Plate under the Okhotsk Plate to the north. Japan was originally attached to the eastern coast of the Eurasian continent. The subducting plates pulled Japan eastward, opening the Sea of Japan around 15 million years ago. Japan has 108 active volcanoes. Destructive earthquakes, often resulting in tsunami, occur several times each century. The 1923 Tokyo earthquake killed over 140,000 people. More recent major quakes are the 1995 Great Hanshin earthquake and the 2011 Tōhoku earthquake, a 9.0-magnitude quake which hit Japan on March 11, 2011, and triggered a large tsunami.

A major feature of Japan’s climate is the clear-cut temperature changes between the four seasons. In spite of its rather small area, the climate differs in regions from a subarctic climate to a subtropical climate. The side of the country which faces the Sea of Japan has a climate with much snow in winter by seasonal winds from the Siberia. Most of the areas have damp rainy season from May to July by seasonal winds from the Pacific Ocean. Japan is frequently visited by typhoons from July to September.

IV. The Philippine Disaster Management System

A. Natural Hazards Likely to Affect the Country

The Philippines is susceptible to various types of natural hazards due to its geographical location and physical environment; being situated in the "Pacific Ring of Fire", between two Tectonic plates (Eurasian and Pacific), an area encircling the Pacific Ocean where frequent earthquakes and volcanic activity result from the movements of said tectonic plates. In fact, the country experiences an average of 20 earthquakes per day (most are too weak to be felt). There are also about 300 volcanoes, of which 22 are active and have been recorded in history to have erupted; while 5 are considered to be the most active namely: Taal, Mayon, Bulusan, Kanlaon and Hibok-Hibok. Also, being located along the typhoon belt/superhighway in the Pacific makes it vulnerable to extreme weather events. An average of 20-30 typhoons/tropical cyclones visit the country every year, with 5-7 of them considered the most destructive. Its 36,289 kms. of coastline is also vulnerable to tsunami, making the country also highly-susceptible to sea level rise and storm surges. Accompanying or resulting from these tropical cyclone events are secondary phenomena such as landslides, floods/flashfloods/flooding, tornadoes, drought, and heavy/monsoon rains.

Over the past decades, the Philippines have been labeled as one of the most disaster-prone countries in the world mainly because of its geographic and geologic location and physical characteristics. The 1,200-km-long Philippine fault zone (PFZ) is a major tectonic feature that transects the whole Philippine archipelago from northwestern Luzon to southeastern Mindanao. This arc-parallel, left-lateral strike slip fault is divided into several segments and has been the source of large-magnitude earthquakes in recent years, such as the 1973 Ragay Gulf earthquake (M 7.0), 1990 Luzon earthquake (Mw 7.7) and 2003 Masbate earthquake (Ms 6.2).

Disaster preparedness including disaster risk reduction has been strengthened in our country especially through the passage of Disaster Risk Reduction Management Act of 2010 (Republic Act (RA) 10121) and with its implementing Rules and Regulations supported by the Climate Change Act of 2009 (RA 9729). Efforts to familiarize the coordination mechanism to different parts of the country have been stepped up to contribute to local disaster preparedness.

B. Major Disasters in the Philippines

1. Typhoon Ketsana *("Ondoy")* (26 September 2009)

On 26 September 2009, Typhoon Ketsana (locally named *"Ondoy"*), the 15th tropical cyclone to enter the Philippine Area of Responsibility (PAR), battered Central Luzon causing the worst flooding in the Philippines, with floodwaters reaching up to a height of 6 meters in 40 years. According to the local weather bureau, the amount of heavy rainfall it brought in only 6 hours which was 341 mm. was recorded as the highest since 1947, even surpassing the 334 mm. recorded highest 24-hour rainfall 42 years ago. It was also almost equal to the average monthly rainfall in Metro Manila, which was pegged at 392 mm. Towns east of Manila were submerged, with landslides in other parts of Luzon. Excessive flooding was experienced particularly in cities in the National Capital Region and in the provinces in Calabarzon areas, which were also heavily-affected by the wrath of Ketsana. Most number of deaths was due to drowning and the water-borne infectious disease called Leptospirosis.

Casualties:

- 464 dead
- 529 injured
- 37 missing

Affected population/areas: 997,983 families / 4,929,382 persons in Regions I, II, III, IV-A, IV-B, V, VI, IX, XII, NCR, ARMM, and CAR

Estimated cost of damage to properties (infrastructure and agriculture): PhP11.106 Billion (US$236.3M)

Damaged houses:

- 6,253 totally destroyed
- 130,736 partially damaged

2. 1994 Mindoro Earthquake and Tsunami

Residents of Mindoro island are still haunted by memories of the tsunami that claimed 78 lives, many of them children, on November 15, 1994. At 3:15 a.m. on that day, a magnitude 7.1 earthquake jolted them awake, triggered by the movement of a previously unacknowledged active Aglubang River Fault. People living in villages along the 40-kilometer northern shore of the island, from Puerto Galera to Pinamalayan, first heard a gush of water less than five minutes after the earthquake.

According to the Philippine Institute of Volcanology and Seismology (Phivolcs), the areas hardest hit by the tsunami were Barangays Malaylay, Old Baco, Wawa and Baco islands, where waves at least six meters high smashed into the shore, destroying 1,530 houses. The tsunami left 41 people dead by drowning, most of them elderly or children below 10 years old.

The event affected 22,452 families in 13 out of 15 municipalities - a total of 273 barangays - in Oriental Mindoro, with 78 confirmed dead and 430 more injured.

The combined effects of the earthquake and the tsunami totally destroyed 1,530 houses and partially damaged 6,036 more. Most of the houses that were totally destroyed were in the municipalities of Calapan and Baco, while most partially damaged houses were in Naujan and Gloria. Officials placed the cost of rehabilitating 24 bridges and 500 kilometers of roads at PhP5.15 Million.

The tsunami knocked down trees and inundated coastal areas as far as 250 meters inland, scoured much of the shallow sandy foreshore of Malaylay island to Wawa and formed a "beach ridge" about a kilometer long along the coast of Wawa, Old Baco and Malaylay.

Luckily, the disaster response machinery of Mindoro province was in place and under the leadership of Governor Rodolfo G. Valencia, response and recovery were prompt, minimizing the toll and losses. National government bodies like the National Disaster Coordinating Council (NDCC), Department of Social Welfare and Development (DSWD) and others, led by former President Fidel V. Ramos himself, were also quick and efficient in extending assistance to the affected local government units.

The 1994 Mindoro earthquake reiterated the lessons highlighted by the 1990 Northern Luzon event and provided another opportunity to deepen our understanding of the processes/phenomena generated or triggered by shallow seated and high magnitude earthquakes. Moreover, it underscored the reality of tsunami and the impossibility of issuing timely warning for tsunami of local origin. The time interval between the earthquake and the tsunami hit is too short (2-5 minutes in the case of the Mindoro event) for any meaningful warning system. Other options must therefore be considered to reduce tsunami disaster in the future.

One option is to adopt and enforce policies regulating settlements in the areas exposed to tsunami, another is to install mitigation structures, but these must be weighed against the fact that tsunami-generating events are rare and far-between. A less costly alternative is to conduct education and information campaigns to make the concerned inhabitants aware of the hazard, take any strong earthquake as a natural warning for tsunami and immediately flee toward pre-identified places of safety whenever they experience extremely strong ground shaking.

The Geologic Hazards Information and Education Alliance (GHIEA) was organized and launched in May 1994, it is an alliance of media and science/hazard-oriented government and non-government organizations which aims to promote awareness of and preparedness for geologic hazards. The alliance focus its information and education campaigns on tsunami hazard nationwide.

3. 1990 Luzon earthquake

The **Luzon earthquake** occurred on Monday, July 16, 1990, at 4:26 PM (local time in the Philippines). The densely populated island of Luzon was struck by an earthquake with a 7.8 M_s (surface-wave magnitude). The earthquake produced a 125 km-long ground rupture that stretched from Dingalan, Aurora to Cuyapo, Nueva Ecija as a result of strike-slip movements along the Philippine Fault and the Digdig Fault within the Philippine Fault System. The earthquake epicenter was placed at 15° 42' N and 121° 7' E near the town of Rizal, Nueva Ecija, northeast of Cabanatuan City.

An estimated 1,621 people were killed in the earthquake, most of the fatalities located in Central Luzon and the Cordillera region.

The earthquake caused damage within in an area of about 20,000 square kilometers, stretching from the mountains of the Cordillera Administrative Region and through the Central Luzon region. The earthquake was strongly felt in Metropolitan Manila, Destroying many buildings and leading to panic and stampedes and ultimately three deaths in the National Capital Region.

The popular tourist destination of Baguio City, was among the areas hardest hit by the Luzon earthquake. The earthquake caused 28 collapsed buildings, including hotels, factories, government and university buildings, as well as many private homes and establishments.

In Cabanatuan City, Nueva Ecija, the tallest building in the city, a six-story concrete school building housing the Christian College of the Philippines, collapsed during the earthquake, which occurred during school hours. Around 154 people were killed at the CCP building.

In Dagupan City, Pangasinan, about 90 buildings in the city were damaged, and about 20 collapsed. Some structures sustained damage because liquefaction caused buildings to sink as much as 1 meter (39 inches). The earthquake caused a decrease in the elevation of the city and several areas were flooded. The city suffered 64 casualties of which 47 survived and 17 died. Most injuries were sustained during stampedes at a university building and a theater.

Five municipalities in La Union were also affected: Agoo, Aringay, Caba, Santo Tomas, and Tubao with a combined population of 132,208. Many buildings collapsed or were severely damaged. 100,000 families were displaced when two coastal villages sank due to liquefaction. The province suffered many casualties and 32 of them died.

The Department of Environment and Natural Resources (DENR) immediately initiated rehabilitation efforts after the July 16 earthquake. Livelihood programs for the victims and the rehabilitation of damaged watersheds were implemented. These, as well as the efforts of other government agencies and non- governmental organizations, however, are mostly of a curative nature and are not enough. There must be preventive approaches developed, if not against earthquakes (which we cannot prevent), at least in terms of early warning, land use planning, improved building codes, and the like. Former President Aquino thus signed on August 6, 1990 the Memorandum Order creating the "Inter-Agency Committee on Documenting and Establishing Database on the July 1990 Luzon Earthquake".

This Inter-Agency Committee chaired by DENR and the Department of Science and Technology (DOST) was tasked to undertake a unified, systematic and scientific documentation of information on earthquakes, particularly the July 16 killer quake for future planning and research.

The Philippine government, through the Department of Environment and Natural Resources (DENR) and the Department of Science and Technology (DOST) is undertaking steps to mitigate the effects of future major earthquake not only in areas affected but also in other developed and liquefaction prone areas in the country.

Lessons Learned

- It is apparent that any effective natural disaster mitigation program should be built around the community. Public awareness on disaster management is very much needed
- The Local Disaster Coordinating Councils, during that time, were incapable of promptly responding to the situation. The local disaster management officials acknowledged their lack of preparedness plans, resources and authority to deal with a major earthquake. However, the local organizations were not totally incapacitated. After recovering from the initial shock, they moved, though not always as DCCs but as individual DCC member organization. Majority of the local DCCs were able to mobilize 34 days after the event.
- Reconstruction and strengthening measures have been reviewed and observed on a range of projects. Contact with local consultants and government engineers has provided further insights into the effects of the earthquake and the key issues faced in the design and construction of seismic resistant buildings and infrastructure.
- Organizational experiences in the 1990 disaster underscored several issues which need to be resolved to prepare the country for similar occurrences in the future: 1) the most appropriate and effective organizational framework for disaster response; 2) division of disaster management responsibilities among: the various levels of organization -- national, regional, provincial, municipal, barangay, and household; and 3) the role of NGOs in disaster management.

Data on Natural Disasters

NATURAL AND HUMAN INDUCED INCIDENTS
SUMMARY OF DISASTERS IN THE PHILIPPINES COVERING THE PERIOD 1970 - 2010

KIND OF INCIDENTS	CASUALTIES			AFFECTED		DAMAGED HOUSES		DAMAGES TO PROPERTIES (P MILLION)			
	DEAD	INJ	MIS	FAMILIES	PERSONS	TOTALLY	PARTIALLY	INFRA	AGRI	PVT/COM	TOTAL
GRAND TOTAL	**39,128**	**62,809**	**14,948**	**30,976,212**	**156,397,487**	**3,004,455**	**7,563,833**	**182,563.473**	**97,172.323**	**20,102.607**	**299,838.403**
A. NATURAL INCIDENTS											
Typhoons (1970 - 2010)	23,892	32,641	8,645	26,978,106	136,543,259	2,854,006	7,293,082	178,396.737	76,770.002	10,292.882	265,459.621
Earthquakes (1968 - 2010)	5,576	12,859	2,266	322,898	1,808,889	27,201	85,749	43.837	1.530	24.376	69.743
Volcanic Eruptions (1991-2010)	959	201	23	355,282	1,697,450	44,247	68,451	7.880	14.608	0.957	23.445
Flashflood/Floodings (1981 - 2010)	919	735	1,527	1,883,185	9,212,959	20,387	101,437	953.917	2,186.935	24.212	3,165.064
Landslides (1981 - 2010)	1,121	807	113	22,382	86,130	887	1,616	73.732	10.144	1.199	85.075
Tornado (1990 - 2010)	48	182	59	9,794	52,008	1,538	1,948	0.344	54.537	2.389	57.270
Drought/El Niño Phenomenon (1990 - 2010)	0	0	0	1,133,042	5,671,679	0	3	0.000	18,132.209	106.221	18,238.430
Sub-Total	**32,515**	**47,425**	**12,633**	**30,704,689**	**155,072,374**	**2,948,266**	**7,552,286**	**179,476.447**	**97,169.965**	**10,452.236**	**287,098.648**

Republic of the Philippines
DEPARTMENT OF NATIONAL DEFENSE
OFFICE OF CIVIL DEFENSE
Camp General Emilio Aguinaldo, Quezon City

MAJOR EARTHQUAKE OCCURRENCES 1968-2008

OCCUR	AREAS AFFECTED	CASUALTIES			AFFECTED		DISPLACED		HOUSES DAMAGED		DAMAGED PROPERTIES			COST
		DEAD	INJURED	MISSING	FAMILIES	PERSONS	FAMILIES	PERSONS	TOTALLY	PARTIALLY	ARGI	INFRA	PVT	(Million Pesos)
1968 2-Aug	Casiguran, Aurora and Metro Manila (Ruby Tower)	270	261											
1973 17-Mar	Ragay Gulf Calauag, Quezon (worst hit town)	5			368	1,840	98	490	98	270				
1976 17-Aug (8 Ms)	**Region IX** (Pagadian City, Zamboanga del Sur, Zambo City, Basilan and Sulu **Region XII** (Sultan Kudarat, Maguindanao, Cotabato City, Lanao del Sur and L del Norte)	3,792	9,240	1,937	60,356	362,136	60,356	362,136			2.048	182.919	61.979	246.94
1990 16-Jul	Luzon Earthquake (Baguio City)	1,283	2,786	321	227,918	1,255,249	29,258	146,290	25,207	77,249	1,425.461	6,844.816	3,954.760	12,225.037
1994 5-Nov	Oriental Mindoro (almost all parts)	83	430	8	22,452	134,712	7,586	37,830	1,530	6,036	65.390	447.631		513.02
1999 2-Dec	Metro Manila and Region I	6	40		67	356				49		333.190		333.19
2000 28-Jul	Batanes		14		2,026	6,892	214	1,070	214	404		10.790		10.79
2002 6-Mar	Mindanao South Cotabato, Sultan Kudarat Sarangani, Davao del Sur	8	39		8,619	40,072			133	679	37.549	87.322	8.119	132.99
2003 5-Feb	Masbate											9.061		9.06
9-Nov	Eastern Samar	1	26		1,072	5,531	16	60	16	1,062		21.600	10.000	31.60
2007 19-Jul	Hinunangan, St Bernard, Southern Leyte (Region VIII)		6		9	45			9			22.900	1.280	24.18
2008 3-Jan	Bangued, Abra				204	1,381				19	1.775	0.306		2.08
	GRAND TOTAL	5,448	12,842	2,266	323,111	1,810,315	97,602	547,876	27,201	85,768	1,532.223	7,960.535	4,036.138	13,528.896
													or	13.529 Billion

Data on Major Earthquake Occurrences in the Philippines

C. Legal Authority

1. The National Disaster Coordinating Council (NDCC)

Leading the collaborative efforts in disaster preparedness planning and mitigation, as well as disaster response operations and rehabilitation both in the government and private sector is the National Disaster Coordinating Council (NDCC). The NDCC is the highest policy-making, coordinating and supervising body at the national level for disaster risk management in the country chaired by the Secretary of National Defense with the Office of Civil Defense (OCD), and has the heads of seventeen (17) other departments and agencies as members.

The NDCC is also responsible for advising the President of the Republic of the Philippines on the status of the national disaster preparedness programs and management plans, disaster operations, and rehabilitation efforts of all stakeholders; and it also recommends to the

President the declaration of the state of calamity and the release of the national calamity fund as needed. NDCC's legal authority is Presidential Decree (PD) 1566 issued on 11 June 1978, entitled, "Strengthening the Philippine Disaster Control Capability and Establishing the National Program on Community Disaster Preparedness".

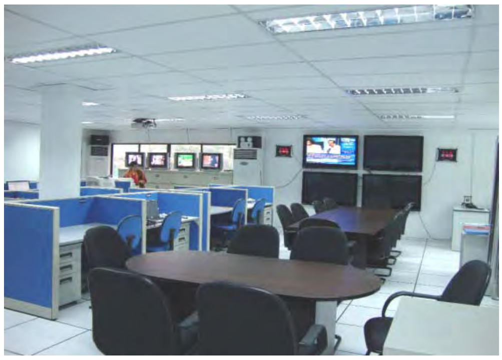
2. The Office of Civil Defense (OCD)

One of the five (5) bureaus of the Department of National Defense (DND) (per PD No. 1 as implemented by Letter of Intent (LOI) No. 19, s-1972, and DND Order Nos. 737 and 737-A, s-1973), the Office of Civil Defense (OCD), officially established on 1 July 1973, serves as the executive arm and secretariat of the National Disaster Coordinating Council per PD 1566.

As the nerve center for alert and monitoring, resource mobilization, response coordination, and information management, it has the primary task of coordinating the activities and functions of various government agencies and instrumentalities, private institutions and civic organizations for the protection and preservation of life and property during emergencies. It has in its vision a service-oriented organization, prepared population and a safe nation. Its mission is to basically administer a comprehensive national civil defense and civil assistance program by providing leadership in the continuous development of measures to reduce risk to communities and manage the consequence of disasters.

Presently, OCD is maintaining 17 fully-operational regional centers which provide secretariat services and serve as executive arm to 17 regional disaster coordinating councils.

OCD and its Regional Centers operate on a 24/7 basis, manned by OCD personnel round-the-clock, with complementation from selected NDCC member-agencies, such as, the Department of Social Welfare and Development (DSWD), Department of Health (DOH), Armed Forces of the Philippines (AFP), Department of Public Works and Highways (DPWH), Philippine National Red Cross (PNRC), among others, during emergency situations.



The National Disaster Management Center ***The OCD-NDCC Operations Center***
(Camp General Emilio Aguinaldo, Quezon City, Philippines)

3. The NDCC Comprehensive Disaster Risk Management Framework

Paradigm Shift

Since the OCD and NDCC's creation, PD 1566 has been the basic law that guides the disaster management programs, projects and strategies implementation in the country. However, it has been observed and noted from past experiences, combined with lessons learned and gaps examination, that the law that creates the Council is more leaning and gives more emphasis on response action, thus, making the implementers reactive to possible disasters rather than taking a proactive stance in disaster risk management.

In early 2005, the OCD-NDCC took a bold step in embracing a paradigm shift of disaster management approaches and strategies from reactive to proactive (from disaster response and preparedness to disaster risk reduction/management (DRR/M). To pursue the DRM Framework, the Government of the Republic of the Philippines, through the NDCC, adopts the following approaches and strategies:

- Multi-hazards approach, which includes both natural and human-induced hazards
- Comprehensive, as it encompasses the four (4) phases of DRM, i.e. mitigation/prevention and preparedness in the pre-disaster phase, and response and rehabilitation/recovery in the post-disaster phase
- Inter-agency/multi-sectoral, multi-stakeholder action and cooperation is needed especially for major disaster events
- Community-based, as the nation strongly pushes that the community is the first line of defense in any emergency situation
- Adheres to nationally and internationally-accepted principles/agreements on disaster management and emergency response (e.g. International Humanitarian Assistance Network (IHAN), ASEAN Agreement on Disaster Management and Emergency Response (AADMER), Oslo Guidelines, UNGPID, etc.)
- Pre-arranged protocols for damage assessment, SAR, emergency relief, early warning thru forging of Memorandum of Understanding (MOUs) with government and non-government organizations

4. The National Disaster Risk Reduction and Management Council (NDRRMC)

Disaster management in the Philippines has started from a purely disaster response approach by focusing on the provision of assistance or intervention during or immediately after a disaster. Within the same perspective, geophysical approaches prevailed that relied on physical and engineering means such as dams, levees, channel improvements and river training. This has been the practice till the 20th century.

On the other hand, scientific studies have started which focused on prediction and modeling of natural hazards such as earthquakes and floods. Such continued to flourish. With science and technology applied to reduce the impact of hazard on human, this has gradually changed some views and perspectives in addressing disasters. Around the same period, international disaster agencies channeled lots of their resources on humanitarian assistance, disaster aid, and relief operations. The way of thinking about solutions was that, it is within the domain of public policy applications of essentially geophysical and engineering knowledge.

In such development process, disaster perspective has shifted from reactive to more proactive framework. The humanitarian, relief and response approach in which the intervention was provided only during or immediately after a disaster has gradually shifted to a developmental approach. Within the developmental approach, disasters are seen in a growing manner as a development concern and may arise as a result of unsustainable development practices.

The previously technical approach using engineering and technological solutions including prediction and modeling of natural hazards and modifying hazards were transformed into promoting non-structural and non-engineering measures such as community-based disaster preparedness and early warning, indigenous knowledge, and land use planning, which emphasize the need to modify vulnerabilities (and capacities) instead of hazards.

The practice of single hazard approach in the past has switched to multi or all-hazards approach. The sectoral focus has become inter-sectoral, inter-agency, and an all-government effort. And the public sector led management of disaster became an all-society approach which is participatory, inclusive, transparent, and gender fair.

Such paradigm shift gave equal emphasis to vulnerabilities and capacities aside from hazard. It provided opportunities for land use planning to be promoted as a tool for disaster risk reduction. The shift in focus from hazards to vulnerabilities had emphasized the varying exposure of population groups living in the city, the poorly constructed buildings, the informal settlements, incorrectly sited developments, and the inadequacy of open spaces, among others, as well as capacities of people and institutions to cope with and adapt to natural hazards.

This paradigm shift likewise involved the promotion of non-structural and non-engineering measures such as community-based disaster preparedness and early warning, the use of indigenous knowledge, and land use planning, therefore, encouraging the application of land use policies and land use planning in disaster risk management.

5. Republic Act (RA) 10121

"An Act Strengthening the Philippine Disaster Risk Reduction (DRR) and Management System Providing for the National Disaster Risk Reduction and Management Framework and Institutionalizing the National DRR and Management Plan, Appropriating Funds Therefore and for Other Purposes" or "Philippine DRR and Management Act of 2010" – passed into Law on May 27, 2010 (Implementing Rules and Regulations (IRR) of RA 10121 approved on September 27, 2010)

6. The NDRRMC Framework

The framework envisions "*safer, adaptive and disaster resilient Filipino communities toward sustainable development*."

Background

Under the previous approach espoused by the old law (i.e., PD 1566 series of 1978), disaster management centered only on the hazard and the impacts of a disaster. It is assumed that disasters cannot be avoided. Most of the plans were on the provision of relief goods and infrastructures like dikes and flood control systems. The government's response to disaster was focused on disaster response. The national and local governments were reactive to disasters.

Recognizing this flawed policy/approach which is detrimental in achieving sustainable development, the Philippine Government approved on 27 May 2010 Republic Act No. 10121 or the DRRM Act of 2010. Said law mandated the development of the National DRRM Framework upon which the National DRRM Plan shall be based.

With the ever increasing risk of the Filipino community to disasters, the development of a National DRRM Framework which promotes a responsive and proactive manner of addressing disasters is imperative. Recent studies show that on the average, annual direct damages of disasters cause as much as PhP 15 Billion and that typhoons alone affect our Gross Domestic Product by 0.5% annually. Undeniably, disasters set back development programming by destroying years of development initiatives.

The Framework aims to raise awareness and understanding on the Philippines' DRRM goal. It shows the country's overall direction and set of priorities on DRRM. It has integrated Disaster

Risk Reduction (DRR) and Disaster Risk Management (DRM) to attain sustainable development through mainstreaming DRR and DRM in our national and local development plans. It seeks to lessen vulnerabilities and increase the capacities of the government and all communities. Furthermore, it promotes multistakeholder partnerships on DRRM projects/activities.

The National DRRM Framework seeks to initiate the following paradigm shifts:

FROM	TO
Top-down and centralized Disaster Management	Bottom-up and participatory Disaster Risk Reduction
Disasters are merely a function of physical hazard	Disaster mainly a reflection of people's vulnerability
Focus on disaster response and anticipation	Integrated approach to genuine social and human development to reduce disaster risk
Reactive to disaster	Pro-active in disaster risk reduction and management

7. Salient Features

- Strengthening the institutional set up/paradigm shift from reactive to proactive approach to disaster risk management
- Upholding people's rights to life and property and adherence to internationally accepted principles, norms and standards for capacity building in DRRM and humanitarian assistance
- Adoption of a holistic, comprehensive, integrated , proactive and multi-sector approach in addressing the impacts of disasters, including climate change
- Development, promotion and implementation of a comprehensive National Disaster Risk Reduction and Management Plan (NDRRMP)
- Mainstreaming DRR and Climate Change in national and local development plans and development processes (e.g. policy formulation, socio-economic development planning, budgeting and governance

It is coherent with international commitments of the Philippines such as the following:

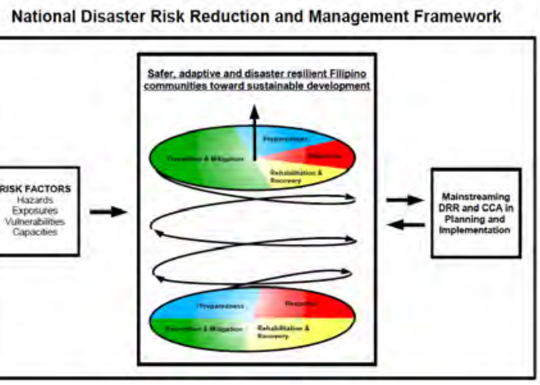
- Millennium Development Goals (MDG)
- ASEAN Agreement on Disaster Management and Emergency Response (AADMER)
- Hyogo Framework of Action (HFA)

It is consistent with and supports current national laws and policies such as the following:

- The Philippine Agenda 21 of 1996
- Republic Act No. 9729 or the Climate Change Act of 2009

It is geared towards the achievement of sustainable development

It captures both the concept of Disaster Risk Reduction (DRR) and Disaster Risk Management (DRM)



The NDRRMC Framework

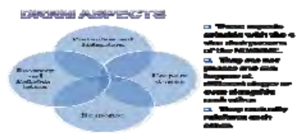
The country is challenged by increasing disaster and climate risks caused by dynamic combinations of natural and human-induced hazards, exposure, and people's vulnerabilities and capacities. There is an urgent need for the country to work together through multi-stakeholder partnerships and robust institutional mechanisms and processes so that Filipinos will be able to live in safer, adaptive and disaster resilient communities on the path to developing sustainably.

This DRRM framework indicates the paradigm shift towards a proactive and preventive approach to disaster management. This conceptual representation emphasizes that resources invested in disaster prevention, mitigation, preparedness and climate change adaptation will be more effective towards attaining the goal of adaptive, disaster resilient communities and sustainable development. The Framework shows that mitigating the potential impacts of existing disaster and climate risks, preventing hazards and small emergencies from becoming disasters, and being prepared for disasters, will substantially reduce loss of life and damage to social, economic and environmental assets. It also highlights the need for effective and coordinated humanitarian assistance and disaster response to save lives and protect the more vulnerable groups during and immediately after a disaster. Further, building back better after a disaster will lead to sustainable development after the recovery and reconstruction process.

The upward motion indicated by the spiraling arrows represents a bottom-up participatory process, enhanced level of awareness, strengthened multi-stakeholder partnerships, and pooling of resources. These positive changes will be realized through the mainstreaming of DRR and CCA into national and local plans which help us refocus our development goals, objectives and targets to be able to adequately respond to as well as identify and implement appropriate interventions to address the impacts of disaster risks.

Mainstreaming DRR is a means towards (a) refocusing the development goals, objectives and targets to be able to adequately respond to disaster risks; and (b) identifying and implementing appropriate interventions to address the impacts of disaster risks. Mainstreaming DRR is an important step towards avoiding huge losses from disasters. Resources invested in risk reduction are justified because these could prevent or at least minimize enormous costs of post-disaster recovery, repair and reconstruction works.

In the end, these processes will synergize efforts and create rippling positive changes toward addressing the underlying causes of vulnerabilities and mainstreaming DRRM in national and local policy-making, planning, investment programming and in the policy/plan implementation.



8. The Framework's Expected Outcome, Key Result Areas and Strategies

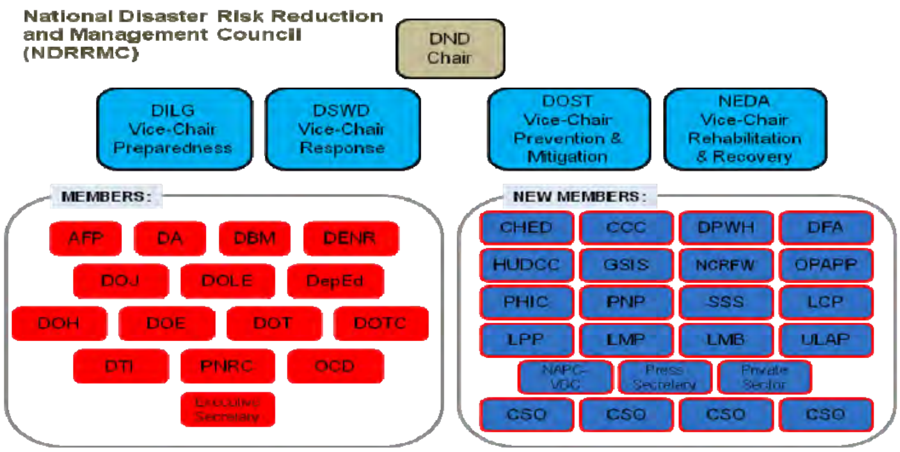
Aspect	Expected Outcome	Key Result Areas
Preparedness	Established and strengthened capacities of communities to anticipate, cope and recover from the negative impacts of emergency occurrences & disasters	1. Community Awareness and understanding of the Risk Factors 2. Contingency Planning at the local level (to include Incident Command System, Early Warning Systems, Pre-emptive evacuation, stockpiling and equipping) 3. Local drills and simulation exercises 4. National disaster response planning

Response	Provided life preservation and met the basic subsistence needs of affected population based on acceptable standards during or immediately after a disaster	1. DANA as a generic activity *(NDRRMC DANA methodology was adopted from ADPC)* 2. Relief Operations 3. Search, Rescue, Retrieval 4. Dissemination/Information sharing of disaster-related information 5. WATSAN and Health 6. Development/provision of temporary shelter 7. Psycho social support 8. Early Recovery Mechanism 9. Management of Dead and Missing 10. Evacuation Management 11. Social Protection Intervention 12. Civil and uniformed services coordination
Rehabilitation and Recovery	Restored and improved facilities, livelihood and living conditions and organizational capacities of affected communities, and reduced disaster risks in accordance with the “building back better” principle	1. Livelihood (1st priority) 2. Shelter (2nd priority) 3. Infrastructure (3rd priority)
Disaster Prevention and Mitigation	Avoided hazards and mitigated their potential impacts by reducing vulnerabilities and exposure and enhancing capacities of communities	1. Mainstreamed and integrated DRR & CCA in national, sectoral, regional and local development, policies, plans and budget. 2. DRRM/CCA sensitive environmental management. 3. Increased disaster resiliency of infrastructure systems. 4. Community based and scientific DRR/CCA assessment, mapping, analysis and monitoring. 5. Risk transfer mechanisms
Strategies The National DRRM Framework employs the following strategies in achieving the Framework’s vision, expected outcome and key result areas: 1. Advocacy and Information, Education and Communication (IEC) 2. Competency-based capability building 3. Contingency Planning 4. Education on DRRM and CCA for ALL 5. Institutionalization of DRRMCs and LDRRMOs 6. Mainstreaming of DRR in ALL plans 7. Research, Technology Development and Knowledge Management		

8. Monitoring, evaluation and learning
9. Networking and partnership building between and among stakeholders, media and tiers of government

9. The National Disaster Risk Reduction and Management Council (NDRRMC)

- Secretary, DND as Chairperson
- *Four (4) Vice-Chairpersons:*
  - DILG – Disaster Preparedness
  - DSWD – Disaster Response
  - DOST – Disaster Prevention and Mitigation
- NEDA – Disaster Rehabilitation and Recovery Executive Director
- OCD Administrator with the rank of Undersecretary



The National Disaster Risk Reduction and Management Council

Members: Thirty-Nine (39)

- **Fourteen (14) line departments**

  Department of Health (DOH)
  Department of Education (DepEd)
  Department of Finance (DOF)
  Department of Foreign Affairs (DFA)
  Department of Agriculture (DA)
  Department of Energy (DOE)
  Department of Trade (DOT)
  Department of Justice (DOJ)
  Department of Trade and Industry (DTI)
  Department of Budget and Management (DBM)
  Department of Labor and Employment (DOLE)
  Department of Public Works and Highways (DPWH)
  Department of Environment and Natural Resources (DENR)
  Department of Transportation and Communication (DOTC)

- **Twelve (12) other government agencies / offices**

  Office of the Executive Secretary
  Philippine National Police (PNP)
  Climate Change Commission (CCC)
  Office of the Press Secretary
  Armed Forces of the Philippines (AFP)
  PHILHEALTH
  Office of Civil Defense (OCD)
  Housing and Urban Development (HUDCC)
  Commission on Higher Education (CHED)
  Office of the Presidential Adviser on Peace Process (OPAPP)
  National Commission on the Role of Filipino Women (NCRFW)

National Anti Poverty Commission – Victims of Disaster and Calamities (NAPC-VDC)

- **Two (2) Government Financial Institutions**
  Government Service Insurance System (GSIS)
  Social Security System (SSS)

- **One quasi-government agency** - Philippine Red Cross (PRC)

- **Five (5) Local Government Units (LGU) Leagues**
  Union of Local Authorities of the Philippines (ULAP)
  League of Province of the Philippines (LPP)
  League of Cities of the Philippines (LCP)
  League of Municipalities of the Philippines (LMP), and
  Liga ng mga Barangay (LnB)

- **Four (4) Civil Society Organizations**
- **One (1) Private Sector Organization**

10. **Authority of the Chairperson** -The Chairperson of the NDRRMC may call upon other instrumentalities or entities of the government and non-government, civic and private organizations for assistance in terms of the use of their facilities and resources for the protection and preservation of life and properties in the whole range of disaster risk reduction and management.

11. **Duties and Responsibilities of the National Council members**
    - The Chairperson, assisted by the four (4) Vice-chairpersons, shall provide the overall direction, exercise supervision and effect coordination of relevant DRRM programs, projects and activities consistent with respective National Council Member Departments or Agency mandates.
    - Every member agency shall be assigned functions relevant to their mandates, programs, geographic jurisdiction and special constituencies to be indicated in the NDRRMP. Each agency shall formulate its own DRRM Implementing Plan and their manual of operations.
    - Every member agency of the NDRRMC shall establish their respective Emergency Operations Center (EOC), subject to exemptions granted by the National

OFFICE OF CIVIL DEFENSE

The Office of Civil Defense (OCD), as the implementing arm of the National Council, shall have the primary mission of administering a comprehensive national civil defense and disaster risk reduction and management program by providing leadership in the continuous development of strategic and systematic approaches as well as measures to reduce the vulnerabilities and risks to hazards and manage the consequences of disasters.

The Administrator – The Administrator of OCD shall also serve as Executive Director of the National Council and as such, shall have the same duties and privileges of a department undersecretary. The Administrator shall be a universally acknowledged expert in the field of disaster risk reduction management and of proven honesty and integrity.

Powers and Functions – The OCD shall have the following powers and functions in partnership and coordination with member agencies and in consultation with key stakeholders, as may be applicable.

(a) Advise the National Council on matters relating to disaster risk reduction and management consistent with the policies and scope as defined in this Act and Rules;
(b) Formulate and implement the NDRRMP within six (6) months from the effectivity of

these rules and provide leadership in the implementation of the plan. It shall ensure that the physical framework, social, economic and environmental plans of communities, cities, municipalities and provinces are consistent with such Plan. The Strategic National Action Plan (SNAP) for Disaster Risk Reduction (DRR) adopted through Executive Order No. 888 shall be used as the strategic foundation and building block for the NDRRMP. The National Council shall approve the NDRRMP.

(c) Identify, assess and prioritize hazards and risks in consultation with key stakeholders;

(d) Develop and ensure the implementation of national standards and standard operating procedures (SOP) in carrying out disaster risk reduction programs including preparedness, mitigation, prevention, response and rehabilitation works, from data collection and analysis, planning, implementation, monitoring and evaluation. These national standards and SPOs shall be developed alongside the NDRRMP.

(e) Review and evaluate the Local Disaster Risk Reduction and Management Plans (LDRRMPs) in coordination with concerned line agencies or instrumentalities to facilitate the integration of disaster risk reduction measures into the local Comprehensive Development Plan (CDP) and Comprehensive Land Use Plan (CLUP);

(f) Ensure that the LGUs, through the Local Disaster Risk Reduction and Management Offices (LDRRMOs) are properly informed and adhere to the national standards and programs;

(g) Formulate standard operating procedures for the deployment of rapid damage assessment and Analysis (DANA) teams, information sharing among different government agencies, and coordination before and after disasters at all levels;

(h) Establish an incident command system (ICS) as part of the country's existing on-scene disaster response system, to ensure effective consequence management of disasters or emergencies.

(i) Establish standard operating procedures on the communication system among provincial, city, municipal, and barangay disaster risk reduction and management councils, for purposes of warning and alerting them and for gathering information on disaster areas before, during and after disasters;

(j) Establish Disaster Risk Reduction and Management Training Institutes in such suitable location as may be deemed appropriate, in accordance of with rule 8 herein

(k) Ensure that all disaster risk reduction programs, projects and activities requiring regional and international support shall be in accordance with duly established national policies and aligned with international agreements;

(l) Ensure that government agencies and LGUs give top priority and take adequate and appropriate measures in disaster risk reduction and management ;

(m) Create an enabling environment for substantial and sustainable participation of CSOs, private groups, volunteers and communities, and recognize their contributions in the government's disaster risk reduction efforts;

(n) Conduct early recovery and post-disaster needs assessment institutionalizing gender analysis as part of it;

(o) Establish an operating facility to be known as the "National Disaster Risk Reduction and Management Operations Center (NDRRMOC)" that shall be operated and staffed on a twenty-four (24) hour basis;

(p) Prepare the criteria and procedure for the enlistment of accredited community disaster volunteers (ACDVs). It shall include a manual of operations for the volunteers which shall be developed by the OCD in consultation with various stakeholders;

(q) Provide advice and technical assistance and assist in mobilizing necessary resources to increase the overall capacity of LGUs, specifically the low income and in high-risk areas;

(r) Create the necessary offices to perform its mandate as provided under this Act; and
(s) Perform secretariat functions of the National Council; and
(t) Perform such other functions as may be necessary for effective operation and implementation of this Act.

V. Disaster Management in Japan

A. Natural Hazards in Japan

Japan is located in the circum-Pacific mobile zone where seismic and volcanic activities occur constantly. The number of earthquakes and distribution of active volcanoes is quite high. The geological formation with plate boundaries of the Pacific plate, the Philippine Sea plate, the Eurasian plate, and the North American plate make Japan an earthquake-prone country. Also because of its geographical, topographical, and meteorological conditions, it is subject to other frequent natural disasters such as typhoons, torrential rains, and heavy snow.

Every year there is a great loss of people's lives and properties in Japan due to natural disasters. Numerous large-scale typhoons and earthquakes caused extensive damage and thousands of casualties in the past. However, with the progress of society's capabilities to address disasters and the mitigation of vulnerabilities to disasters by developing disaster management systems, promoting national land conservation, improving weather forecasting technologies, and upgrading disaster information communications systems, disaster damage has shown remarkable declining tendency.

The disaster management system has been developed and strengthened following the bitter experiences of large-scale natural disasters and accidents.

B. Recent Major Disasters in Japan

1. Great East Japan Earthquake/ Tsunami (March 2011)

The **2011 earthquake off the Pacific coast of Tohoku**, also known as the **2011 Tōhoku earthquake** or the **Great East Japan Earthquake**, was a magnitude 9.0 (M_w) undersea megathrust earthquake off the coast of Japan that occurred at 14:46 JST (05:46 UTC) on Friday, 11 March 2011, with the epicenter approximately 70 kilometers (43 mi) east of the Oshika Peninsula of Tōhoku and the hypocenter at an underwater depth of approximately 32 km (20 mi). It was the most powerful known earthquake ever to have hit Japan, and one of the five most powerful earthquakes in the world overall since modern record-keeping began in 1900. The earthquake triggered powerful tsunami waves, which reached heights of up to 40.5 meters (133 ft) in Miyako in Tōhoku's Iwate Prefecture, and which in the Sendai area travelled up to 10 km (6 mi) inland. In addition to loss of life and destruction of infrastructure, the tsunami caused a number of nuclear accidents, primarily the ongoing level 7 meltdowns at three reactors in the Fukushima I Nuclear Power Plant complex, and the associated evacuation zones affecting hundreds of thousands of residents.

The Japanese National Police Agency has confirmed 24,000 people as dead or missing as of April 2011 across eighteen prefectures, as well as over 125,000 buildings damaged or destroyed. The earthquake and tsunami caused extensive and severe structural damage in Japan, including heavy damage to roads and railways as well as fires in many areas, and a dam collapse. Around 4.4 million households in northeastern Japan were left without electricity and 1.5 million without water. 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. Residents within a 20 km (12 mi) radius of the Fukushima I Nuclear Power Plant and a 10 km (6.2 mi) radius of the Fukushima II 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 banking system on 14 March in an effort to normalize market conditions. The overall cost could exceed US$300 billion, making it the most expensive natural disaster on record. The earthquake moved Honshu 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).

2. Great Hanshin-Awaji Earthquake (January 1995)

On 17 January 1995, an earthquake with a 7.3 magnitud e on the Richter scale occurred at Awaji Island of Hyogo Prefecture in Western Japan. It killed 6,434 people; injured 43,792; destroyed 104,906 houses; half destroyed 144,274 houses; and partially destroyed 390,506 houses. The fires that broke out because of the earthquake burned down an area of 835,858 square meters.

Restoration Process and Efforts Toward “Creative Reconstruction”

Despite difficult conditions, including severed traffic networks and paralyzed urban functions, steady restoration took place through the dedicated efforts of those involved and with generous assistance from around the world. In only six days following the Earthquake, provisional supply of electricity was restored, with water and gas reconnected in three months.

The Priority Three-Year Reconstruction Plan was implemented to press forward the urgently needed reconstruction of living quarters for the victims, and also the restoration of industries and infrastructure such as roads, harbors, and railways. In addition, the Great Hanshin-Awaji Earthquake Reconstruction Plan (Hyogo Phoenix Plan) was formulated with the aim of achieving “creative reconstruction” over a period of ten years. The Phoenix Plan called for not only mere restoration but also the creation of urban communities that meet the needs of the increasingly aging society and Japan’s highly maturing economy.

With the extent of restoration in housing, industries, and urban infrastructure accomplished thus far, the quantitative targets set in the Priority Three-Year Reconstruction Plan were successfully achieved.
On January 17, 2005, the 10th Great Hanshin-Awaji Earthquake Memorial Service was held in the presence of Their Majesties The Emperor and Empress of Japan.
Hyogo continues to exert its utmost efforts to support disaster-hit elderly citizens to regain their self-reliance, create sources of communal vitality, and establish safe and secure communities.

3. Typhoon No. 23 (TOKAGE) (October 2004)

On 20 October 2004, Typhoon No. 23 landed on Japan and caused floods and landslides triggered by record-breaking torrential rain and high wave. Ninety-five (95) people were killed; 555 injured; 909 houses were totally destroyed; more than 18,000 houses were damaged; and about 55,000 were inundated.

Natural Disasters in Japan from 1900 to 2011

		# of Events	Killed	Total Affected	Damage (000 US$)
Drought	Drought	1	–	–	–
	ave. per event		–	–	–
Earthquake (seismic activity)	Earthquake (ground shaking)	43	161796	951578	146841400
	ave. per event		3762.7	22129.7	3414916.3
	Tsunami	14	40780	560127	212821000
	ave. per event		2912.9	40009.1	15201500
Epidemic	Bacterial Infectious Diseases	2	1	534	–
	ave. per event		0.5	267	–
	Viral Infectious Diseases	1	–	2000000	–
	ave. per event		–	2000000	–
Extreme temperature	Heat wave	3	242	18300	–
	ave. per event		80.7	6100	–
Flood	Unspecified	31	12814	7015269	268300
	ave. per event		413.4	226299	8654.8
	Flash flood	1	21	25807	1950000
	ave. per event		21	25807	1950000
	General flood	12	197	99266	1814000
	ave. per event		16.4	8272.2	151166.7
	Storm surge/coastal flood	2	34	384143	7440000
	ave. per event		17	192071.5	3720000
Mass movement wet	Avalanche	1	13	–	–
	ave. per event		13	–	–
	Landslide	20	989	25706	210000
	ave. per event		49.5	1285.3	10500
Storm	Unspecified	24	1890	192814	453500
	ave. per event		78.8	8033.9	18895.8
	Local storm	6	27	100499	363000
	ave. per event		4.5	16749.8	60500
	Tropical cyclone	109	32500	7512095	53055500
	ave. per event		298.2	68918.3	486747.7
Volcano	Volcanic eruption	15	515	99979	132000
	ave. per event		34.3	6665.3	8800
Wildfire	Forest fire	1	–	222	–
	ave. per event		–	222	–

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Source: "EM-DAT: The OFDA/CRED International Disaster Database
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Top 10 Natural Disasters in Japan
for the period 1900 to 2011
sorted by numbers of total affected people:

Disaster	Date	No Total Affected
Flood	18-Sep-1965	3,000,000
Epidemic	Feb-1978	2,000,000
Flood	23-Jun-1953	1,886,760
Storm	26-Sep-1959	1,500,000
Storm	18-Sep-1945	1,340,691
Flood	Jun-1961	1,302,249
Storm	25-Sep-1953	1,000,000
Storm	Sep-1950	642,117
Earthquake (seismic activity)	17-Jan-1995	541,636
Storm	Oct-1945	540,981

Top 10 Disasters in Japan for the Period 1900 to 2011

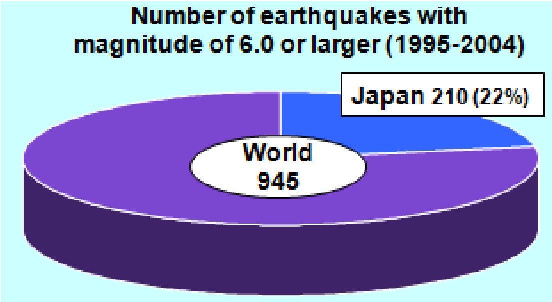
Top 10 Natural Disasters in Japan
for the period 1900 to 2011
sorted by economic damage costs:

Disaster	Date	Damage (000 US$)
Earthquake (seismic activity)	11-Mar-2011	210,000,000
Earthquake (seismic activity)	17-Jan-1995	100,000,000
Earthquake (seismic activity)	23-Oct-2004	28,000,000
Earthquake (seismic activity)	16-Jul-2007	12,500,000
Storm	27-Sep-1991	10,000,000
Storm	3-Sep-2004	9,000,000
Flood	10-Sep-2000	7,440,000
Storm	22-Sep-1999	5,000,000
Storm	17-Sep-1990	4,000,000
Storm	22-Sep-1998	3,000,000

Source:"EM-DAT: The OFDA/CRED International Disaster Database, www.emdat.be - Université catholique de Louvain - Brussels - Belgium"

C. Disaster Management in Japan

Japan is located in the circum-Pacific mobile zone where seismic and volcanic activities occur constantly. Although the country covers only 0.25% of the land area, the number of earthquakes and distribution of active volcanoes is quite high. Also, because of geographical, topographical and meteorological conditions, it is also subject to frequent natural disasters such as typhoons, torrential rains and heavy snows.



Every year, there is a great loss of people's lives and property in Japan due to natural disasters. Up until the 1950s, numerous large-scale typhoons and earthquakes caused extensive damage and thousands of casualties. However, with the progress of society's capabilities to address disasters and mitigation of vulnerabilities to disasters by developing disaster management systems, promoting national land conservation, improving weather forecasting technologies, and upgrading disaster information communications system, disaster damage has shown a declining tendency.

In spite of such efforts, in 1995, more than 6,400 people became casualties of the Great Hanshin-Awaji Earthquake, and in 2004, 10 typhoons – the largest number in a single year on record – crossed over Japan, causing damage throughout the nation. There is also a high probability of the occurrence of large-scale earthquakes in the coming decades. As such, natural disasters remain a menacing threat to the safety and security of the country.

1. Progress in Disaster Management Law and Systems

Repeated flooding of large rivers in Japan in the 1890s led to the enactment of the River Act (1897), which served as the basis for flood control and Forest Act (1897), which served as the basis for flood control planning and establishment of systematic flood control management. The Nankai Earthquake of 1946 that left 1,432 dead or missing also exposed the shortcomings of rescue systems and led to the establishment of the 1947 Disaster Relief Law.

Furthermore, in order to implement systematic emergency measures, the Fire Services Act and Flood Control Act were formulated in 1948 and 1949, respectively, followed by other legislation such as the Seashore Act (1956) and the Landslide Prevention Act (1958). However, the immense damage caused by Typhoon Ise-wan in 1959, with 5,098 either dead or missing, marked a turning point in disaster management, giving rise to a movement to plan and prepare a comprehensive disaster management system, and in 1961, the Basic Act for Disaster Countermeasures came into force. To protect the country, and lives and properties of people from disaster, the Basic Act stipulates that the Government, local governments and public institutions shall work out appropriate disaster management systems with each of these sectors assigned its own responsibilities while formulating measures against disasters including disaster prevention, emergency response and restoration in the event of a disaster.

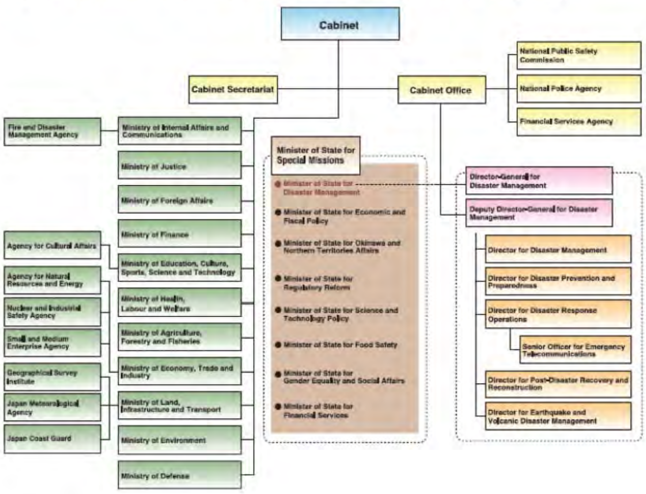
Following the enactment of the Disaster Countermeasures Basic Act, various initiatives have been taken to achieve affective disaster preparedness including the passing of related laws, establishment of disaster management systems, promotion of national land conservation projects and research and development in science and technology to mitigate the effects of disaster.

2. Mission of the Cabinet Office

Along with a series of reforms of central government systems in 2001, the post of Minister of State for Disaster Management was newly established to integrate and coordinate disaster reduction policies and measures of ministries and agencies. In the Cabinet Office, which is responsible for securing cooperation and collaboration among related government organizations in wide-ranging issues, the Director-General for Disaster Management is mandated to undertake the planning of basic disaster management policies and response to large-scale disasters, as well as conduct overall coordination.

Additionally, taking into account the lessons learned from the Great Hanshin-Awaji Earthquake, the Cabinet Secretariat system was also strengthened, including the appointment of the Deputy Chief Cabinet Secretary for Crisis Management and the establishment of the Cabinet Information Collection Center, to strengthen risk management functions to address emergencies such as large scale disasters and serious accidents. Thereby, the Cabinet Office has a role in supporting the Cabinet Secretariat regarding disaster management matters.

Organization of National Government and Cabinet Office (Disaster Management)



3. The Central Management Council

The Central Management Council is one of the Councils that deal with crucial policies of the Cabinet, and is established in the Cabinet Office based on the Disaster Countermeasures Basic Act. The council consists of the Prime Minister, who is the chairperson, Minister of State for Disaster Management, all ministers, heads of major public institutions and experts. The council promotes comprehensive disaster countermeasures including deliberating important issues on disaster reduction according to requests from the Prime Minister or Minister of State for Disaster Management.

Organization of Central Disaster Management Council

4. Duties of the Central Management Council

- ➢ Formulate and promote implementation of the Basic Disaster Management Plan and Earthquake Countermeasures Plans
- ➢ Formulate and promote implementation of the urgent measures plan for major disasters
- ➢ Deliberate important issues on disaster reduction according to request from the Prime Minister or Minister of State for Disaster Management (basic disaster management policies, overall coordination of disaster countermeasures and declaration of state of disaster emergency)
- ➢ Offer opinions regarding important issues on disaster reduction to the Prime Minister and Minister of State for Disaster Management

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5. Disaster Management Planning

A. Disaster Management Planning System

- ➢ Basic Disaster Management Plan: This plan is a basis for disaster reduction activities and is prepared by the Central Disaster Management Council based on the Disaster Countermeasures Basic Act.
- ➢ Disaster Management Plan: This a plan made by each designated government organization and designated public corporation based on the Basic Disaster Management Plan
- ➢ Local Disaster Management Plan: This is a plan made by each prefectural and municipal disaster management council, subject to local circumstances and based on the Basic Disaster Management Plan.

B Basic Disaster Management Plan

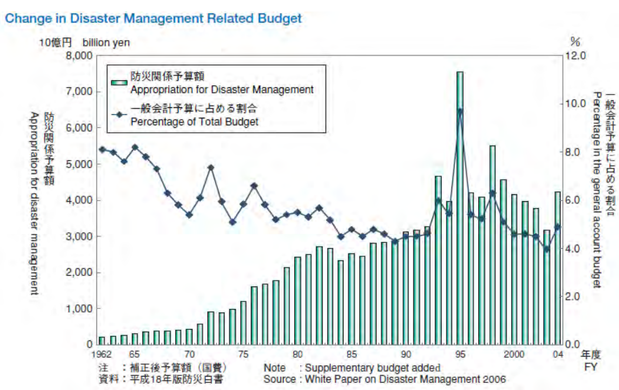
The Basic Disaster Management Plan states comprehensive and long-term disaster reduction issued such as disaster management related systems, disaster reduction projects, early and appropriate disaster recovery and rehabilitation, as well as scientific and technical research.

It consists of various plans for each type of disaster, where tangible countermeasures to be taken by each stakeholder such as the national and local governments, public corporations and other entities are described for easy reference according to the disaster phases of prevention and preparedness, emergency response, as well as recovery and rehabilitation.

6. Disaster Management Related Budget

The national budget for disaster management is Approximately 4.5 Trillion Yen (average annual budget from 1995 to 2004), accounting for approximately 5% of the total amount of the budget for general accounts. The percentage for each field:

- ➢ Scientific Technology Research – 1.3%



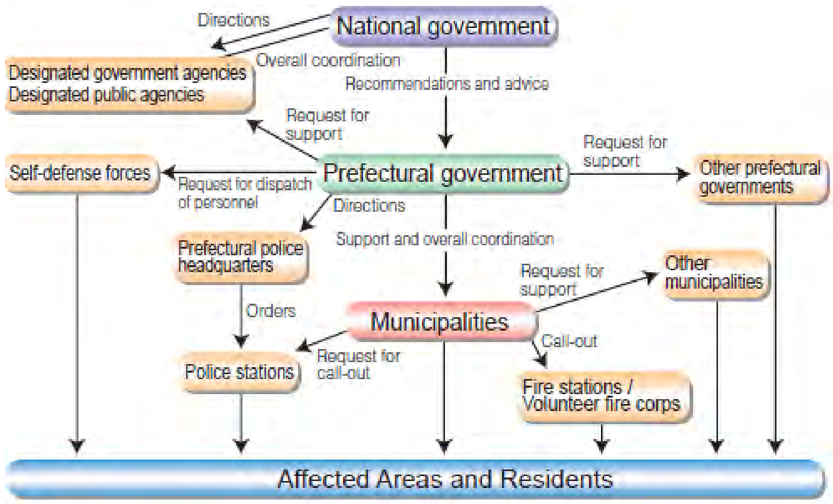
- ➢ Disaster Prevention and Preparedness – 23.6%
- ➢ National Land Conservation – 48.7%, and
- ➢ Disaster Recovery and Rehabilitation – 26.4%

7. Disaster Response Mechanism

In Japan's disaster management system, it is the responsibility of the affected municipalities to respond to disasters, and only in extreme cases do the related prefectures support the municipalities by carrying out overall coordination efforts.

Furthermore, when even the prefectures are having difficulty handling the situation the national government steps in to help.

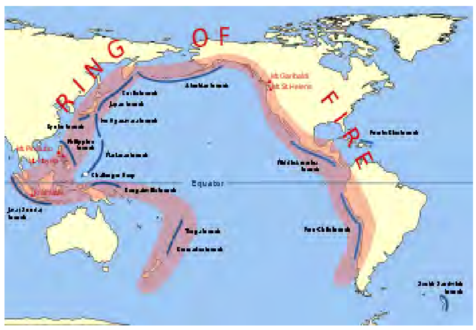
For large-scale disasters, affecting wide areas, the Prefectural Emergency Relief Headquarters is expected to play a central role in the recovery process.



VI. Research Study on Earthquake

An earthquake is a tremor of the earth's surface usually triggered by the release of underground stress along fault lines. This release causes movement in masses of rock and resulting shock waves. In spite of extensive research and sophisticated equipment, it is impossible to predict an earthquake, although experts can estimate the likelihood of an earthquake occurring in a particular region.

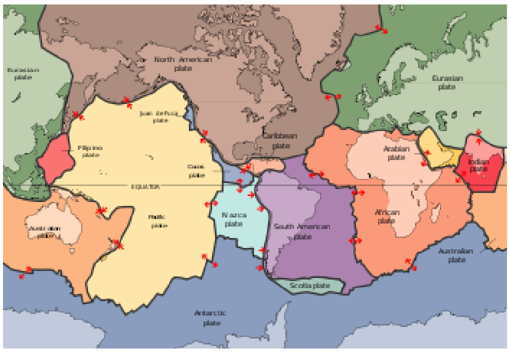
A. Pacific Ring of Fire



The **Pacific Ring of Fire** (or sometimes just **the Ring of Fire**) is an area where large numbers of earthquakes and volcanic eruptions occur in the basin of the Pacific Ocean. In a 40,000 km (25,000 mi) horseshoe shape, it is associated with a nearly continuous series of oceanic trenches, volcanic arcs, and volcanic belts and/or plate movements. The Ring of Fire has 452 volcanoes and is home to over 75% of the world's active and dormant volcanoes. It is sometimes called the circum-Pacific belt or the circum-Pacific seismic belt**.**

About 90% of the world's earthquakes and 80% of the world's largest earthquakes occur along the Ring of Fire. The next most seismic region (5–6% of earthquakes and 17% of the world's largest earthquakes) is the Alpide belt, which extends from Java to Sumatra through the Himalayas, the Mediterranean, and out into the Atlantic. The Mid-Atlantic Ridge is the third most prominent earthquake belt.

Tectonic plates of the world



The Ring of Fire is a direct result of plate tectonics and the movement and collisions of lithospheric plates. The eastern section of the ring is the result of the Nazca Plate and the Cocos Plate being subducted beneath the westward moving South American Plate. The Cocos Plate is being subducted beneath the Caribbean Plate, in Central America. A portion of the Pacific Plate along with the small Juan de Fuca Plate are being subducted beneath the North American Plate. Along the northern portion the northwestward moving Pacific plate is being subducted beneath the Aleutian Islands arc. Further west the Pacific plate is being subducted along the Kamchatka Peninsula arcs on south past Japan. The southern portion is more complex with a number of smaller tectonic plates in collision with the Pacific plate from the Mariana Islands, the Philippines, Bougainville, Tonga, and New Zealand; this portion excludes Australia, since it lies in the center of its tectonic plate. Indonesia lies between the *Ring of Fire* along the northeastern islands adjacent to and including New Guinea and the *Alpide belt* along the south and west from Sumatra, Java, Bali, Flores, and Timor. The famous and very active San Andreas Fault zone of California is a transform fault which offsets a portion of the East Pacific Rise under southwestern United States and Mexico. The motion of the fault generates numerous small earthquakes, at multiple times a day, most of which are too small to be felt. The active Queen Charlotte Fault on the west coast of the Queen Charlotte Islands, British Columbia, Canada, has generated three large earthquakes during the 20th century: a magnitude 7 event in 1929, a magnitude 8.1 occurred in 1949 (Canada's largest recorded earthquake) and a magnitude 7.4 in 1970.

While most earthquakes are caused by movement of the Earth's tectonic plates, human activity can also produce earthquakes. Four main activities contribute to this phenomenon: storing large amounts of water behind a dam (and possibly building an extremely heavy building), drilling and injecting liquid into wells, and by coal mining and oil drilling. Perhaps the best known example is the 2008 Sichuan earthquake in China's Sichuan Province in May; this tremor resulted in 69,227 fatalities and is the 19th deadliest earthquake of all time. The Zipingpu Dam is believed to have fluctuated the pressure of the fault 1,650 feet (503 m) away; this pressure probably increased the power of the earthquake and accelerated the rate of movement for the fault. The greatest earthquake in Australia's history is also claimed to be induced by humanity, through coal mining. The city of Newcastle was built over a large sector of coal mining areas. The earthquake has been reported to be spawned from a fault that reactivated due to the millions of tonnes of rock removed in the mining process.

Earthquakes can be recorded by seismometers up to great distances, because seismic waves travel through the whole Earth's interior. The absolute magnitude of a quake is conventionally reported by numbers on the Moment magnitude scale (formerly Richter scale, magnitude 7 causing serious damage over large areas), whereas the felt magnitude is reported using the modified Mercalli intensity scale (intensity II–XII).

Every tremor produces different types of seismic waves, which travel through rock with different velocities:

- Longitudinal P-waves (shock- or pressure waves) - The name P-wave stands either for **primary wave**, as it has the highest velocity and is therefore the first to be recorded; or **pressure wave**, as it is formed from alternating compressions and rarefactions
  As an earthquake warning

  Earthquake advance warning is possible by detecting the non-destructive primary waves that travel more quickly through the Earth's crust than do the destructive secondary and Rayleigh waves, in the same way that lightning flashes reaches our eyes before we hear the thunder during a storm. The amount of advance warning depends on the delay between the arrival of the P-wave and other destructive waves, generally on the order of seconds up to about 60–90 seconds for deep, distant, large quakes such as Tokyo would have received before the 2011 Tohoku earthquake and tsunami. The effectiveness of advance warning depends on accurate detection of the P-waves and rejection of ground vibrations caused by local activity (such as trucks or construction) otherwise false-positive warnings will result. Technology currently in use known as the Quake Guard system employs this technique to automate emergency response procedures that protect against loss of life and reduce property damage

- Transverse S-waves (both body waves) - A type of seismic wave, the **S-wave**, **secondary wave**, or **shear wave** (sometimes called an **elastic S-wave**) is one of the two main types of elastic body waves, so named because they move through the body of an object, unlike surface waves.
  The S-wave moves as a shear or transverse wave, so motion is perpendicular to the direction of wave propagation: S-waves are like waves in a rope, as opposed to waves moving through a slinky, the P-wave. The wave moves through elastic media, and the main restoring force comes from shear effects. These waves do not diverge, and they obey the continuity equation for incompressible media:

- Surface waves — (Rayleigh and Love waves)

Propagation velocity of the seismic waves ranges from approx. 3 km/s up to 13 km/s, depending on the density and elasticity of the medium. In the Earth's interior the shock- or P waves travel much faster than the S waves (approx. relation 1.7 : 1). The differences in travel time from the epicentre to the observatory are a measure of the distance and can be used to image both sources of quakes and structures within the Earth. Also the depth of the hypocenter can be computed roughly.

In solid rock P-waves travel at about 6 to 7 km per second; the velocity increases within the deep mantle to ~13 km/s. The velocity of S-waves ranges from 2–3 km/s in light sediments and 4–5 km/s in the Earth's crust up to 7 km/s in the deep mantle. As a consequence, the first waves of a distant earth quake arrive at an observatory via the Earth's mantle.

Hyatt Hotel, Baguio City, 16 July 1990 Luzon Earthquake

B. HAZARDS POSED BY EARTHQUAKES

1. GROUND SHAKING

The destructive effects of earthquakes are due mainly to intense GROUND SHAKING or vibration. Because of severe ground shaking, low and tall buildings, towers and posts may tilt, split, topple or collapse, foundation of roads, railroad tracks and bridges may break, water pipes and other utility installations may get dislocated, dams and similar structures may break and cause flooding, and other forms of mass movement may be generated. It can also cause secondary hazards such as liquefaction and landslides. Liquefaction and landslides can be experienced as far away as 100km from the epicenter. These destructive effects of earthquakes may cause casualties and short to long term socioeconomic disruptions

2. GROUND RUPTURE

Calapan, Oriental Mindoro, 15 Nov. 1994 Mindoro Earthquake

Many strong earthquakes originate along faults that break the earth's rigid crust. GROUND RUPTURE is a deformation on the ground that marks the intersection of the fault plane with the earth's surface. The most common manifestation is a long fissure extending from a few kilometers to tens of kilometers, although ground rupture may also occur as a series of discontinuous crack, mounds or depressions. The length of ground rupture and the width of the zone of deformation generally increase with the magnitude and type of earthquake. A ground rupture is rarely confined to a simple narrow and distinct line and the zone of deformation could be as wide as 100m.

3. TSUNAMI

Brgy. Malaylay, Baco, Oriental Mindoro, 15 Nov. 1994 Mindoro Earthquake

Tsunamis are giant sea waves generated mostly by submarine earthquakes. Not all submarine earthquakes, however, can cause tsunamis to occur. Tsunamis can only occur when the earthquake is shallow-seated, and strong enough about (M6) to displace parts of the seabed and disturb the mass of water over it. Other causes of tsunamis include submarine or coastal landslides, pyroclastic flows and large volume debris avalanches from submarine and partly submerge volcanoes, and caldera collapse

4. LIQUEFACTION

A.B. Fernandez St., Dagupan City, 16 July 1990 Earthquake

Liquefaction is a process where particles of loosely consolidated and water-saturated deposits of fine sand are rearranged into more compact state. Water and sediments are squeezed out towards the surface in the form of water and sand fountaining (sand boiling) and thus creating a condition resembling 'quick sand'. The consequent loss in volume and underlying support results in subsidence of the ground on top of the liquefying sandy layers and with it, the sinking and /or tilting of any structures above it. Liquefaction prone areas can be found in beach zones, sand spits, sand bars, tombolos, wide coastal plains, deltaic plains, floodplains, abandoned river meanders, former lake beds, former or existing marshlands and swamplands, and in areas underlain by sandy lahar deposits.

5. LANDSLIDES

Landslides are downward movement of slope materials either slowly or quickly. A landslide may be a rock fall, topple, and slide or lateral spreading. Intense ground shaking can trigger a landslide by loosening the cohesion that bonds the slope materials together, thereby making it easier for gravity to pull it downwards. Hilly and mountainous areas, escarpments, and steep river banks, sea cliffs, and other steep slopes are prone to landsliding. The main effect of landsliding is burial.

6. FIRE

Earthquakes can cause fires by damaging electrical power or gas lines. In the event of water mains rupturing and a loss of pressure, it may also become difficult to stop the spread of a fire once it has started. For example, more deaths in the 1906 San Francisco earthquake were caused by fire than by the earthquake itself.

7. FLOOD

A flood is an overflow of any amount of water that reaches land. Floods occur usually when the volume of water within a body of water, such as a river or lake, exceeds the total capacity of the formation, and as a result some of the water flows or sits outside of the normal perimeter of the body. However, floods may be secondary effects of earthquakes, if dams are damaged. Earthquakes may cause landslips to dam rivers, which collapse and cause floods.

8. HUMAN IMPACT

An earthquake may cause injury and loss of lives. The aftermath may bring diseases due to lack of basic necessities.

VII. EARTHQUAKES AROUND THE WORLD

Worldwide, over the last few decades, a marked increase in more powerful earthquake activity is painfully obvious. Information, preparation and understanding of these massive natural disasters is critical for the effective reduction in loss of lives and properties. The carefully prepared and knowledgeable response from managers and first responders through effective training and preparation programs is an absolute necessity.

Earthquakes caused the greatest loss of life, while powerful, were deadly because of their proximity to either heavily populated areas or the ocean, where earthquakes often create tsunamis that can devastate communities thousands of kilometers away. Regions most at risk for great loss of life include those where earthquakes are relatively rare but powerful, and poor regions with lax, unenforced, or nonexistent seismic building codes.

Many different methods have been developed for predicting the time and place in which earthquakes will occur. Despite considerable research efforts by seismologists, scientifically reproducible predictions cannot yet be made to a specific day or month. However, for well-understood faults the probability that a segment may rupture during the next few decades can be estimated.

Earthquake warning systems have been developed that can provide regional notification of an earthquake in progress, but before the ground surface has begun to move, potentially allowing people within the system's range to seek shelter before the earthquake's impact is felt.

A. Japan

Japan is located at a point on the earth's surface where four of more than 10 tectonic plates covering the globe crushed against each other, making it earthquake-prone. More than 20% of the world's earthquakes (magnitude 6 or greater) have occurred in or around Japan.

Japan is well acquainted with the massive inter-plate earthquakes produced by plate subduction (such as the Great Kanto Earthquake of 1923) and the inland crustal earthquakes caused by plate movements (such as the Great Hanshin-Awaji Earthquake of 1995)

It has been pointed out with a great sense of urgency that Japan can be struck by a large-scale earthquakes in the next few decades, such as the Tokai Earthquake, Tonankai and Nankai Earthquakes, earthquakes around Japan and Chishima trenches and Tokyo Inland earthquakes.

Regarding trench-type earthquakes, following related laws and regulations, respective actions are being undertaken; including the designation of areas where various countermeasures need to be strengthened, the reinforcement of observations systems and the formulation of a plan of action by relevant government organizations and private corporations. In addition, preparations such as improvements in evacuation sites and firefighting facilities are being promoted based on laws specifying special financial measures.

1. Study on the Tonankai and Nankai Earthquake:

Tonankai Earthquake is potentially a twin or triple earthquake that could occur practically simultaneously (from the same day scale to years delay scale.) The last case of the Tonankai Earthquake Disaster happened in 1944 and its twin one, the Nankai Earthquake Disaster occurred in 1946, two years later. The next Tonankai is predicted to occur within the earlier half of this 21st century with a probability of 80 to 90 percent. This twin or triple earthquake disaster is known to be periodic with a frequency of 100 to 150 years. Every time it occurs, it is twin or triple and the impact of each single earthquake is colossal, with a magnitude of more than 8.0 in Richter scale. If multiplied by simultaneous occurrences, the damage would be devastating.

The Government of Japan and research communities of natural hazard and disaster prevention in Japan have already started special research projects such as "Daitoshi-Daikibo Jishin Saigai Tokubetsu Project" known as "Dai-Dai-Toku Project" for short. (The meaning is Pacific Megalopolis Catastrophic Earthquake Disaster Research Initiative Project. It is commonly called the "Tonankai Initiative Project" in English.)

In 2003, the Central Disaster Management announced a damage estimation after examining the possible epicenter zone, strength of tremors and distribution of tsunami wave height.

Estimation of Damage caused by Possible Earthquakes

Maximum Case	Tokai Earthquake	Tonankai / Nankai Earthquakes
No. of Victims (Persons)	9,200 (7,900 by strong tremor)	18,000 (8,600 by tsunami)
No. of Houses Destroyed	260,000	36,000
Economic Loss	37,000	57,000

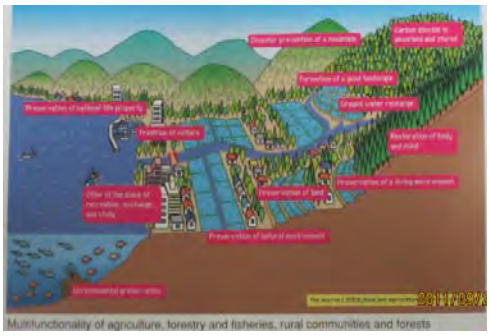
In 2003, the Central Disaster Management Council established the "Policy Framework for Tonankai and Nankai Earthquakes," which establishes the tsunami disaster management system and wide-area disaster management support system, and promoting the planned urgent prevention countermeasures.

In 2005, the Central Disaster Management Council drafted the "Tonankai and Nankai Earthquake Disaster Reduction Strategy, " which sets forth an overarching goal of halving the estimated deaths and economic loss within a 10-year period, as well as the strategic targets to create a tsunami hazard map in all the relevant municipalities. In 2006, the "Guidelines for Tonankai and Nankai Earthquake Emergency Response Activities" were drafted.

1.1 Disaster Prevention and Preparedness

The immense damage caused by Typhoon Ise-wan in 1959, with 5,098 either dead or missing, marked the turning point in disaster management in Japan. The incident prompted the government to draw up Disaster Countermeasures Act, invest in disaster preventive facilities and proactive policy-making started in an organized manner, leading to the establishment of the foundations of the comprehensive disaster prevention system.

a. National Land Conservation



Multifunctionality of agriculture, forestry and fisheries, rural communities and forests

National land conservation projects such as river improvement, soil erosion control (sabo), and soil and coastline conservation are carried out strategically for protecting national land, citizen's live and property from various disasters. Although long term plans by field had been formulated in the past, the "Selective Infrastructure Improvement Plan" was set forth in 2002 to promote prioritized, effective and efficient infrastructure improvement projects. Additionally, the "Forest Improvement and Conservation Works master Plan" was formulated in 2003 to promote comprehensive and effective forestry improvement and soil conservation project.

To create an environment in which people not only in the rural area but also in cities can live safely, it is essential to conserve multi-functionality by the conservation and redevelopment of agriculture, forestry and fisheries, rural communities and forests.

b. Observing, Forecasting and Warning of Disaster Risks

Observation systems that can accurately detect disaster risks in real-time have been progressively improved for establishing early warning systems, supporting the early evacuation of residents and response activities of disaster management organizations, and thereby reducing disaster damage. The Japan Meteorological Agency (JMA) use 24-hour systems to carefully monitor various natural phenomena and weather conditions.

In addition to announcing observed information related to natural phenomena, the JMA issues a wide range of forecasts, warnings and advisories regarding earthquake-generated tsunamis and severe weather events such as heavy rains.

c. Information and Communication Systems

The development of a quick and accurate communications system is essential for the effective use of early warning information. The JMA has built and online system linking disaster management organization of the national and local governments and media organizations.

Disaster management organizations have also been developing radio communications networks exclusively for disasters: the Central Disaster Management Radio Communication Systems which connects national organizations; the Fire Disaster Management Radio Communications System which connects firefighting organizations across the country; and prefectural and municipal disaster management radio communications systems which connect local disaster management organizations and resident. The Cabinet Office has developed the Central Disaster Management Radio Communications System so that designated government organizations and designated public corporations can use telephones or facsimiles via a hotline and has prepared an image transmission circuit so that pictures of disaster situations can be transmitted from helicopters in real-time. Furthermore, as a backup for terrestrial communications, a satellite communications system has also been constructed.

Simultaneous wireless communications systems using outdoor loudspeakers and indoor radio receivers are used to disseminate disaster information to residents. Tsunami and severe weather warnings are widely provided to citizens via TV and radio broadcasts.

d. Integrated Disaster Management Information System

Based on the experiences of the Great Hanshin-Awaji Earthquake, the Cabinet Office has been developing an integrated disaster management information system that helps to grasp the situation sharing among relevant organizations, thereby enabling quick and appropriate decision-making for emergency response operations.

1. Earthquake Disaster Information System (DIS)
   DIS is automatically activated upon the receipt of earthquake (intensity level 4 or greater) information from the JMA to estimate the approximate distribution of seismic intensity and scale of damage (human suffering and building damage) within 30 minutes.
2. Real Damage Analysis System by Artificial Satellite (RAS)
   RAS uses satellite images to assess actual disaster damage when it is otherwise difficult to determine the disaster situation due to the disruption of transportation and communication networks.
3. Disaster Information Sharing Platform (PF)
   PF is common information sharing system with a standardized information format, where various disaster information provided by ministries and agencies, local government, relevant organizations and residents can be posted and freely accessed by all.

e. Development of Disaster Management Bases

In order to secure wide-area collaboration for quick and smooth response and recovery and rehabilitation activities at the time of a large-scale disaster, disaster management bases with such functions as information management, operations coordination and logistics need to be developed and networks formed.

The Cabinet Office is constructing main wide-area disaster management bases in cooperation with relevant ministries in Ariake-no-Oka (Tokyo) and Higashi-Ogishima (Kanagawa) in the Tokyo Bay area; these will function as core bases for responding to a large-scale disaster in the Tokyo metropolitan area.

Additionally, subsidies are provided to local governments to promote qualitative and quantitative improvements of local disaster management bases.

f. Issuing of Evacuation Order and Instruction

When a disaster occurs or is imminent, residents may start evacuating on their own and the Mayor of the municipality may also issue an evacuation order or instruction.

It is effective for municipalities to prepare a manual explaining the criteria regarding disaster situations that require the issuance of evacuation orders or instructions, thereby helping the Mayor's quick decision. The Cabinet Office, in cooperation with relevant ministries, published the "Guidelines for Producing Decision and Dissemination Manual for Evacuation Orders and Instructions" in 2005, and is promoting its implementation.

g. Measures for People Requiring Assistance During Disaster

In view of the aging society and the increasing number of the elderly being killed or injured by disasters, measures to provide necessary assistance to those such as the elderly and physically impaired at the time of a disaster need to be reinforced.

In cooperation with relevant ministries, the Cabinet Office published the "Guidelines for Evacuation Support of People Requiring Assistance During a Disaster" in 2005 (revised in 2006) to be implemented at the municipal level. The guidelines describe:

a. Improving the information communications system
b. Sharing of information concerning people requiring assistance during disaster
c. Creating a tangible evacuation support plan for those people
d. Assistance at evacuation centers; and
e. Collaboration among related organizations.

Tangible countermeasures are included such as the issuance of evacuation preparation information which calls for the early evacuation of people requiring assistance among disaster management and social welfare-related organizations (exceptional use of social welfare-related personal information to prepare evacuation support system for the elderly and others).

h. Disaster Reduction Drills and Exercises

Disaster reduction drills and exercises are good opportunities to review the effectiveness of the disaster management system in view of quick and appropriate emergency operations and to enhance public awareness through wide participation. The Disaster Countermeasures Basic Act stipulates the obligations of disaster reduction drills. In order to promote various drills and exercises nationwide, the Central Disaster

Management Council sets forth an annual “Comprehensive Disaster Reduction Drills Plan,” which stipulates the basic principles for executing the drills and outlines the comprehensive disaster reduction drills carried out by the national government in cooperation with local governments and relevant organizations.

2. EARTHQUAKE DISASTER COUNTERMEASURES

A. Observation System

1. Japan Meteorological Agency (JMA)

In order to constantly monitor seismic activity, the Japan Meteorological Agency (JMA) and other relevant organizations install and maintain seismometers that are used for estimating the location of the epicenter and magnitude of an earthquake as well as for tsunamis forecasts and seismic intensity meters that measure the intensity of ground motion, in numerous places nationwide. As soon as the earthquake occurs in or around Japan, the JMA analyzes the date from various seismometers and seismic intensity meters. Within about two minutes, it issues as seismic intensity information report for earthquakes of intensity 3 or greater and within about five minutes issues an earthquake information report indicating the epicenter and magnitude of the earthquake and seismic intensity in the municipalities where strong shaking was observed.

As disaster risk management system took shape, science and technology was also making advances, social infrastructure became more organized and the mass media became increasingly conscious of the importance of disaster prevention.

2. Japan Agency for Marine Science and Technology (JAMSTEC)

JAMSTEC set "Leading project" aside from usual research sections, to focus on research development tasks which the government takes its initiative, e.g., development of real-time monitoring system for massive ocean-trench earthquake, active contribution to the IPCC Fifth Assessment Report, and research for submarine resources and recyclable energies with upgrading of exploration technologies.

Earthquake and Tsunami research project for Disaster Prevention

JAMSTEC has a primary role to the contract researches requested by MEXT such as "Dense Oceanfloor Network system for Earthquakes and Tsunamis" (DONET), "Research concerning Interaction between the Tokai, Tonankai and Nankai Earthquakes". JAMSTEC explores earthquake related research intensively to aim for the contribution to the development of the state-of-the-art ocean floor observation technology, advancement of simulation models of earthquake recurrences, disaster reduction and mitigation.

JAMSTEC develops real-time dense Oceanfloor network system around the area of Kumano-nada off Kii peninsula.

The DONET is a submarine cabled real-time seafloor observatory network for the precise earthquake and tsunami monitoring. For the purpose of understanding and forecasting the earthquake and related activities underneath the seafloor, the twenty sets of state-of-arts submarine cabled sub-sea measurement instrument will be deployed in seafloor at the interval of 15-20km. The twenty sets of preliminary interface are prepared in consideration of the improvement of observation capability in the future. Operating large-scale subsea infrastructure over a long period of time (20-30 years) is one of a challenge of underwater technology. The increase of measurement instruments has a big influence on the total system reliability, because of the state-of-arts instrument is a bottleneck to maintain long-term reliability. A novel system design concept is necessary for the observatory network development to make two demands such as 'high reliability system design' and 'state-of-arts measurement' united. The observatory network should be able to replace, maintenance and extend while operating, and should be have a redundancy for the internal or external observatory network component failure. To achieve these requirements, the DONET proposes a composition that consists of three major components with different system reliability. There are high reliability backbone cable system, replaceable science node, and extendable measurement instruments.

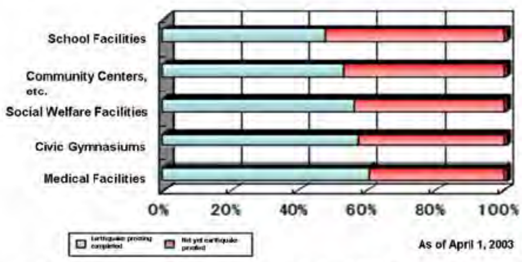
DONET also contributes mitigation of earthquake and tsunami disasters by rapid detection and data processing of seismic shaking and tsunami immediately after the earthquake.

B. Earthquake-proofing of Housing and Buildings

More than 80% of the casualties in the Great Hanshin-Awaji Earthquake were caused by building collapse. Likewise, it is presumed that building collapse will be the cause of a large number of deaths in the damage estimation related to future large-scale earthquakes. However, it is estimated that there is a problem of earthquake resistance in 25% of the existing residences as they were built before 1981, when stricter earthquake-proofing building codes were introduced. Nearly half of the schools and hospitals are pointed out to have problems related to resistance to earthquake. To promote seismic retrofit of these houses and buildings, a governmental financial support system, such as subsidiary, low interest loan and favorable taxation has been established.

In view of this situation, the Central Disaster Management Council drafted the “Urgent Countermeasures Guidelines for Promoting the Earthquake-proofing of House and Buildings” in 2005, which stipulates that earthquake-proofing throughout the country should be urgently and strictly enforced in close cooperation with related ministries as a national priority.

The Ratio of Retrofitted Public Schools in Japan



From report on survey of status of earthquake proofing in public facilities, etc., to be used as disaster management bases

From Ministry of Education, Culture, Sports, Science and Technology materials

Survey by Ministry of Education, Culture, Sports, Science and Technology-Japan in 2010

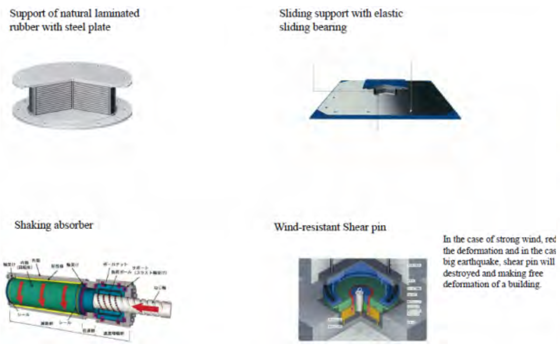
	2006	2007	2008	2009	2010
Preschool	50.5%	54.5%	57.8%	60.1%	66.2%
Elementary & Junior High School	54.7%	58.6%	62.3%	67.0%	73.3%
High School	57.5%	60.9%	64.4%	67.8%	72.9%
School for the Handicapped	74.8%	78.2%	80.5%	82.8%	87.9%

Methods on Retrofitting

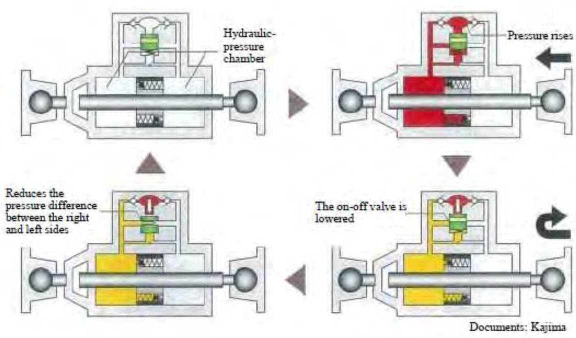
Pane
Type

Earthquake Resistant Wall SRC Brace Method

Seismic Free Devices



Vibration Control Technology



The development of seismic retrofitting of roads and bridges is also being implemented. In order to prevent or mitigate damage caused by major earthquakes, such as fragmentation of the road system (with a significant adverse impact on society), the government have been conducting various road disaster prevention measures.

In particular, securing emergency road transportation routes that links together disaster management bases that can be used for rescue activities and transportation of goods at the time of a large-scale earthquake. To ensure that highway bridges located on emergency transportation routes are earthquake resistant, they are urgently developing new highway bridges and effecting seismic retrofit of existing highway bridges according to the new seismic design standard.

As Japan is surrounded by sea, ships play a vital role in the transportation of foodstuffs, daily necessities, raw materials for industry and manufactured products. The reliance on sea transport makes ports indispensable in Japan's social and economic life. The Port of Kobe, one of the leading ports in the world, suffered significant damage during the Great Hanshin-Awaji Earthquake and this had a grave impact on economies at home and abroad.

Many of the Kobe port facilities were damaged, but the earthquake-resistant quays designed to withstand large-scale earthquake suffered no damage and were used for transportation of relief goods within three days after the earthquake. They were used to evacuate residents and for commuting to work, since parts of the overland traffic system were partly damaged.

Furthermore, approximately 70,000 houses in the city of Kobe were damaged. Since acquiring a relatively large space of land is easier in the port environs, approximately 16% (5,200 units) were built in the Port of Kobe. Passengers and other vessels moored at the unaffected quays serves as places for rest and lodging. Having learned from this experience, the Ministry of Land, Infrastructure and Transport have constructed earthquake-resistant quays all over the country, to withstand the large-scale earthquakes that are considered to be imminent.

C. Coastline Projects

Japan, totally surrounded by sea, has a deeply indented complex coastline approximately 35,000 kilometers long. And because the country is so narrow and mountainous and the amount of flat land is so limited, the population, assets and social capital are concentrated along the coast.

The government has been pushing ahead with coastline projects to build coastal conservation facilities such as embankments, revetments and offshore breakwaters in order to protect lives and property concentrated along the coast from disasters and to secure national land. These measures are designed to reduce the effects of natural disasters occurring in coastal areas.

By introducing comprehensive program to protect the coasts through the multiple functions provided by a number of extensively laid-out facilities such as artificial reefs, artificial beaches and gently sloping revetments, enhancing the durability of the facilities and achieving a high level of coastal conservation including erosion countermeasures but they also take into consideration the creation of beaches for recreational purposes and the maintenance of the physical landscape.

3. TSUNAMI COUNTERMEASURES

Surrounded by water on all sides with long and complex coastlines, Japan is highly vulnerable to earthquake-generated tsunamis. In reality, there has been severe damage caused by various tsunamis in the past, including the Nihon-kai-Chubu Earthquake (1983), Hokkaido Nansei-oki Earthquake (1993) and the most recent one, the Tohoku Earthquake (March 2011). In addition to local tsunamis generated by earthquakes near the coast, Japan has also suffered major damage from the onslaught of distant tsunamis generated by open-sea earthquakes.

When tsunamis is expected to cause coastal damage, the JMA issues a tsunami warning or advisory within 2-3 minutes after the earthquake and then follows up with announcements about the estimated height and arrival time of the tsunami. The information is transmitted immediately to disaster management organizations and media outlets, and further forwarded to residents and maritime vessels.

Tsunami countermeasures, such as expediting the announcement/transmission of tsunami forecasts and improving coastal embankments (tidal embankments) and tide prevention gates, have been carried out. The Cabinet Office, in cooperation with relevant ministries has prepared guidelines for the creation of a tsunami hazard map and designation/development of tsunami evacuation buildings by local governments and is working on disseminating the guidelines.

a. Disaster Awareness Enhancement and Disaster Knowledge Dissemination]

The government has also been augmenting the disaster risk reduction system through the combined activities of self-help, mutual help and public help, which has led to disaster prevention education in schools, development of voluntary disaster prevention organizations and other initiatives.

Disaster education in schools is important for learning necessary disaster knowledge from childhood. It is therefore taught in various school curriculums. Social education at the community level including town-watching and hazard-mapping programs in which residents participate is also important. The Cabinet Office promotes disaster education including sharing good examples of disaster education programs.

To reduce the damage and injuries caused by disasters, it is very important to notify the local residents of safe evacuation methods and routes beforehand so that they act appropriately when a natural disaster occurs. To that end, municipal governments have been taking the lead in preparing and publishing al local Hazard Map, which contains information on danger zones exposed to the risk of floods, storm surges and tidal waves, landslides, volcanic activity, etc., and on evacuation routes. The government has been supporting this local initiatives by providing technical manuals and organizing the necessary basic information, and promoting the creation and circulation of Hazard Maps.

Hazard Maps provide guidance to the public so that they will take appropriate action when faced with an imminent natural disaster; therefore, understanding the nature and purpose of a Hazard Map is important. Various local activities are being carried out, such as “Town Watching.” This activity involves local residents monitoring the situation in their hometowns in order to identify any signs of an impending disaster. Disaster prevention workshops are also held, through which residents gain a better understanding of the Hazard Map, and they are then able to collectively participate in the creation of a community disaster prevention map. These activities will increase the recognition and knowledge of the community regarding disasters and their prevention, and lead to the generation of public proposals on how to reduce vulnerability, contributing to enhance local ability to mitigate or prevent disaster.

The Japan Coast Guard has been implementing numerical calculations of tidal waves caused by the likely earthquakes in the Tokai, Tonankai and Nankai areas, as the probability of major seismic events in these regions in the near future is high and has proceeded with the making of tidal wave disaster prevention information maps reflecting the results of calculations, in order to reduce damages caused by tidal waves.

B. Improvement of Environment for Disaster Reduction Volunteer Activities

Community-based voluntary disaster reduction organizations, firefighting teams and floodfighting teams play valuable roles in disaster reduction activities. Following the Great Hanshin-Awaji Earthquake, volunteer activities have expanded in all aspects of disaster prevention, emergency response and recovery and rehabilitation.

The national government has designated January 17th of each year as Disaster Reduction and Volunteer Day and January 15th and 21st of each year as Disaster Reduction and Volunteer Week. The Cabinet Office creates opportunities to share information among volunteer groups and relevant entities and provides useful information to improve the environment for disaster reduction volunteer activities, including the holding of Disaster Reduction and Volunteer Forum every year and publishing an Information and Hints Handbook based on information exchange of actual experiences and challenges of volunteer activities in cooperation with relevant ministries.

B. Philippines

The Pacific Rim is not only a community of the fastest growing and most dynamic nations in the world. It is also the area exposed to a wide range of natural disaster. The Philippines archipelago, located near the western edge of the Pacific Ocean, is in the direct path of seasonal typhoons and monsoon rains which bring floods, storms, storm surges, and their attendant landslides and other forms of devastation. The Philippines also sits on the "ring of fire" where the continental plates collide and thus experience periodic earthquakes and volcanic eruptions. The Philippine exposure to natural disasters may be characterized as frequent, varied, and severe; a combination which has made the Philippines society and government extremely sensitive to the challenge of disaster reduction

Over the past decades, the Philippines have been labeled as one of the most disaster-prone countries in the world mainly because of its geographic and geologic location and physical characteristics. The country lies along several active fault lines and have active, inactive and potentially active volcanoes all over the country. Records shows an average of 20 earthquakes per day and around 100-150 earthquakes felt per year.

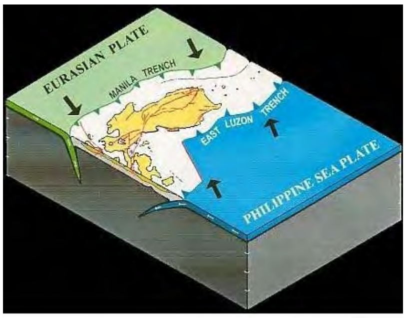
1. Study on the Metro Manila Earthquake

a. Fault in the Philippines

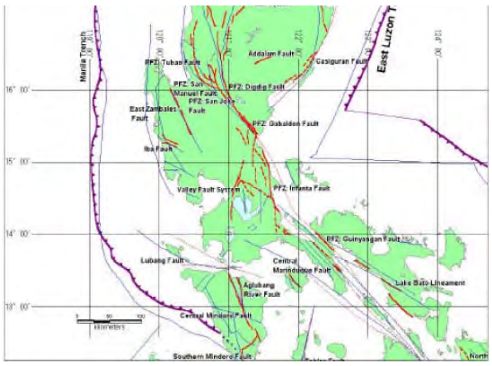
The Philippines is located in latitude 5° to 19°45' N. and longitude 116° to 128° E. Metropolitan Manila is located in the center of Luzon Island, between Manila Bay, which extends to the South China Sea, and Laguna de Bay. Many earthquake generators are distributed all over the country

b. Earthquake Generators

The Eurasian Plate (or South China Plate) subducts eastward beneath Luzon Island along the Manila Trench, and the Philippine Sea Plate subducts westward along the East Luzon Trench simultaneously. Because of this complex tectonic setting, Luzon Island shows high seismic activity. The Philippine Islands are sandwiched between two opposite subduction zones. A long, inland Philippine Fault Zone (PFZ) lies parallel to the subduction trenches. The PFZ is assumed to release the shear stress caused by the oblique subduction of the ocean plates. Many faults are identified around Metropolitan Manila; the West Valley Fault (WVF) and the East Valley Fault (EVF), which run north to south along the west and east edge of the Marikina Valley, are thought to pose the greatest threat to Metropolitan Manila due to their proximity.



Subducting Plates under Luzon Island



The faults and trenches around Metropolitan Manila are shown in the picture. The fault traces based on geological survey (bold lines) are used for the analysis of inland fault and the fault traces based on seismic activities (thin lines) are used for the analysis of offshore fault. Results of several trenching excavation surveys at WVF and EVF indicate that at least two or perhaps four large surface-rupturing events have occurred since AD 600. Therefore, the recurrence interval of the earthquakes generated is less than 500 years. Study shows that the 1658 and

1771 earthquakes could be candidate events for the EVF. However, no event along the WVF is known. If no earthquake had occurred at the WVF after the 16th century, then the earthquake occurrence along the WVF becomes a serious threat.

Since 1900, more than 30 earthquakes have caused some damage to Metropolitan Manila. Many faults have been identified around and within Metropolitan Manila, but the Valley Fault System that runs north to south along the west and east edges of the Marikina Valley is thought to pose the greatest threat to Metropolitan Manila due to its close proximity.

Of all the natural disasters that Metropolitan Manila has experienced throughout its history (such as tropical cyclones, droughts and floods, tsunamis, volcanic eruptions, and earthquakes), earthquakes pose the greatest threat to the life, property, and the economy. Since Metropolitan Manila is the leading city in the Philippines, and the center of governmental, financial, commercial, and social activities, the impact of a large earthquake in Metropolitan Manila will greatly affect the nation.

2. **The Philippine Response towards Disasters Reduction**

The Philippine response towards disaster reduction has been progressively developed and grown more extensive with every disaster the country has encountered. The disaster management program covers disaster preparedness, organization and training, construction of disaster reduction facilities, disaster response and rehabilitation, public information, and research and development.

Organization and training are continuing disaster preparedness tasks which are performed by the various Disaster Risk Reduction and Management Centers. Over the past few years, various emergency services necessary during disasters have been developed in all the regions and provinces. Designated organizations have been oriented in their various roles in disaster management. Local chief executives, particularly those elected to their posts for the first time, have been provided training on disaster management to equip them to effectively lead their local disaster coordinating councils. Specialized skills in search and rescue, evacuation, disaster medicine, vulnerability analysis, damage assessment and first-aid have been widely undertaken.

Other disaster preparedness measures have also been undertaken such as disaster drills and exercises, and the establishment of disaster management operations centers. Disaster management operations centers have been established with capabilities for a wide range of emergency services which include rescue, evacuation, emergency housing and relief services.

The National Disaster Risk Reduction and Management Council (NDRRMC) is the focal inter-institutional organization in disaster-risk management. It establishes the priorities in the allocation of funds, services, and relief supplied and plays an advisory role to lower DRRMCs through the Office of Civil Defense by issuing guidelines. The NDDRRMC issues policy guidelines on emergency preparedness and disaster operations.

Background of the Study

3. The Metro Manila Earthquake Impact Reduction Study (MMEIRS)

The Earthquake Impact Reduction Study of Metro Manila **(MMEIRS)** project was implemented from 2002 to 2004 under the collaborative efforts of the Philippine Institute of Volcanology and Seismology (PHIVOLCS), the Japan International Cooperation Agency (JICA) and the Metro Manila Development Authority (MMDA). The product was enhanced by inputs from various stakeholders that comprised the MMEIRS Technical Working Group during the course of the study. The stakeholders included local government units, member agencies of the National Disaster Risk Reduction Management Council (NDRRMC) formerly the NDCC, and other national government agencies, utility companies, professional organizations, and academic institutions. In support of MMEIRS, the Metro Manila Council has adopted a resolution "declaring the commitment to make Metro Manila seismically safe, and establishing the mutual aid agreement among the local government units of Metro Manila in the event of disasters." The project aimed to produce a master plan for earthquake impact reduction for Metro Manila.

The project developed 18 scenario hazard (ground shaking and liquefaction) maps for the metropolis. The scenarios ranged from possible movement along the various earthquake source zones surrounding or in the metropolis including the Valley Fault System. The study also computed for the projected casualties (death and injuries) including possible disruption to lifeline facilities that may result from the three worst case scenarios.

Metropolitan Manila, composed of 13 cities and 4 municipalities by its administrative boundaries, is the political, economic, and cultural center of the Philippines. The population of Metropolitan Manila is approximately 10 million at present and it is now one of the most densely populated areas in Southeast Asia. Geographically, Metropolitan Manila is located on Luzon Island. Numerous earthquake sources are located in and around it. Among these faults, the Valley Fault System, which transects the study area, is considered to potentially cause the largest impact to the Metropolitan Manila area should it generate a large earthquake. Many research studies indicate that active phases of the Valley Faults are approaching and the estimated magnitude will be around 7 or more. In order to manage a potential earthquake disaster in Manila, it is necessary to prepare an earthquake disaster mitigation plan, and to start actions as soon as possible.

The objectives of the Study are: 1) to formulate a master plan for earthquake impact reduction for Metropolitan Manila in the Republic of the Philippines, and 2) to carry out technology transfer to Philippine counterpart personnel of MMDA and PHIVOLCS in the course of the Study. Major contents of the Study are: 1) existing data collection and evaluation, 2) geological survey, 3) social condition survey, 4) Building and infrastructure survey, 5) important public facilities survey and dangerous material treatment facilities survey, 6) GIS database development, 7) production of 1:5,000 scale digital topographic maps, 8) analysis of earthquake ground motion and hazards, 9) earthquake damage estimation, 10) preparation of disaster management plan for Metropolitan Mania, and 11) community based disaster management activities. The damage estimation of a potential rupture of the West Valley Fault, is that 40% of the total number of residential buildings within Metropolitan Manila will be heavily or partly damaged, and the earthquake will cause approximately 34,000 deaths and 1,144,000 injuries. Moreover, fire spreading as a secondary effect of the earthquake will cause an additional 18,000 deaths.

The Metropolitan Manila area, together with neighboring provinces, is expected to grow continuously and reach 25 million inhabitants in the expanded urbanized area of 1,500 km2 by 2015. This growing urbanization is creating unacceptable levels of an earthquake disaster in terms of both human and property losses. Therefore, the Metropolitan Manila Earthquake Impact Reduction Study was undertaken to develop a plan and strategies for ***“A Safer Metropolitan***

Manila from Earthquake Impact”.

Basic Condition		-Scenario earthquake: Model 08 (West Valley Fault, Magnitude 7.2) -Occurrence of earthquake: 7PM, wind speed 8m/sec.				
Items		**0-1 hour**	**1-24 hours**	**1-3 days**	**3-7days**	**7days after**
Buildings	Residential houses	• 170,000 heavily damaged or collapsed (13% of total buildings) • 340,000 moderately damaged (26% of total buildings) • 10,000 Liquefaction affected building alongside of Manila Bay • Damage ratio of concrete-made buildings is 9%, wooden-made buildings is 16% • Damage ratio in squatter building is 27% • These figures include damaged caused by aftershocks	• Aftershock causes further building damage • 1,260,000 people lost their residential house (people living in collapsed or heavily damaged residential buildings)			• Debris removal
	Hospital, school, fire fighting, police, government	• 8 – 10% heavily damaged or collapsed • 20-25% moderately damaged	• Residents begin to evacuate to slightly damaged public buildings • Official function severely limited	• Public buildings are occupied with refugees • Staffs can not reach to the Buildings • Official function severely limited		• Temporary repairs initiated • Debris removal
	Mid-rise and High-rise	• 11% heavily damaged or collapsed, 27% moderately damaged for total of 1000 10-30 stories building • 2% heavily damaged or collapsed, 12% moderately damaged for total of 100 30-60 stories building	• Many people are trapped in elevators by electric power failure • Damage expands by aftershocks	• Collapse of moderately damaged buildings by series of aftershocks • No power and water supply in not severely damaged buildings • Habitation impossible in high-rise residences		
Casualties	Dead	• 34,000 dead, 90% of dead from pressure of collapsed building • This figure includes trapped persons who are not rescued from collapsed buildings and die. • Number of dead is small in squatter area	• 20,000 trapped in damaged building burnt to death • Burnt to death in squatter area occurs • Building Collapse by aftershocks make further dead people		• Persons trapped in the collapsed building are all dead • Some dead bodies are dug out • Absolute limitation of burial • Death of heavily injured persons as to limitation of appropriate medical treatment	• More dead bodies are dug out
	Injured	• 110,000 people with non-life-threatening injuries • Trauma, fracture of a bone, visceral cleft caused by collapsed building and falling furniture • Non structural elements fall from mid-rise and high-rise buildings	• Non structural elements fall from mid-rise and high-rise buildings	• Many crush syndromes occur to the rescued from collapsed building	• Limitation of clean water • Patients increasing by contamination, unsanitary living conditions, especially in infants • Wounds become infected	

A. Possible Regional Separation

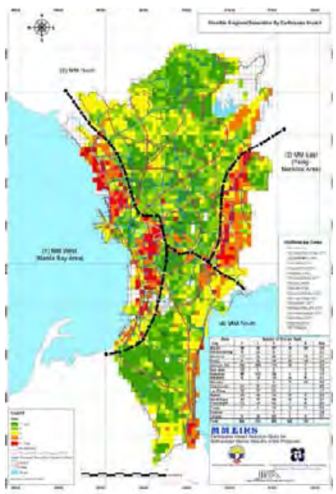


Figure 2.3.4 Possible Regional Separation by Earthquake Impact

The proposed emergency road network was overlain onto the comprehensive regional vulnerability map to determine the possible separation of areas in Metropolitan Manila because of earthquake impact. Obviously, roads crossing or passing through the high vulnerable areas are with a high probability of becoming impassable. Overall, by analyzing passable and impassible roads, it can be deduced that Metropolitan Manila will possibly be separated into four regions by the earthquake impact. Reasons for regional separation are summarized below

.

Metro Manila West

Western part of Metropolitan Manila will be isolated from other part of Metropolitan Manila by fire and building collapse

Metro Manila North and Metro Manila South

Northern and Southern part of Metropolitan Manila will be separated by the building collapse and the geographical condition. The area between Mandaluyong and Makati has a high possibility of building collapse; Moreover, Pasig River is running east-west which is naturally disadvantageous in terms of separation.

Metro Manila East

All road networks running east-west, which are on the fault will be broken due to the movement. Other roads running north-south near in fault areas will be difficult to use, due to the high number of building collapse.

B. The Goals

The vision resulting from MMEIRS is for "A Safer Metropolitan Manila from Earthquake Impact." To achieve this vision, the project listed six basic goals:

1) Develop National System Resistant to Earthquake Impact

Metropolitan Manila is the only mega urban center in the Philippines that includes the national functional backbone consisting of economic, financial, and information activities. Metropolitan Manila generates about 35% of the total GDP of the Philippines. Also, it is the seat of the Philippine national government including administrative, legislative, and judiciary functions, and international activities. With the rupture of the West Valley Fault, national functions will be paralyzed, and in the worst case, the earthquake will lead to chaos and disruption of the national economy. Therefore, Metropolitan Manila needs to develop national systems resistant to earthquake impact through improvement and updating of existing systems. Especially targeted are the following: items for updating of regulations for earthquake disaster prevention, promotion of research and development for disaster prevention technology, capacity building for disaster response staff from national to community level, installation of modern equipment for disaster management agencies. Improvement and enhancement of these existing systems are already being implemented.

2) Improve Metropolitan Manila's Urban Structure Resistant to Earthquakes

Recent earthquake damage in the urbanized areas in the world illustrate the extreme vulnerability of urban structures including buildings and infrastructure (such as roads, railways, port facilities), and lifelines (including electricity, telecommunication and water supply). Based on the damage estimation by West Valley Fault system rupture, it is estimated that 40% of the total residential buildings in Metropolitan Manila will be affected. Since building collapse causes the greatest number of deaths and injuries, the reinforcement and strengthening of buildings are a priority measure to reduce loss of life. Research and technology development on building structures and materials should also be promoted including improvement of building codes, development of design standard for low cost housing and cost-effective construction. Furthermore, building collapse is the major cause of fire breakouts, so building collapse in the highly fire-prone areas needs to be reduced. Existing urban structures in the severe damage estimation area should be improved through re-development of land use. Buildings should be constructed with higher resistive structures and fireproof materials. Location of open spaces and road widening should be involved for urban re-development. The results of the damage estimation of infrastructure and lifelines also show the possible impact to society. For example, malfunction of the port caused by the liquefaction or the collapse of bridges over the Marikina and Pasig rivers will greatly affect the transportation of people, goods and services to and from and within the Metropolitan area. The urban structure of Metropolitan Manila including transportation infrastructures and lifelines needs to be made resistant to earthquakes in order to reduce loss of life and associated impacts.

3) Enhance Effective Risk Management System

A great number of casualties and injuries are anticipated in the scenario of the West Valley Fault System rupture, but the actual number of losses will vary depending on the level of preparedness and effectiveness of the risk management and emergency response systems. Therefore, to reduce overall losses, an effective risk management system is necessary. Necessary actions include preventing secondary effects and damages, strengthening disaster management practices and response capacity, and ensuring access to critical information. Robust legal and institutional arrangements, including systems for inter-institutional coordination and clearly defined and practiced roles of national, regional, city and municipal, and barangay level governmental and non-governmental entities, are essential to effective management of earthquake risk.

4) Enhance Community Disaster Management Capacity

In case of large disasters such as a major earthquake, most of the community members will not be reachable by public assistance immediately. Therefore, to protect community members from large earthquake impacts, it is important to maximize the preparedness and disaster response capacity of the community beforehand, through enhancement of social capital. Social capital in the Metropolitan Manila communities can be developed while recognizing community autonomy, local leadership, and community dynamics. This enhancement will be promoted through self-reliant and mutual-help risk management including disaster awareness through education and enlightenment.

5) Formulate Reconstruction Systems

To facilitate recovery and maximize the effectiveness of the reconstruction process of the damaged Metropolitan Manila, the preparation of recovery and reconstruction policies, strategies and procedures and their acceptance by the relevant agencies are indispensable. At present, the preparation of the risk management system is not fully developed for effective recovery and reconstruction. Nonexistence of a reconstruction structure and system will generate additional losses to the society and exacerbate inappropriate and vulnerable urban development. Both rehabilitation and reconstruction require careful planning and development to prevent further deterioration of urban structures and environmental degradation.

6) Promote Research and Technology Development on Earthquakes

For the promotion of earthquake impact reduction measures, analysis of present conditions and future projections related to earthquakes will play an important role. Especially, scientific research on large earthquake fault rupture mechanisms, return periods, and distribution of the active faults are important. The existing research and technology development system in the Philippines can be enhanced on earthquake science, earthquake engineering, geosciences under comprehensive those coordination. Especially mechanism of earthquake occurrence, estimation of earthquake motion, estimation of earthquake damages, comprehensive disaster condition estimation including secondary disaster are to be studied in depth.

C. High Priority Action Plan

Area	Aim
Enhance legal framework and institutional capacity for disaster management	By consolidating the legal background for disaster management from national to barangay level, the disaster management system of Metropolitan Manila will be strengthened
Build Basic Capacity for Relief and Recovery	Prepare for responding to the survival needs of the people
Strengthen Community Preparedness	To survive by the community's own capacity without relying on governmental institutions
Reduce Damage of Residential Buildings	Reducing the amount of damages to residential buildings will minimize the estimated losses
Enhance National System Resistant to Earthquake	Enhancing national system resistant to earthquake and disruption

4. EARTHQUAKE DISASTER COUNTERMEASURES

A. Integration of Disaster Risk Management in development programs

In 1991 the Philippine Government started a process to integrate disaster mitigation and sustainable development issues within the Medium Term Philippine Development Plans, under the Development Sector Administration. Within this framework, local governments are required to integrate their disaster management plans into their respective local development plans. The most recent “Medium-Term Philippine Development Plan 2004-2010” regarded the issue of disaster risk management in different areas:

- The need for “geohazard mapping to determine the most vulnerable areas and guide development plans on settlements, industries and production areas. More importantly, this will guide relocations and serve as an alert system for existing settlements located in highly vulnerable areas. The plan described both structural and nonstructural measures to “Mitigate the occurrence of natural disasters to prevent the loss of lives and properties”. Nonstructural measures include:
  - Complete the geohazard mapping
  - Conduct soil stability measures (e.g., reforestation and planting in river banks) for landslide-vulnerable areas; and
  - Ensure integration of disaster preparedness and management strategy in the development planning process at all levels of governance. This shall be done through the following activities, namely, among others: periodic risk assessments, updating of respective land use policy based on the assessment, conduct of disaster management orientation/training among LGU officials and concerned local bodies, institutionalization of community-based mechanisms for disaster management.

B. READY PROJECT

The **READY project** is in line with the national government’s priorities for disaster preparedness, mitigation and response. Moreover, the project currently addresses the Hyogo Framework for Action’s identified priorities for action. As this is employing a multi -hazard approach, it significantly includes hydro-meteorological hazards assessment and promotes community preparedness actions for those most at risk to the dangers and negative impacts of the changing climate. The outputs of this project – specifically the hydro-meteorological related hazard maps, i.e. flood/ flashfloods, rain-induce landslide, and storm surge -- feeds into the local / municipal / provincial studies and analysis of options for climate change adaptation. The learned and acquired experience of communities in the observation of their own early warning system for floods and the conduct of drills help them develop their resilience to better adapt to the climate-induced environment.

Natural disasters know no bounds or limits, but, preparing our communities for its ill effects is our responsibility regardless of culture and ethnicity. Thus, this project is in response to the need for a more rational and effective basis for contingency and long term development planning and most importantly, increasing the capacities of our communities to prepare for and respond to natural disasters and ultimately, develop adaptive capacity to address climatic risks.

The **“Hazards Mapping and Assessment for Effective Community-based Disaster Risk Management” or READY Project** aims to develop a systematic approach to community based disaster risk management through: (1) scientific multi-hazard mapping as the first step to risk assessment; (2) community based disaster preparedness; and (3) initiation of mainstreaming of disaster risk reduction into the development planning process of the local government units. This project is most applicable to communities which are prone to natural disaster due to its geologic setting such as the Philippines. Most specifically, it is applicable for developing countries where DRRM has started to gain momentum along with efforts to promote Climate Risk Reduction. In the Philippines, the project addresses the problem of disaster risk management both at the national and local level. At the national level, the project aims to institutionalize and standardize DRM measures and processes by different organizations involved its delivery as such while management of the timing of project implementation and engagement with local government have been prioritized. At the community level, it aims to address the non-availability of hazard maps, the lack of community based hazard monitoring and warning systems and the need to build up the capacity of community leaders to implement activities and measures for disaster reduction. It also aims to empower the most vulnerable municipalities and cities in the country and enable them to develop effective disaster risk management plans.

The READY project has three main components which articulate the processes of how DRR is implemented as designed by the key players. Its partnership built through the years has been the driver in pushing for the achievements of its objectives. The three main components are:

Component I. Multi-hazard identification and assessment
(hazard maps produced in the 27 target provinces).

Natural hazards posing risks to concerned communities are documented in the form of multi-hazard maps. These maps are peer reviewed by the multiagency mapping group (which includes PHIVOLCS, PAGASA, NAMRIA, and MGB) together with the executing agency which is OCD. Once revised and finalized these are then converted into digital format with all data and analysis integrated by National Mapping and Resource Information Authority (NAMRIA). The integrated maps will then be presented to concerned local government units (LGUs) through the conduct of IEC campaigns. Updates and further technical comments are then integrated for the finalization and printing of the maps which are distributed to target LGUs, government offices and decision makers.

Component II: Community-based Disaster Preparedness

1. *Development of Information, Education and Communication (IEC) strategies and materials for specific target groups*

   The result of the Project's mapping are presented to the concerned local government units (LGU) to inform disaster risk management and development planning. In preparation of the IEC event, LGU coordination is promoted where maps undergo peer review, dry run for lectures are held, and training on how to conduct effective IEC with media/press beefing/conference and the review/report of activity. Participants in the IEC Workshops include local leaders (province, municipalities, cities & villages) and teachers. The Project has also developed standardized IEC materials such as posters and flyers user-friendly technical terms for each hazards.

2. *Establishment of Community-based Early Warning System*

The community based early warning systems (CBEWS) for floods and tsunami is a low-cost, non-structural mitigating system that empowers the concerned community to plan and act in the event of sudden on- set disasters like floods/flashfloods and tsunami. In all CBEWS activities, memoranda of agreements are forged between READY agencies (PAGASA, OCD, PHIVOLCS, MGB) and local communities for sustainability. Under the said agreements, the LGUs provide financial allocations for the operation and maintenance of the CBEWS to ensure sustainability of the system.

Above: some examples of the finished multi-hazard maps produced under the project

A. Community-based Flood Early Warning System (CBFEWS)

For flood hazards, a community based and river basin approach is employed and a network of rainfall and water level monitoring gauges in the river basin of concern is installed. The communities covering each basin are linked together under one CBFEWS with strategically installed rain gauges and water level monitoring systems. The warning set up is based on the source, path and depositional area. Site surveys, installation of monitoring facilities, measurement of the depth or carrying capacities of rivers to establish flood warning levels, on-site and formal training of observers and volunteers and pilot testing of the systems through flood drills. Procedures and activities undertaken include:

Volunteers identified by the LGU officials are mobilized to conduct early warning readings. The volunteers/ observers are trained to observe and transmit the data to the Disaster Operation Centers (DOC) of the city/ municipality/village. The observed data is the basis for the LGUs to issue flood warnings, together with the weather forecasts from the local PAGASA station.

B. Community-based Early Warning System for Tsunami

For tsunami hazards, CBEWS, training of trainers for local planners and disaster risk managers are conducted, signage is installed, evacuation maps are made and tsunami drills are undertaken in pilot sites recommended by the experts in consultation with local officials in concerned LGUs. Preparatory activities include site suitability assessment involving site investigation, gathering of community maps, identification and evaluation of evacuation sites and routes and determination of tsunami signage location. IEC campaign are conducted a few days before the tsunami drill, when information on earthquakes and how these can generate tsunamis and on preparedness activities are taught during these IEC. The whole community is involved in the evacuation drills and in the conduct of an on-site assessment – done immediately to improve the effectiveness of the exercise. A set of preparedness activities that teaches barangay stakeholders information on tsunami and appropriate response to its hazard are also executed.

C. Information, Education and Communication campaign conducted for 27 provinces

The READY Project Team is directly responsible for the design and user friendly publication on natural hazards in the country. Designs have been standardized for the reproduction of posters and flyers. Mapping results and IEC materials are disseminated province-wide as part of IEC campaigns with IEC materials covering disaster risk mitigation. In addition, hazard signage (i.e. floods, tsunami, landslides and rock fall) are installed and special IECs for rain-induced landslide and flashflood hazards are also being conducted.

Component II: Initiation of mainstreaming of disaster risk reduction into the local planning process.

Capacity Building takes place through Training workshops on the use of a hazard and risk assessment software (REDAS). Developed by PHIVOLCS in 2002-2004 under the DOST-Grant-in-Aid project, the REDAS (Rapid Earthquake Damage Assessment System) is aseismic hazard simulation software that aims to produce hazard and risk maps immediately after the occurrence of a strong earthquake or for a potentially damaging earthquake (scenarios). Other hazard maps produced under the project are incorporated into the REDAS software. The software contains a database of earthquakes and also of critical facilities and elements at risk (schools, bridges, urban areas, houses). The risk database can be updated by local government. LGUs were trained on how to use the REDAS risk assessment tools. Target officials trained include Planning Officers, Disaster Coordinating Council (DCC) members. The modules includes map reading and functionality of REDAS (e.g. sorting, query, database building, etc), basic concepts on land use planning, and it also trained Community Officials on how to build their own hazard and risk database. This GIS software serves as the tools of local planners and disaster risk managers utilized for land use planning, contingency planning as well development of preparedness plans in their respective localities.

Project Impacts

The READY Project has become a catalyst in realizing the National Economic and the Development Authority (NEDA) of the Philippines' endeavor on mainstreaming DRR & CCA in its Physical Framework Planning. It has triggered sustainable partnerships with the scientific and engineering community, both from the government and private sector, bridged the gap of science-based tools for decision-makers/takers, development planners and DRR Managers. It further demonstrates to the international partners that government agencies involved in the project can deliver and prudently use the funds that it entrusted, thus, trust and confidence of international & regional bilateral/multilateral partners in projects implementation has been enhanced resulting in a generation of innovative ideas towards DRR implementation and widening the scope of partnerships for more relevant programs. Most importantly, there is increased recognition, at all levels, that DRR strategies are indeed interlinked with CCA and it is the most basic applied discipline in pushing for progressive development, in almost all sectors. The READY Project is continuing its implementation in the remaining provinces to be covered and its methodologies and strategies have been recognized such that its template has been adopted for the greater Metro Manila area and

recognized and at the regional arena.

Lessons Learned

- ♦ A multi-hazard approach and tapping expertise of multi-agencies are effective strategies to ensure holistic and effective hazard mapping and public education campaigns.
- ♦ Development of sustainable community-based early warning systems especially for sudden-onset natural hazards is an effective way to empower communities in disaster risk mitigation.
- ♦ Effective and sustainable DRM in the community level must always have LGU support to succeed.
- ♦ Local technical expertise exists in the field of hazard mapping and must be engaged/ explored.
- ♦ It is best to tap local experts for IEC campaigns as they are more familiar with local needs and can relate more with local people
- ♦ It is important to link non government organizations (NGO) in ensuring sustainable disaster risk mitigation efforts.

C. "Rapid Earthquake Damage Assessment System (REDAS)" software for the Philippines

Training Community Officials How to Build their own Hazard and Risk Database

The few minutes after the occurrence of a large and potentially damaging earthquake are very crucial in making timely decisions especially information regarding the deployment of relief and rescue operations. The agency mandated to issue earthquake bulletins and provide pertinent information to the public after an earthquake is the Philippine Institute of Volcanology and Seismology (PHIVOLCS) of the Department of Science and Technology (DOST). This responsibility becomes very important when large-magnitude earthquakes occur and the public wants to know immediately the possible impacts and damages that a given event might have caused. To address this concern, a simple and user-friendly simulation tool or software that can give a rapid estimate of the possible seismic hazards which can be used for inferring the severity of impacts to various elements-at-risk was developed. This software is called "**R**apid **E**arthquake **D**amage **A**ssessment **S**ystem" or **REDAS**. The software was developed by PHIVOLCS-DOST thru a Grant-in-Aid (GIA) from the Department of Science and Technology (DOST).

Lecture on map reading and on the various capabilities of REDAS (e.g. sorting, query, database building, etc)

REDAS aims to provide quick and near real-time simulated earthquake hazard information to disaster managers which will help them in assessing the distribution and extent of the impacts of a strong earthquake. This could help them to decide and prioritize the deployment of timely rescue and relief operations. The second objective is for the software to serve as a tool in convincing land use planners, policy makers, city and town development planners and even local government executives to consider earthquake hazards in their planning and development efforts so as to ensure long-term mitigation of seismic risks. The hazards that could be computed using this tool are ground shaking, earthquake-induced landslides, liquefaction and tsunami.

The risk database that are continuously being built in REDAS include population centers, roads and communication networks, lifelines, high rise buildings, hospitals, schools, churches, banks, markets, hotels, fire stations, power plants, dams and other critical facilities. Other capabilities of REDAS include earthquake sorting capability, produces seismicity maps, can perform query of data points, can produce maps of different sizes, can perform on-screen map digitization and more importantly, it allows users to build their own risk database by themselves. To date, the software has been provided to some local government units (LGU) as part of the NDRRMC's READY Project. To make the software address the other hazards including hydrometeorological hazards, the READY multi-hazard maps are also incorporated in REDAS to make it multi-hazard in approach. For each LGU, training on its use is also provided and the participants are also taught how to build their own risk database using maps and GPS. The software is still being continuously improved by getting feedbacks and inputs from users to make it more attuned to their needs.

D. Installation of Earthquake Intensity Meters

A Phivolcs official lectures on disaster alerts

Almost two weeks after the 8.9-magnitude quake that rocked Japan and took thousands of lives and billions of dollars in infrastructure, the Philippine Institute of Volcanology and Seismology (PHIVOLCS) announced that it will scatter 100 intensity earthquake meters nationwide in order to make more precise readings of earthquakes. The project, said to cost P200M, will commence this year. The project was funded partly by the Japan International Cooperation Agency (JICA).

The quake meters would allow seismologists to spread alerts for tsunamis and landslides faster and, ultimately, save more lives. Several of these meters are to be placed in Metro Manila and neighboring provinces, populated areas that lie along fault lines. The rest will be installed throughout the archipelago. PHIVOLCS' goal was to set up 40 meters in 2011, 30 in 2012, and 30 more in the years to follow.

Each seismic meter, said to be worth P85,000, is a box that contains a tiny monitor and equipped with data communication capabilities and will be placed in selected buildings. The sensors in the meters will instantly calculate the intensity of any tremor felt and then transmit such data to the database of PHIVOLCS.

Accordingly, a quick and accurate means of measuring an earthquake's intensity is crucial in lessening the number of fatalities as well as the amount of damage in the face of a major natural catastrophe.

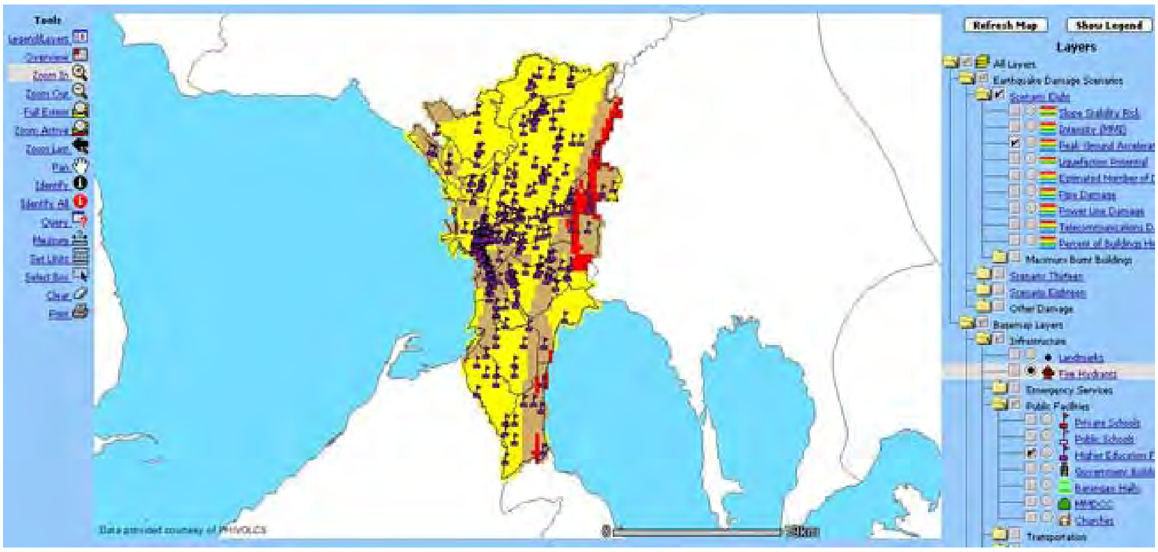
In places where there are no sensors or PHIVOLCS observatories, scientists currently have to rely on descriptions of the quake's effects to estimate tremor's intensity. By getting more accurate data, PHIVOLCS could issue faster warnings to at-risk communities and hopefully save lives and properties. With more sensors, PHIVOLCS can get a clearer picture of when and where a tsunami or landslide could take place as a result of an earthquake. This vital information could then be passed to local governments and emergency councils.

E. Manila Map Viewer

The **Metro Manila Map Viewer** is a GIS-based Internet tool and is currently being implemented as a prototype for earthquakes in Metro Manila, Philippines. The Metro Manila Map Viewer allows users to retrieve useful information and maps from datasets including hazards, transportation, public facilities, emergency services, elevation, land use/zoning, and high-resolution imagery.

The Metro Manila Map Viewer is part of the **risk communication tools** that are jointly being developed and endorsed by the **Pacific Disaster Center** (PDC), and the **Earthquakes and Megacities Initiative** (EMI) to facilitate information sharing, and to promote city stakeholders participation, ownership transfer, and a better understanding of the linkages between disaster risk reduction and development progress. Map Viewers are developed at PDC's headquarters in Maui, Hawaii, with the ultimate goal of transferring capacity to local clients.

This tool was implemented in Metro Manila as part of EMI's **Cross-Cutting Capacity Development (3cd) Program** (see **www.earthquakesandmegacities.org** and/or **www.pdc.org/emi**)—a long-term inter-disciplinary program envisioned to assist "megacity" governments in implementing sound disaster risk management practices. The Metro Manila Map Viewer increases awareness about public safety, is useful during emergencies, also supports post-disaster recovery processes.



The Metro Manila Map Viewer

F. Metro Manila Development Authority (MMDA) Initiatives

The MMDA is responsible for services that have metro-wide impact and transcend local political boundaries, or entail huge expenditures beyond the capability of the individual local government units (LGUs) of Metropolitan Manila. These services include:

Development Planning - which includes the preparation of medium and long term development plans; the development evaluation and packaging of projects; investment programming and coordination as well as the monitoring of plans, program, project implementation.

Transport and Traffic Management – which includes the formulation, coordination and monitoring of policies, standards, programs and projects to rationalize the existing transport operations, infrastructure requirements, the use of thoroughfares; and promotion of safe and convenient movement of persons, goods; provision for the mass transport system and the institution of a system to regulate road users; administration and implementation of all traffic enforcement operations, traffic engineering services and traffic education programs.

Solid Waste Disposal and Management - which includes formulation and implementation of policies, standards, programs and projects for proper and sanitation waste disposal. It also involve the establishment and operation of sanitary landfill and related facilities and the implementation of other alternative programs intended to reduce, reuse, and recycle solid waste.

Flood Control and sewerage management - which includes the formulation and implementation of policies, standards, rules and regulations, programs and projects for an integrated flood control, drainage and sewerage system.

Urban Renewal, Zoning and Land Use Planning and Shelter Services – which includes the formulation, adoption and implementation of policies, standards, rules and regulations, programs and projects to rationalize and optimize urban land use and provide direction to urban growth and expansion, the rehabilitation and development of slum and blighted areas, the development of shelter and housing facilities and the provision of necessary social services.

Health and Sanitation, Urban Protection and Pollution Control – which includes the formulation and implementation of policies, rules and regulations, standards, programs and projects for the promotion and safeguarding of the health and sanitation of the region and for the enhancement of ecological balance and the prevention, control and abatement of environmental pollution.

Public Safety – which includes the formulation and implementation of programs and policies and procedures to achieve public safety, especially the preparedness for preventive or rescue operations during times of calamities and disasters such as conflagrations, earthquake, flood and tidal waves; and coordination and mobilization of resources and the implementation for rehabilitation and relief operations in coordination with national agencies concerned

The disaster management thrusts of MMDA and MMDCC are:

1. Emergency Preparedness and Response Capacity-Building
2. Safety Advocacy and Accident Prevention
3. Disaster Consciousness and Education
4. Disaster Mitigation

PROGRAMS
In order to realize the vision that has been set, the MMDA, the national agencies constituting the MMDCC, and the Metro Manila LGUs complement each other in implementing disaster management programs in line with the thrusts. The following activities are currently being undertaken:

- **Disaster Preparedness** through Public Awareness, Education, Planning, and Drills and Demonstrations
- **Emergency Response Capacity-Building** through organization and training of disaster control groups, response planning and rehearsals, institutionalization of emergency response network, and development of protocols and standards
- **Disaster Control** through the provision of essential services and needs to affected communities, mobilization of emergency resource and coordination to evacuation, search, rescue, recovery, and relief operations wherever there is a prevailing hazards, disaster, or emergency incidents
- **Disaster Prevention and Mitigation** through studies, researches and hazards and disaster information dissemination; Warning and advisories; evacuation of people from risk areas, formulation of policies, standards, rules and regulations; and structures inspections and retrofitting
- **Rehabilitation and Recovery Assistance** through financial support and technical assistance.

Implementation of the above-mentioned programs is done through the cooperation and collaboration of efforts by the various levels and of governance and sector. Each level or sector shares their resource and expertise in the conduct of disaster management activities in the metropolis. Even the private enterprises (e.g. Chinese Fire Brigade), non-government organizations (e.g. ABS-CBN Foundation Inc., a giant media network) and volunteers (e.g. Mozart, mountaineers volunteers) play active roles.

The disaster management activities that have been undertaken by the different agencies constituting MMDCC are:

- Structural Inspections and retrofitting – annual activity of the Department of Public Works and Highways (DPWH) to all bridges and fly-overs
- Drainage systems clearing, reconstruction, and flood Control facilities maintenance – the MMDA in collaboration with DPWH work on clearing and dredging of canals, rivers and others waterways
- Removal, relocation and evacuation of settlers from risk areas
- Hazards Awareness and Disaster Consciousness projects – July 1-7 of every years declared as Disaster Consciousness Week; demonstration on Rescue and Evacuation, First Aid and Pre-emergency Care; giving awards to personnel that do heroic acts in cases of emergencies.
- Capacity-building to improve emergency response-emergency response personnel undergo rigid training on rescue and evacuation, helicopter and high-rise building rappels, first aid,

underwater rescue operation, etc.

- Emergency Preparedness Training and Disaster Management Seminars
- Enforcement of Standards and Rules on Structures, Land Use, and Zoning – e.g. national Building Code; Metro Manila Zoning Ordinance 81-01
- Review and update of current laws and codes with safety implications – Fire Codes of the Philippines and National Building Code
- Preparedness and Response Plans Formulation, Review and Updating

The Metropolitan Manila Development Authority (MMDA) being the lead agency of disaster management efforts in Manila undertakes / accomplished the following:

- Instituted a 24-hour Emergency Response System and upgrade the existing Metro manila Emergency Operations Control and Coordinating Center (upgraded in terms of equipment and vehicle support)
- Developed and implementation emergency response training modules (eight modules for LGUs, NGOs, MMDA and students)
- Conducted emergency drills and training of around 4,000 students, educators, traffic enforcement officers, armed forces reservists, drivers, and others
- Evacuated people from flood-risk areas during height of tropical cyclones and rains
- Provided the public with the information, warnings and advisories prior to and during times when there were hazards and emergency incidents
- Responded the calls for non-emergency medical assistance
- Complemented others agencies` efforts in drainage systems clearing

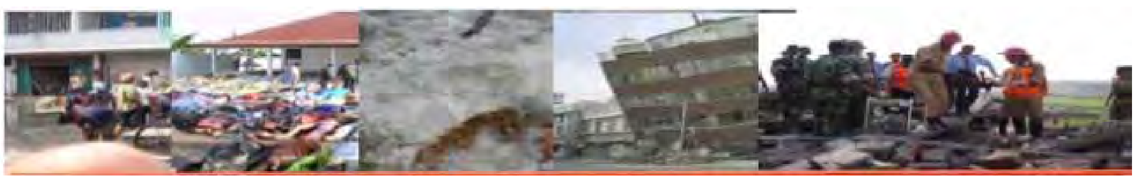
Collaboration with Civil Engineers with earthquake preparedness measures

The Metro Manila Development Authority (MMDA) and the 17 mayors of Metro Manila have agreed to tie up with the Philippine Institute of Civil Engineers (PICE) to address earthquake preparedness and risk reduction in the National Capital Region.

Engineers from PICE, a non-government organization, have volunteered to conduct metro-wide inspections of various buildings and structures to assess their structural soundness and safety.

According to MMDA, the partnership is a most welcome development in the midst of a heightened concern over the vulnerabilities of the region in case of an earthquake. PICE will also come up with detailed and viable proposals on how they can assist the government in reducing the dangers posed by poorly-built and ill-maintained residential structures in Metro Manila.

G. **Program for Enhancement of Emergency Response (PEER)**



The Program for Enhancement of Emergency Response (PEER) is a regional training program initiated in 1998 by the U.S. Agency for International Development Office of Foreign Disaster Assistance (USAID/OFDA) and managed by National Society for Earthquake (NSET) to strengthen disaster response capacities in four Asian countries: India, Indonesia, Nepal, and the **Philippines**. These countries were selected to participate in the program based on their high seismic vulnerability, their need to improve their disaster response capacity, and the interest on the part of their national governments to participate in the program.

All of the involved countries have either prepared disaster response policies or have access to institutions to help them develop disaster response policies, but they do not have adequate emergency/disaster response capacity-building programs, as evidenced by a lack of training curriculum, instructors, and agencies to offer training on a regular basis. While emergency medical response is at a different stage of development in each of the four countries, none of them has a fully established emergency medical response service. For these reasons, PEER was selected by OFDA as the best intervention to improve the standards of disaster response and preparedness in the four countries.

The Asian Disaster Preparedness Center, Thailand managed the program from 1999-2003. Miami-Dade Fire Department, Florida, USA, collaborated with ADPC to implement Phase I of the program. PEER Phase I served to establish the program foundation within each of the participating countries, to test and adapt the courses to the Asian context, and to start developing a pool of instructors to PEER Phase II, 2003-2008, includes the four PEER countries, with the addition of Bangladesh. The National Society for Earthquake Technology– Nepal manages PEER in collaboration with three U.S. Partners: International Resources Group (IRG), Johns Hopkins University/Center for International Emergencies, Disasters and Refugee Studies (CIEDRS), and Safety Solutions, Inc.

Program Objectives

- Establish and strengthen the capability of PEER countries to provide collapsed structure, search and rescue support, as well as basic and advanced life support, beginning with first responder agencies and continuing with personnel in medical facilities.

- Develop a training system that continually provides disaster response with qualified personnel for search and rescue and medical first response and medical facilities prepared to receive victims.

- Establish a coordinating network of emergency and medical response and training institutions and individuals in PEER countries that ensure the continuation of the PEER process and further promote its evolution.

- PEER curriculum includes four interrelated courses:
    - Medical First Responder (MFR)
    - Collapsed Structure Search and Rescue (CSSR)
    - Hospital Preparedness for Emergencies (HOPE)
    - Training for Instructor (TFI)

H. **Department of Education and Commission of Higher Education Initiatives**

As a preventive measure against disaster the Department of Education (DepEd), the Office of Civil Defense (OCD) and the Commission on Higher Education (CHED) have mandates to concretize disaster preparedness by integrating disaster reduction and management education in the curricula of the public secondary and tertiary schools.

The soon to be integrated disaster risk reduction education is outlined under Republic Act 10121 otherwise known as the Disaster Risk Reduction and Management Act of 2010.

It is during calamities that children are most vulnerable. It was learned that some schools have started adopting introductory courses and modules on disaster risk reduction at the start of classes this year. The NDRRMC tied up with the DepEd in the conduct of a training and seminar for teachers expected to handle the subject.

Some schools have already included disaster risk reduction in their Earth Science subject even if the subject have yet to be formally ironed out between the National Disaster Risk Reduction Management Council (NDRRMC) and the DepEd. The subject will also be taught in the National Service Training Program (NSTP) for tertiary schools, technical-vocational, indigenous learning and in out of school youth courses.

1. Conduct of Earthquake Drills

Regular conduct of quarterly earthquake drill to improve further the capability to execute emergency management response coordination and procedures:

- Capacity Building through Organization Disaster Management Team in every school, office and private establishments - to enhance the organizational plan (including organization of faculty members, student council and safety system especially for the special children), Disaster Preparedness, and Incident Command System (ICS)
- Regular conduct of earthquake orientation/workshop (things to do - before, during and after an earthquake)
- Updating of earthquake evacuation plan and enhancement of information dissemination and inculcate among the students and teachers the importance of disaster management
- Reproduction of Information and Education Campaign (IEC) materials (for distribution) to different schools, offices, business establishments, etc.

In compliance to the NDCC Four Point Plan of Action for Disaster Preparedness and pursuant to the pronouncement and instruction of then President Gloria Macapagal-Arroyo after the 1st Nationwide Earthquake Drill on June 20, 2006 that earthquake drills should be conducted on a quarterly basis and further expand t he participation to government and private offices and establishments, until such time that it will be perfected and people's reaction during and after an earthquake become second nature to prevent casualties, the nationwide earthquake drill is held on a quarterly basis.

The Department of Education (DepEd) Secretary issued DepEd Memo No. 300 dated August 23, 2006 to all DepEd Regional and Division Offices for widest dissemination and compliance to the directive of PGMA re: Conduct of Quarterly Earthquake Drills in Schools.

An orientation/workshop on How to Conduct a School Earthquake Drill was also conducted prior to the actual day of the earthquake drill with the following objectives: to ensure the safety of parents, students, teachers and staff during and after damaging earthquake (real or drill); to help school administrators and their disaster action groups to design specific response plan of the school f or earthquakes; to train teachers, school staff and students on how to practice proper action and response during earthquakes; and to test various elements of the response plan designed by the School Disaster Management Committee.

EARTHQUAKE DRILLS CONDUCTED IN THE PHILIPPINES

NATIONWIDE SIMULTANEOUS EARTHQUAKE DRILLS
For the period covered from YEAR 2006 to 2010

YEAR	SCHOOLS/GAs/OFFICES/ESTABLISHMENTS/PARTICIPANTS								TOTAL	
	SCHOOLS (Public and Private)	Number of Participants	PUBLIC/ GOV'T. AGENCIES / OFFICES	Number of Participants	BUSINESS / COMMERCIAL ESTABLISHMENTS/ NGOs	Number of Participants	OTHERS	Number of Participants	Schools/ Public-GAs/ Business/ Commercial/ NGOs	Number of Participants
2006	4,344	3,124,846	99	15,733	42	9,540	2	100	4,487	3,150,219
2007	4,453	3,641,578	98	17,387	63	14,607	4	250	4,618	3,673,822
2008	3,904	2,514,435	89	10,337	39	6,882	9	517	4,041	2,532,171
2009	8,528	5,432,720	234	35,518	76	20,059	12	708	8,850	5,489,005
2010 (1st Quarter)	1,703	1,312,882	177	35,734	44	14,978	10	568	1,934	1,364,162
TOTAL	22,932	16,026,461	697	114,709	264	66,066	37	2,143	23,930	16,209,379

NOTE: BASED ON ACTUAL REPORTS SUBMITTED BY PARTICIPATING SCHOOLS/AGENCIES/OFFICES/ESTABLISHMENTS

NATIONWIDE SIMULTANEOUS EARTHQUAKE DRILLS
REGION-WIDE (YEAR 2006 to 2010)

YEAR	SCHOOLS/GAs/OFFICES/ESTABLISHMENTS/PARTICIPANTS								TOTAL	
	SCHOOLS (Public and Private)	Number of Participants	PUBLIC/ GOV'T. AGENCIES / OFFICES	Number of Participants	BUSINESS / COMMERCIAL ESTABLISHMENTS/ NGOs	Number of Participants	OTHERS	Number of Participants	Schools/ Public-GAs/ Business/ Commercial/ NGOs	Number of Participants
Region I	470	388,082	6	1,105	4	110	-	-	480	389,297
Region II	2,329	832,453	-	-	-	-	-	-	2,329	832,453
Region III	8,897	4,414,000	306	11,900	111	11,400	32	1,800	9,346	4,439,100
Region IV-A	89	14,490	19	1,820	6	1,260	-	-	114	17,570
Region IV-B	2,385	804,682	9	540	-	-	-	-	2,394	805,222
Region V	159	183,230	111	25,097	4	533	-	-	274	208,860
Region VI	113	144,434	1	500	-	-	-	-	114	144,934
Region VII	596	205,862	37	1,397	13	13,432	-	-	646	220,691
Region VIII	349	26,350	9	1,185	2	600	1	100	361	28,235
Region IX	500	283,510	-	-	-	-	-	-	500	283,510
Region X	294	249,731	17	2,477	2	712	3	166	316	253,086
Region XI	1,731	1,214,192	21	3,210	5	1,378	-	-	1,757	1,218,780
Region XII	145	132,586	29	8,626	10	364	-	-	184	141,576
CAR	143	210,228	16	3,760	7	2,157	-	-	166	216,145
CARAGA	169	120,427	56	14,792	-	-	1	77	226	135,296
NCR	4,560	6,799,850	60	38,300	100	34,120	-	-	4,720	6,872,270
TOTAL	22,932	16,026,461	697	114,709	264	66,066	37	2,143	23,930	16,209,379

NOTE: BASED ON ACTUAL REPORTS SUBMITTED BY PARTICIPATING SCHOOLS/AGENCIES/OFFICES/ESTABLISHMENTS

5. TSUNAMI COUNTERMEASURES

A. PHIVOLCS Seismic Monitoring Network

The Philippines is prone to earthquakes because it is situated in a geotectonically active region. It is prone to tsunamis because its coastlines are facing major earthquake generators that are under the sea. In the past 400 years, the Philippines was affected by at least 40 tsunamis.

Through the years, the Philippine Institute of Volcanology and Seismology (Phivolcs) and the Department of Science and Technology (DOST) have come up with strategies and programs on strengthening monitoring and hazard mapping, increasing public awareness and establishing community-based early warning systems for tsunami.

After the northern Luzon earthquake of July 16, 1990, Phivolcs-DOST greatly improved its earthquake-monitoring system. From 12 stations in 1984, they are now operating 66 seismic stations nationwide. The data is received in real time through satellite, which enables them to release bulletins in less than 10 minutes.

PHIVOLCS-DOST monitors earthquakes not only nationwide but also globally. To keep watch of tsunami-generating earthquakes that might occur outside the country but could hit the coastal areas, PHIVOLCS acquired and installed global earthquake-monitoring tools in 2010. With these tools, they receive seismic data from other world seismic networks. An alarm would automatically set off whenever a significant earthquake is detected outside the Philippines, which is why access to information has become quicker.

1. Tidetool

Another tool that became handy during the monitoring of the tsunami from the Chile 2010 event and the tsunami from Japan on March 11 was a software known as Tidetool from the US National Oceanic and Atmospheric Administration.

This tool enables to monitor if tsunami waves had already hit certain tide gauges installed all around the Pacific Ocean at an estimated height.

2. Hazard maps

In 2005-2007, PHIVOLCS implemented a project called Tsunami Risk Mitigation. One of the major outcomes of this program was the generation of tsunami-hazard maps for 43 provinces of the Philippines with coastal communities. The tsunami-hazard maps were generated based on modeling of tsunami heights and arrival times.

The tsunami-hazard maps were distributed to provincial offices so that local government units have information that could be used as basis for land-use and development planning, and earthquake- and tsunami-disaster preparedness.

B. Smart Wireless Engineering Education Program (SWEEP) Schools

Schools are on their way to helping the Philippine Institute of Volcanology and Seismology (PHIVOLCS) improve earthquake monitoring across the country with the selection of a low-cost intensity meter prototype developed by students of the University of San Carlos in Cebu City.

Once improvements are made, the device will be deployed to schools under the Smart Wireless Engineering Education Program (SWEEP), who are participating in a first-of-its-kind government-industry-academe partnership between PHIVOLCS, wireless leader Smart Communications, Inc. (SMART), and SWEEP schools.

The partnership involves getting the schools to research on low-cost remote monitoring systems for seismic data transmission and to use the selected prototype to detect ground movement and help augment findings of PHIVOLCS’ 64 seismic stations nationwide.

The academe also plays a critical role in monitoring hazards. Their mission is to develop a program where schools form part of a nationwide monitoring system that can help government and communities monitor the environment and respond appropriately. The teams themselves tried to find solutions to certain issues like transmission, accuracy, and presentation of data in a form that members of the community will understand.

Ateneo de Davao University developed a system where the data being collected can be stored in an SD card, allowing it to work in remote areas and to function without constant human monitoring. University of Baguio had a well-developed packaging of the instrument, with a mini-drum recorder. Adamson University came up with Internet-accessible monitoring information and dissemination of findings through GSM (or Global System for Moble communications). To address the problem of delays in the transmission of data, the students used WiFi technology. Not only was their design the least expensive to produce and fabricate, it is also user-friendly and compact, making it easy to deploy where needed.

Plans are now underway to further improve the selected prototype by adding the features and innovative solutions developed by other participating universities, thus making the project a real collaborative effort. The next step is to fabricate and produce the earthquake-monitoring instrument , to have them deployed to the SWEEP partner schools for them to be involved in the monitoring of seismic and network them to Phivolcs via Smart connectivity solutions.

Since SMART initiated the partnership in 2005, at least 11 SWEEP schools have committed to help improve disaster preparedness by researching and developing low-cost intensity meters and participating in monitoring seismic activity to help augment data collected via PHIVOLCS' existing seismic stations.

To date, there are 40 SWEEP partner schools nationwide. A community initiative of SMART, the program was launched in 2003 to help raise the level of technology and engineering education in the country. Now on its second phase, SWEEP is focused on educating schools in wireless broadband technology, as well as getting them involved in community service initiatives, one of which is in the field of disaster preparedness

6. NDRRMC Partnership Agreement with Private Sectors

a. Department of Foreign Affairs and International Trade (DFAIT) Canada

Government of Canada Gouvernement du Canada Canada

Canada provides
PhP 18-million
worth of hazardrous material protective equipment to NDCC

Canada is contributing PhP 18-million worth of Chemical, Biological, Radiological and Nuclear (CBRN) Event Preparedness Equipment to the National Disaster Coordinating Council (NDCC).

The contribution includes both personal protective and detection equipment used in the event of a CBRN incident

Canadian Ambassador Robert Desjardins and Defense Secretary Gilbert Teodoro, chair of the NDCC, will sign an amended memorandum of understanding. This will supplement last year's MOU which provided PhP 9 million-worth of equipment

Canada has doubled that amount this year.

In addition to the contribution of CBRN Event Preparedness equipment, Canada has been providing First Responder training in the Philippines since 2005. More than 500 Filipino firefighters, police personnel, soldiers, and other first responders have benefitted from this training program. The course is currently being handed over to the Philippines and will soon be completely delivered by Filipino trainers, providing participants with a locally-tailored program

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b. Association of Carriers and Equipment Leasers Inc. (ACEL)

- ACEL was organized in May of 1966 as a logical step in addressing the problems associated with the procurement and utilization of equipment needed to pursue national initiatives.

c. Civil Defense Action Group Inc. (CDAG)

- CDAG train young men and women in the basic solutions that will help you to respond and attend to any troubles. We teach them how to save lives and properties, test their agility, perseverance, their efficiency, honesty and above all their dedication to volunteerism. As of today, CDAG was appointed to head the Asia-Pacific Maritime Search and Rescue Advisory Group (AMSARAG) of the Asia Pacific Network in order to create maritime emergency responders throughout the Asia Pacific Region
.

d. **Task Force Disaster Mitigation, Adaptation & Preparedness Strategies (DMAPS)**

- It is the task force's goal to set a mechanism to realize a common goal in developing and applying science-based maps and models of natural hazards; model of vulnerable infrastructure and environment; and engineering-based technologies to reduce the associated natural risks to any infrastructure development.

e. Office on Muslim Affairs (OMA)

- Having been tasked to address various issues of the Filipino Muslim in their participation in nation-building, OMA shall collaborate with NDCC in terms of disaster preparedness and capacity building for local disaster management mindful of social-cultural sensitivities.

f. **Private Sector Disaster Management Network (PSDMN)**

- As a consortium of private sector organizations' corporate social responsibility initiatives, PSDMN pledges to provide voluntary disaster management and relief services to affected communities. PSDMN hopes to further its cause of providing effective disaster response as a corporate advocacy

g. **Regional Emergency Assistance Communications Team (REACT)**

- As its name implies, the main objective of REACT is to provide emergency assistance in every region of the country. To achieve this, the volunteer members are required to be equipped with two way radios.
- REACT membership represents cross sections of the society, diverse in their vocations, unified by a common goal to render humanitarian service. With 73 groups in 14 regions, REACT now is considered as the largest civic communications organization in the country. Its capability is supported with 6 ambulances, 5 fire trucks and 11 radio repeaters

h. Phil. Mine Safety and Environment Association and Chamber of Mines of the Philippines

- to contribute their technical skills and expertise, through the setting up of Safety Networking Action Program-Emergency Response Teams (SNAP-ERTs) to OCD-NDCC in times of emergencies and national disasters

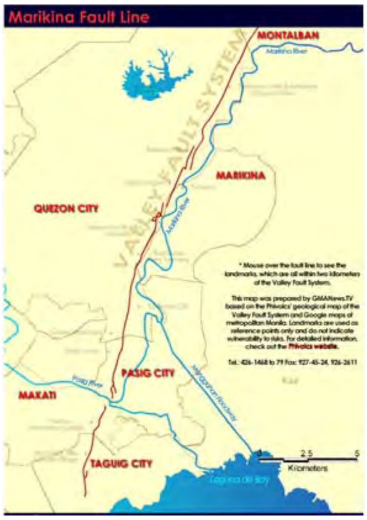
i. **DHL Asia Pacific**

- providing the NDCC a DHL DRT for technical advice free of charge on airport logistics management to ensure uninterrupted and effective supply chain at the disaster site airport

j. **Pharmaceutical and Healthcare Association of the Philippines (PHAPCARES) Foundation Inc.**

- a public and private partnerships as a strategy to better respond to the medical needs of disaster victims (Service and medicines free of charge)
- PHAP through its Foundation coordinates the efforts of its members to provide assistance for relief work in the aftermath of calamities, in cooperation with other national organizations and projects of government agencies.

VIII. Disaster Preparedness of Metro Manila Municipalities and Cities



The strict implementation of building, construction and zoning codes will help in terms of structural preparedness for buildings. However, physical interventions such as re-development and investments in hazard-resistant infrastructures are just two of the many aspects of disaster risk reduction. Metro Manila is a case in point. As much as it is important to ensure the safety and integrity of infrastructures, trainings and capacity-building of stakeholders - local government units and their constituents – need to translate to knowledge of what it is that must be done assuming the projected magnitude hits the Philippines

The Metro Manila Mayors (Marikina City, Makati City, Quezon City, Pasig City Taguig City, Pateros, Pasay City and Muntinlupa) together with their respective disaster preparedness partners are continuously studying and revisiting their respective national framework for disaster risk management. They provide programs, projects and activities on preparedness, mitigation, operational response and recovery in emergency situations. They also ensure effective coordination of resources and operatives to, during and after disasters.

IX. Conclusion:

1. It is very important to revisit the priority plan of action of the Metro Manila Earthquake Impact Reduction Study Report. Since the study was conducted few years back, various parts of Metro Manila have undergone rapid urban development since then, adding a significant number of structures to the totals indicated in the report. Should an earthquake occur, there is a possibility that actual casualties and damages will be higher than the estimates in the study.

2. The Local Government Units need to strictly adopt land-use planning/zoning and adherence to the latest National Building Code of the Philippines. The political will of the mayors will not only sustain the disaster management effort, but will also motivate support from the other key actors like the city/municipal council, the dedicated staff of the concerned departments of the government, private companies and NGOS. Urban preparedness and mitigation requires the coordination of efforts by multiple agencies.

3. There must be continuous efforts among the government and various stakeholders on public awareness and preparedness. The local government need to establish a Disaster Preparedness Education Center, where an Audio Visual/Training Room, a small disaster management museum, and a disaster management library that can be used by children as well as adults. A Disaster Management Handbook that contains instructions on how the public should prepare for emergencies, lists what to do during emergencies, and other emergency information is essential in public information. This handbook should be distributed to the residents and other community organizations.

4. Capacity building and resource management in anticipation of potentially strong earthquakes. The Local Government Units need to invest on the emergency equipment which they can use during emergency situation. Volunteers / responders should continuously undergo emergency training courses.

References

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