RESEARCH REPORT

Tsunami Response Plan for the coastal Areas of Pakistan and Livelihood improvement along with other scalable DRR interventions for Coastal areas of the country - Case Study of Japan

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Document:

Research Report - Tsunami Response Plan for the coastal Areas of Pakistan and Livelihood improvement along with other scalable DRR interventions for Coastal areas of the country - Case Study of Japan -

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Abstract

Pakistan is ranked 7th most vulnerable country in terms of Disasters. It is the prime location of various fault lines crossing treaties of the state which provide the exact place to occur in this region. The common phenomena of Pakistan are Earthquake, Tsunami, flooding, Drought, FLOF, Landslides etc. Further, the wide range of coastline, more than 1026 km, can cause huge earthquakes and Tsunami in the region because of two major fault lines crossing the narrow strain of the country. There are several references which prove that this region remains under threat of big earthquakes and tsunamis in the past.

In fact, the most common fault line passes into two provinces of the state Sindh and Balochistan known as Makran Subduction Zone (MSZ). The Makran Subduction Zone (MSZ) is located where the oceanic crust of the Arabian plate is sliding under the Eurasian plate at a rate of ~20mm/year 20mm/year. The eastern Makran is a relatively active seismic zone and hosted two instrumentally recorded tsunamis in 1945 (Magnitude 8.81) and 2013 (Magnitude with 7.77). The pattern of offshore seismicity suggests the segmentation of the MSZ into western and eastern parts. There is significant uncertainty about the tsunami hazard along the MSZ with distinct differences in seismicity between the western and eastern segments. According to experts, Tsunami can occur at any time due to the short distance from MSZ which is only 00 km away from the coast of Gwadar region. It is also predicted by the residents of the area that the tsunami remains a regular disastrous situation in the past which gives clues of next havoc in the emergent situation.

After the 2005 earthquake a robust disaster management system was established in the country but due to less occurrence of tsunami in the region it failed to obtain the attention of disaster management authorities as compared to hydrological hazards. But the 1945 mega earthquake and tsunami of coastal belt of Pakistan cannot be ignored which brought a huge destruction in the shape of 4000 human casualties. It is essential to combat such threat in future and provide a pleasant and secure environment to residents. The Disaster management authorities are focusing on such hazards and signed an agreement to counter tsunami threat in the region. The National Disaster Management Authority, have established the Disaster Risk Reduction plan for coastal belts and accordingly implemented it in true spirit for combating the tsunami risk from the region. Moreover, the school safety Guidelines have also been developed to secure the next generation from such threats. Subsequently, the mock drills are being conducted twice in a year with the support of international and local organizations but need to do more for ensuring the safety of the public living near the coast of Makran Subduction Zone.

Additionally, it is the prime responsibility of the state to protect the life and property of residents by taking into consideration different levels of strategies, plans and to ensure implementation. To prevent natural disasters is impossible but with the massive awareness, mock drills, seminars, observing the disaster days, organizing the various programs at local levels, talk shows on Television and social media, the risk of Tsunami can be reduced.

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Acronyms

ADRC:	Asian Disaster Reduction Center
ADPC:	Asian Disaster Preparedness Center
BHU:	Basic Health Unit
CADRE:	Community Actions for Disaster Response
CBDRM:	Community Based Disaster Risk Management
CBO:	Community Based Organization
CDA:	Coastal Devolvement Authority
CA:	Coastal Area
COVID-19:	Corona Virus Disease-2019
CPEC:	China Pakistan Economic Cooperation
DC:	Deputy Commissioner
DCR:	District Census Report
DDMA:	District Disaster Management Authority
DDMO:	District Disaster Management Officer
DPMRP:	Disaster Preparedness, Mitigation and Response Plan
DDRT:	District Disaster Response Team
DEOC:	District Emergency Operation Center
DRM:	Disaster Risk Management
DRR:	Disaster Risk Reduction
EWS:	Early Warning System
INGO:	International Non-Government Organization
LHV:	Lady Health Visitor
MC:	Municipal Committee
MSZ:	Makran Subduction Zone
MERC:	Medical Emergency Response Center
MHVRA:	Multi-Hazard, Vulnerability Risk Assessment
MIRA:	Multi-Sector Initial Rapid Assessment
MO:	Medical Officer
MSZ:	Makran Subduction Zone

NDMA:	National Disaster Management Authority
NGO:	Non-Government Organization
PDMA:	Provincial Disaster Management Authority
PMD:	Pakistan Meteorological Department
PRCS:	Pakistan Red Crescent Society
PWD:	Persons with Disabilities
RHC:	Rural Health Center
SHO:	Station House Officer
TDRMC:	Tehsil Disaster Risk Management Committee
TDRMP:	Tehsil Disaster Risk Management Plan
TOT:	Training of Trainers
UC:	Union Council
UCDRMC:	Union Council Disaster Risk Management Committee
UN:	United Nations
UNDP:	United Nations Development Programme

1. Introduction

1-1. Background

The Pakistan is prone to several natural and human-induced hazards including earthquake, tsunami, flood, cyclone, drought, sea erosion and oil spells along the seashore etc. Among these, the probability of occurrence of earthquake and tsunami hazards are high due to the Makran subduction zone which is an active fault line running parallel in the sea along the coastline of District Gwadar. After the promulgation of the National Disaster Management Act in 2010, a robust disaster management system has been established from National to District levels which help in orientating strategic planning from reactive to proactive approach with more focus on preparedness, mitigation and prevention. Under the National Disaster Management Act, The National Disaster Management Authority has developed a National Disaster Management Plan 2012-2022 which reiterates the need of developing disaster management plans at Provincial and District level.

Approximately, more than 1050 –km coastline is divided administratively comprising into two provinces i.e. Sindh and Balochistan which further extended into seven districts. On November 28th 1945, an earthquake with the magnitude of 8+ and 13-meter-high waves hit the coast of Makran followed by a devastating tsunami which resulted in more than 4000 casualties and number of damages near to the coastline of Pakistan. Tsunami took place in 1945 near to the coast of Gwadar, Balochistan and left disastrous impacts but more than 70 years has been passed to this event and as compared to other disasters it is a not a frequent event and could not get attention in the national hazard mitigation plan. Although, more than 70 years has passed since the tsunami and as per Pakistan Meteorological Department (PMD) any earthquake of more than 6.5 Richter scale shall generate tsunami in the northwest of Arabian sea. MSZ can still have the potential and is posing a high risk of earthquake followed by tsunami in the coastal areas, as most areas along the coastline are situated at a distance of more or less 100km from the fault line. With such a short distance from the fault line, it is believed that the generated tsunami will take minutes to reach the coastline which can be very devastating to the coastal areas of Gwadar, Ormara, Pasni, Malir, Kimarhi, District West and some nearby areas of Karachi.

Recently, the tsunami of Indian ocean 2004 and Japan tsunami in 2011 have left devastating destruction which resulted in several casualties and house damages. Additionally, the lack of preparedness, absence of proactive early warning and awareness caused not only humans but also huge economic loss.

Subsequently, these major events compelled to Pakistan to step down towards tsunami preparedness and various measures took places in response of mitigations to combat tsunami in the coastal areas of provinces as Gwadar is going to become as a regional-hub for trade in between central Asian Countries. Likewise, the District Disaster Risk Management Plan, an annual exercise/ drill on different levels initiated at the district to provide basic knowledge to the community to understand the risk and preparatory measures in case of urgency/ emergency. Many counterpart organizations have responsibilities and authority for combating earthquake and Tsunami risk reduction, present in coastal areas of the country. It is the primary responsibility of the government to encourage such stakeholders, private companies who are working to reduce the risk of tsunami in the region through a comprehensive and well-coordinated manner. In this research, the structural and nonstructural measures of Pakistan and Japan will be discussed and a good practice, lesson learned exercises will be shared to adopt comprehensive strategies for making Pakistan as disaster resilient country specially in terms of earthquake and Tsunami.

Keywords: Local tsunami, hazard and risk assessment, Response Plan, disaster Risk Reduction, Makran Subduction Zone, Early Warning System mitigation, preparedness, standardized format, stakeholders' coordination.

1-2. Objectives and Scope of Research

The aim of the research is to obtain a comprehensive knowledge of the following systems that exist in Japan and compares it with Pakistan's disaster management system also in line with the strategic priority areas of the National Disaster Management Plan 2012-2022, the following objectives have been set forth;

1. To streamline and strengthen the capacities of the district administration, humanitarian organizations and communities, with achievable planning to increase disaster resilience.
2. To assess the underlying risks and develop action plans with different stakeholders to reduce disaster risks in their circumferences.
3. To reinforce the coordination mechanism among stakeholders with the aim of fostering a holistic approach for the implementation of the plan.
4. To strengthen the existing emergency response mechanism and widen its scope to local level disaster risk management committees.
5. Understanding the Disaster Risk Reduction policies/framework at national, prefecture and local level of Japan
6. Strategies for planning in terms of preparation of Hazard /vulnerability map by municipal level in Japan and preparation of localized Disaster Management plans (development of DRR plans, BCP, and community awareness plan etc.
7. Improvement of early Warning Systems for dissemination of information to the community in case of Tsunami hazards.
8. Resilient Infrastructure patterns for all hazard sustainability with special reference to Tsunami hazard.

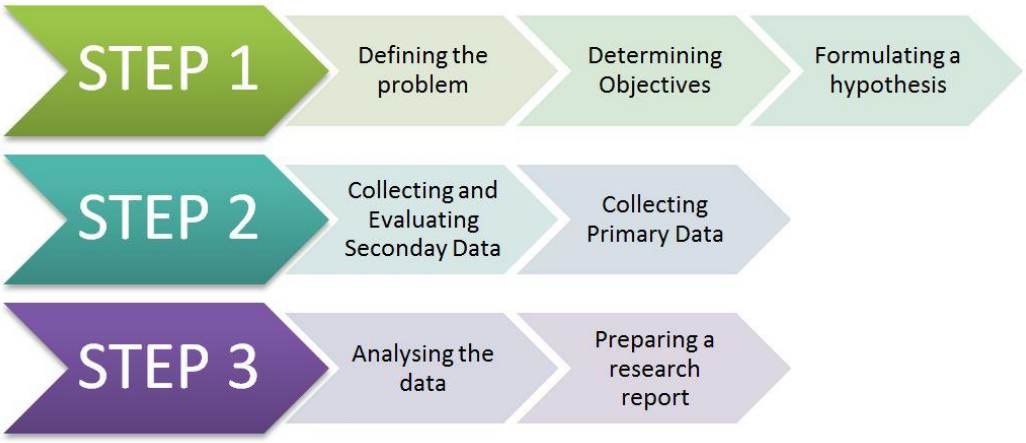


Figure 1-1. Shows research methodology

(Source: https://r.search.yahoo.com/fbbamantra.com.conducting-consumer-research-steps)

Increase outreach to all communities, including demographic of the art at risk population to raise awareness, improve preparedness and encourage the development of tsunami response plans for the

coastal areas of Pakistan. The study will facilitate a comprehensive knowledge to address the following issues:

I. Understanding local disaster management system in Japan along with various approaches for incorporation of DRR measures into development plans
II. Improvement of early Warning Systems for dissemination of information to community level in case of Tsunami hazards.
III. improvement of living standards for pre-during and aftermath Tsunami situation in the coast of Pakistan.
IV. To point out the resilient structural measures for making buildings resilient.
V. To operationalize the institutional mechanism for effective disaster management at local level.
VI. To implement the priority disaster risk reduction measures in line with the national and provincial priorities.

1-3. Methodology

Data Collection

Collection of data involves primary and secondary Data processes but most of the data has been gathered from internet, books, White paper of Japan, ADRC reports, online portals, brochures etc. Furthermore, the collection of primary data is more qualitative than quantitative. However, collection of Qualitative data comprises discussions, interviews, open-ended questions, observation, case studies etc. Mostly, the primary data is collected from lectures, study tours, relevant site visits and some of the data has been got from experts of the relevant department during lectures and visits.

Data Analysis

Mostly, the Data analysis is gathered from field visits, opinion of the experts, questionnaires during lectures and some of data has been collected via asking questions form the lectures. Data has been analyzed qualitatively and mostly is opinion based. No quantitative method of analysis is applied during the research since the time was limited.

Study Area.

Visits were carried out according to research topics by Ikeda-San (Mentor). Especially relevant with my research topic.

Limitation of Study

Each visit has provided much knowledge with regards to my research topic and Disaster Risk Reduction information but due to a limited period of 2 months, it is impossible to collect all the data/information. Therefore, my research may be considered as a preliminary report of investigating surveys of the study area.

2. Literature Review

2-1. Pakistan

Introduction of Makran Subduction Zone (MSZ)

The Makran Subduction Zone (MSZ) is located where the oceanic crust of the Arabian plate is sliding under the Eurasian plate at a rate of ~20mm/year 20mm/year. The future tsunami genic potential of the Makran subduction zone remains uncertain due to its low and strange offshore seismicity. In addition, some seismic tectonic characteristics of the Makran subduction zone, such as the offshore seismicity, width and dip of the slab, segmentation, partial locking, were frequently debated and questioned. The pattern of offshore seismicity suggests the segmentation of the MSZ into western and eastern parts. There is significant uncertainty about the tsunami hazard along the MSZ with distinct differences in seismicity between the western and eastern segments. According to Mokhtari et al. "This appears to be due to the collision of continental crust in the west, in contrast to subduction of oceanic crust in the east".

The eastern Makran is a relatively active seismic zone and hosted two instrumentally recorded tsunamis in 1945 (Magnitude 8.81) and 2013 (Magnitude with 7.77). The western Makran is marked with no major seismicity in recent centuries. According to Rajendran et al. "The various lines of evidence thus suggest that although the western segment is potentially seismogenic, large earthquakes have not occurred there in the recent past, at least during the last 600 years 600 years". It should be noted that the historical records regarding seismicity and tsunamis in the MSZ are very scant. The seismicity of the Makran subduction zone is sparse. The beginning year of complete reporting of earthquakes for Makran was estimated at 1919 in Mirzaei et al. Rajendran et al. He discussed three interpretations for the current seismic status of the western Makran: the whole segment is aseismic, subduction does not occur any more along this segment and the western Makran segment is currently locked and has the potential of producing future great subduction earthquakes. Also, other kinds of evidence such as GPS measurements and the marine terraces gave rise to speculation that there is a possible locked seismogenic zone in the western Makran.

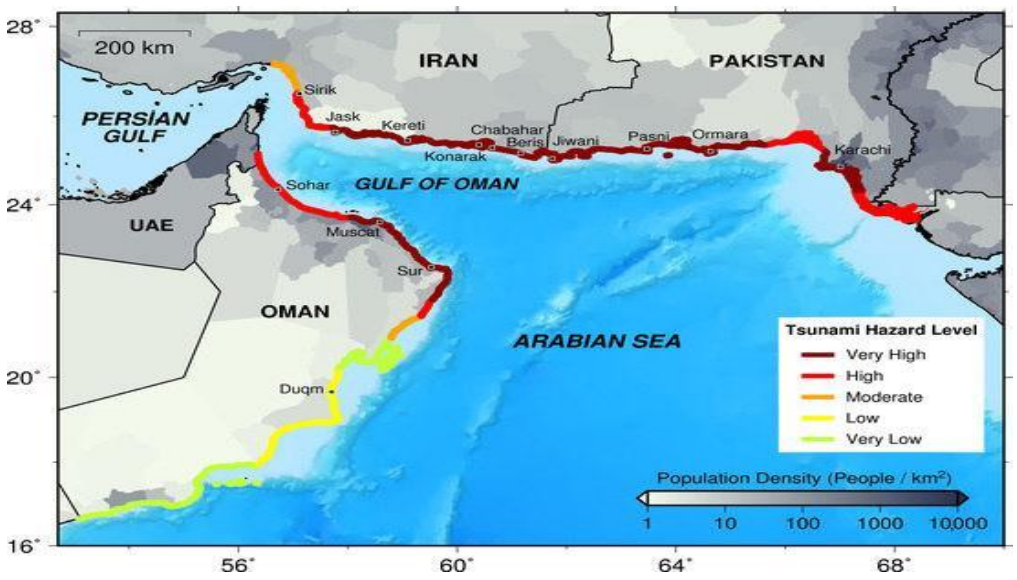


Figure 2-1. Geographical abstract of Makran Subduction Zone

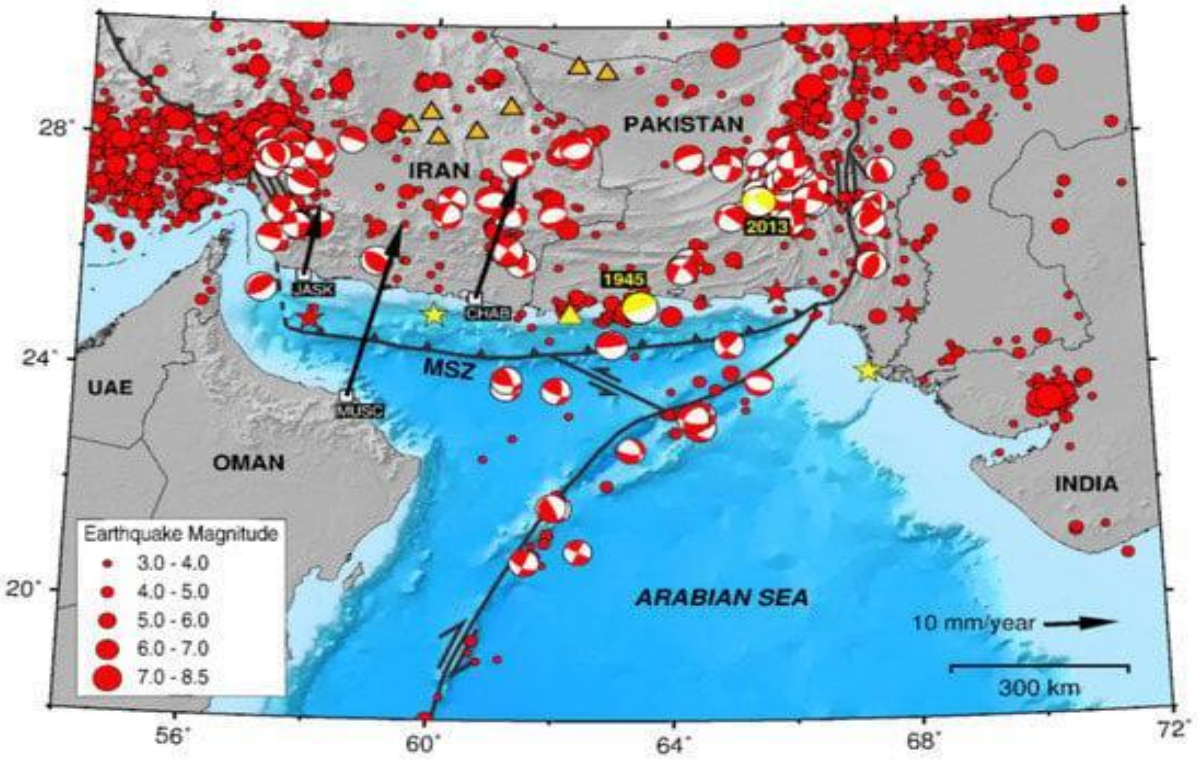


Figure 2-2 Seismicity of the Makran subduction zone (MSZ).

Circles represent earthquakes from 1900 to 2019 from the ISC Catalog. Stars are historical earthquakes (pre-1900) from Heidarzadeh et al. Orange and yellow triangles represent volcanoes. Tsunamigenic events are illustrated by yellow color. Focal mechanisms are from the Global CMT Catalog. Dashed and solid black lines show the plate boundaries. Black arrows display estimated GPS horizontal velocities for JASK, CHAB, MUSC sites from Vernant et al.

(Source: https://www.mdpi.com/2076-3263/10/9/372#B7-geosciences-10-00372)

Tsunami Sources in the Makran Subduction Zone

Below we will give a brief overview of tsunami sources around the Makran region by dividing them into two main groups: near-field (local and regional) and far-field (distant).

Near-Field Tsunami Sources in the Makran Subduction Zone (Earthquakes)

Earthquakes are the major source for tsunamis in the Makran region similarly to other tsunami genic zones. The hypocenter location of these earthquakes can be either offshore (e.g., the 1945 tsunami) or onshore (e.g., the 2013 tsunami). However, the fault rupture that generates the tsunami can pass through the coastline. As considered explicitly by Byrne et al, uplift at Ormara implies that the 1945 fault rupture extended beneath the coast. Heidarzadeh et al, presented a catalog of historical tsunamis in the Makran subduction zone compiling many archival records. Their study is the best reference concerning the history of tsunamis in the MSZ, although there are other studies that mention tsunamigenic events in the northwestern Indian Ocean. According to Heidarzadeh et al, Makran experienced at least four tsunamis (in 326 BC, 1008, 1524 and 1897) in addition to the 1945 and 2013 events. Heidarzadeh et al, found that the 1897 event was a volcanic tsunami and the events of 326 BC, 1008 and 1524 were tectonic tsunamis. Alternatively, the 326 BC event resulted from tides, and the 1008 tsunami was sourced in the Persian Gulf, Heidarzadeh et al, concluded that the mean return period for tectonic tsunamis in the MSZ is about 800 years and for a magnitude 8+8+ earthquake between 100 and 250 years.

The Makran subduction thrust is the main tsunami source in the region. Smith et al. introduced a wide potential seismogenic zone of up to ∼350km350km for the MSZ based on thermal modeling. However, they suggested a minimum rupture width of 210km210km for the MSZ based on the limit of significant offshore seismicity. The estimated rupture width for the 1945 Makran earthquake is in the range of 70–100 km. Frohling and Szeliga proposed a locking depth of 38km38km for the MSZ. Consequently, considering an approximate length of 900km900km, the MSZ can generate megathrust earthquakes up to M 8.88.8. According to Nemati, the width of the subduction slab is about 120km120km in the western and about 150km150km in the eastern Makran regions. Nemati suggested a seismogenic depth of ∼90–120 km and ∼160km160km for the western and eastern Makran, respectively.

The degree of slip heterogeneity and the location of greatest slip on the rupture area control the power of a tsunamigenic source. Due to the lack of data and the unknown seismic status of the western Makran, there is not a clear idea about how slip may occur during possible future events. However, modeling the recent megathrust events in the world revealed complex and non-uniform ruptures. The MSZ is segmented and the convergence rate changes from west to east along the subduction zone. It is not certain that the strain accumulation along the MSZ is uniform or non-uniform. The fault-coupling model of Frohling and Szeliga for the MSZ divides it into three segments (i.e., western, central and

eastern). The plate coupling ratio in the central part is lower than the western and eastern segments. Ruff and Kenmore suggested that the plate coupling corresponds with the size of asperity. Thus, the fault-coupling model of Frohling and Szeliga may suggest the presence of multiple small asperities along the MSZ. However, Frohling and Szeliga, still consider the possibility of a single segment rupture. For example, the Nankai Trough is also segmented, but that did not impede a long rupture in 1707. Kato remarks that an asperity on a plate boundary is non-uniform and encompassed by aseismic slip. The slip complexity and behavior in a megathrust event are affected by the plate coupling degree, the slab geometry, fluids, slow-slip motions, sediments, the topography of the subduction plate and the geology of the upper plate.

Other important sources for generating local tectonic tsunamis in the Makran regions are splay faults. Although splay faults are small, they are important because they can spread the displacement over a large area and therefore can cause big earthquakes. Splay faults can break either during the occurrence of megathrust earthquakes or independently of the subduction thrust in which they are rooted. In the well-documented case of the 1964 Alaska earthquake, splay faulting accompanied slip on the master thrust, and the steeper dip of a splay contributed to tsunami generation by producing greater seafloor uplift in its vicinity. Tsunami scenarios can presuppose splay faulting, as a factor of safety, to increase tsunami size. Interpretation of seismic profiles revealed a shallow E-W-trending splay fault system along the Makran subduction zone. The results of numerical modeling show that splay faulting in MSZ can significantly increase the tsunami hazard. In addition to splay faults, normal faults were also detected in seismic data near the coastline; other candidates for near-field tectonic sources are the Minab-Zendan and Ornach-Nal fault zones, the Murray ridge and the Owen fracture zone (Figure 2-3).

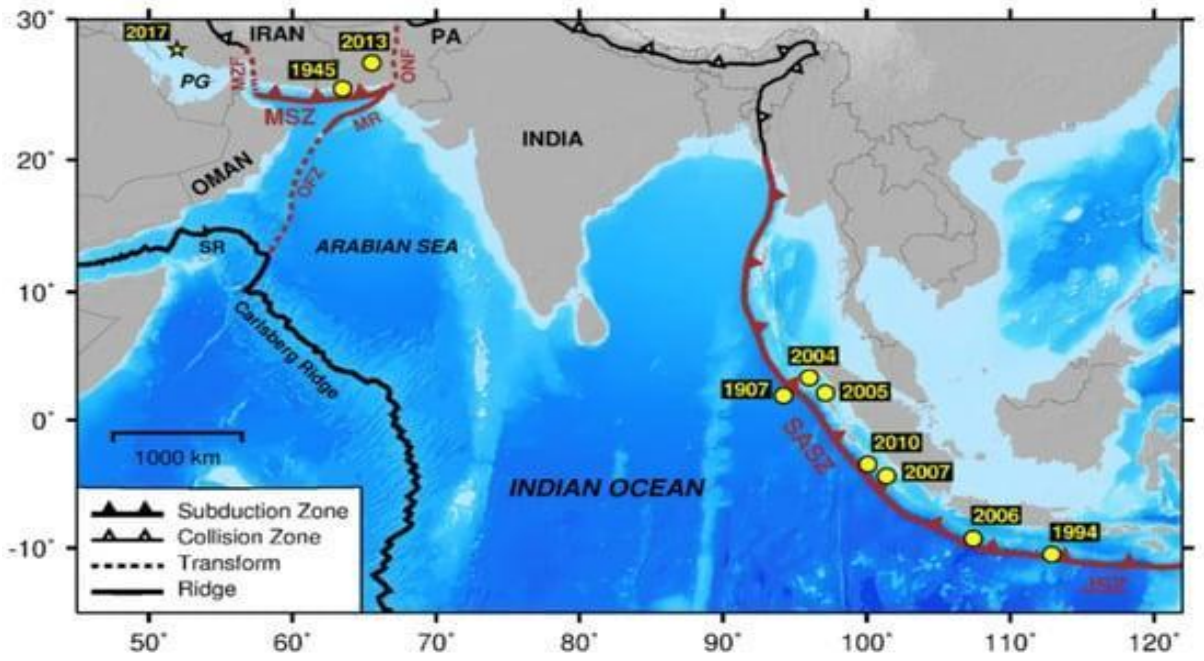


Figure 2-3. Near-field and Far-field sources around the Makran subduction zone (brown lines) and other plate boundaries (black lines). Yellow circles show the tectonic tsunamis in the Indian Ocean and the yellow star represents the 2017 Persian Gulf meteotsunami. PG Persian Gulf, PA Pakistan, MZF Minab-Zendan Fault, ONF Ornach-Nal Fault, MR Murray Ridge, OFZ Owen Fracture Zone, SR Sheba Ridge, SASZ Sumatra-Andaman Subduction Zone, JSZ Java Subduction Zone

Over the last decade, admirable efforts were made to understand the effects of the 1945 Makran tsunami through collecting information and interviews with the tsunami survivors. The effects of the 1945 tsunami are summarized by Hoffmann et al, in a review of several types of information including scientific reports, newspaper articles and eyewitness reports to evaluate the impact of the 1945 Makran tsunami on the Makran coastlines. Based on their investigations, they concluded that the death toll of 4000 people due to the 1945 Makran tsunami is overestimated and the actual number of deaths is in the order of a couple of hundreds. A field survey was carried out in 2010 to investigate and report the impacts of the 1945 Makran tsunami on the southeastern Iran's coasts. The run-up amplitudes due to the 1945 Makran were estimated at 3 to 7, by combining the information from tsunami survivor interviews and field measurements for nine locations along the coastline of Iran. This survey was done in parallel with similar efforts in Oman, Pakistan, and India under the United Nations umbrella. Qualitative results compiled in an online booklet.

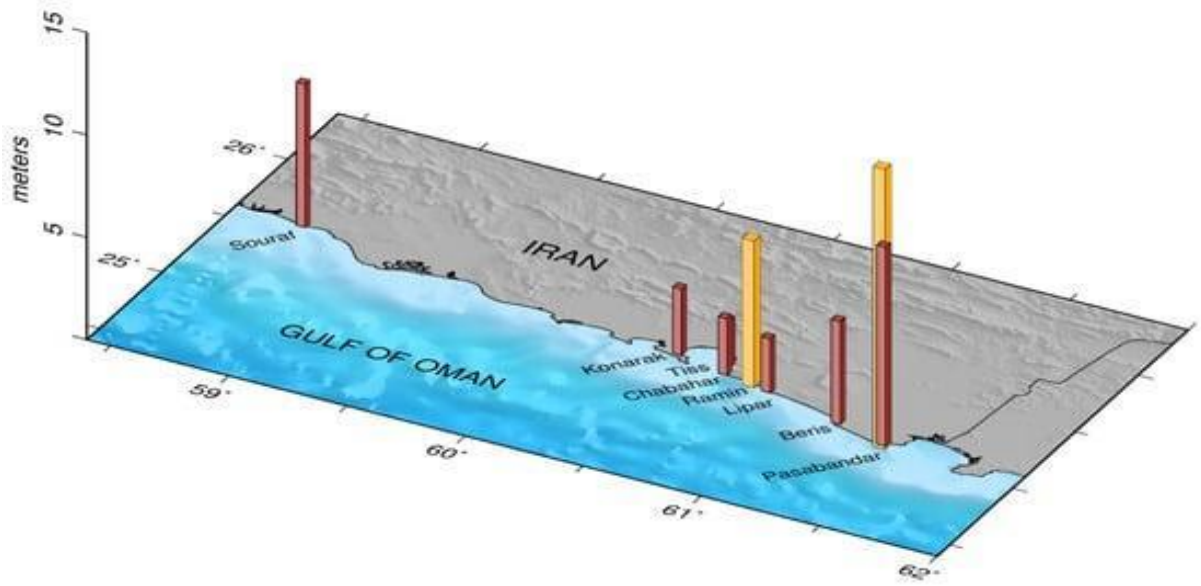


Figure 2-4. The results of the 2010 fieldwork by Okal et al in terms of estimated run-up (brown bars) or splash (orange bars) caused by the 1945 Makran tsunami for nine locations along the coastline of Iran

The only available instrumental records of the 1945 tsunami are two tide gauge records at Karachi and Mumbai. These two gauges were derided and exploited in numerical modeling studies of the 1945 tsunami. Recently, Adams et al detided and analyzed the long version of the Karachi marigram for the 1945 Makran tsunami. They detected an early anomaly before the main shock, through an unconventional detiding manner, and interpreted it as the result of an instrumental or human error, or an earthquake precursor. The tide-gauge may also undervalued the maximum tsunami wave height due to a perceived gap in the marigram that likely coincided with the largest wave. As stated in two different ways, the maximum gauged height is about 0.50.5 m. The ungauged wave of the marigram gap was probably higher; however, as judged from effects elsewhere in Karachi Harbour.

2-2. Japan

Japan as a well-developed state has a marvelous mechanism for combating disasters such as Tsunami, Earthquake, Floods, volcanic eruption etc. Further, the east Japan earthquake and Tsunami of 2011 has badly affected Japan and as per economic experts' view more than 40 % of total GDP has been lost in this devastating disaster. However, the early warning system can be used as a tool for minimizing the human, property and economic loss but it seems the east Japan earthquake was more than the expectation of the Japanese Government. The Government Department has only limited implementation measures which were of enough to complete the 2011 tsunami of Japan. In addition to such measures, a new institution for early warning systems for combating earthquake and tsunami requires studies with

modern technologies, proper training, mock exercises for every level. Disaster risk Reduction should be part of the education system for sensitizing the community towards natural disasters. More, better coordination will lead the nations towards success.

The national government, local governments, and research organizations have installed seismometers, seismic intensity meters, and tsunami monitoring facilities throughout the country. The Japan Meteorological Agency collects this observation data to monitor seismic activity and tsunamis. In Japan, to reduce disaster-related damage at initial level, it is considered highly important to make residents of at-risk areas aware of safe evacuation methods and nearby evacuation routes and sites ahead of time so that they can take appropriate actions based on early warning information. The public awareness sessions are also considered as a more proactive approach as 1st September (the day of the 1923 Great Kanto Earthquake) has been declared Disaster Day in Japan and from August 30th to 5th September a week has also been designated as disaster week. During this weekly time different public awareness events are organized, including disaster reduction drills and outreach activities conducted.

The Government of Japan has developed various model for early warning system and state of the art system to reach covers nationwide services such as JMA, FDMA, MLIT, prefecture to local municipalities level are the frontline responders and ensuring the dissemination of early warning system by using different platforms which make them able to combat the impacts of earthquake and tsunami.

Early Warning System in Japan

Today Japan has become one of the leading countries in the world to effectively manage disasters in pre and post occurrence scenarios. The country has developed some most advanced versions of early warning equipment that are continuously being upgraded by time and again. The early warning information evacuation prior to the occurrence of a tsunami or any other disaster is well calculated and ensures the message should reach every concerned person and organization. The early warning about disasters during the disaster period is imminent information upon which propriety and life of people depend therefore, all means and resources including town level radio communication systems, J-Alert (a satellite-based system that allows authorities to quickly broadcast alerts to local media and to citizens directly via system of speakers), television, mobile phones etc are utilized, and tsunami warnings are effectively delivered to the people.

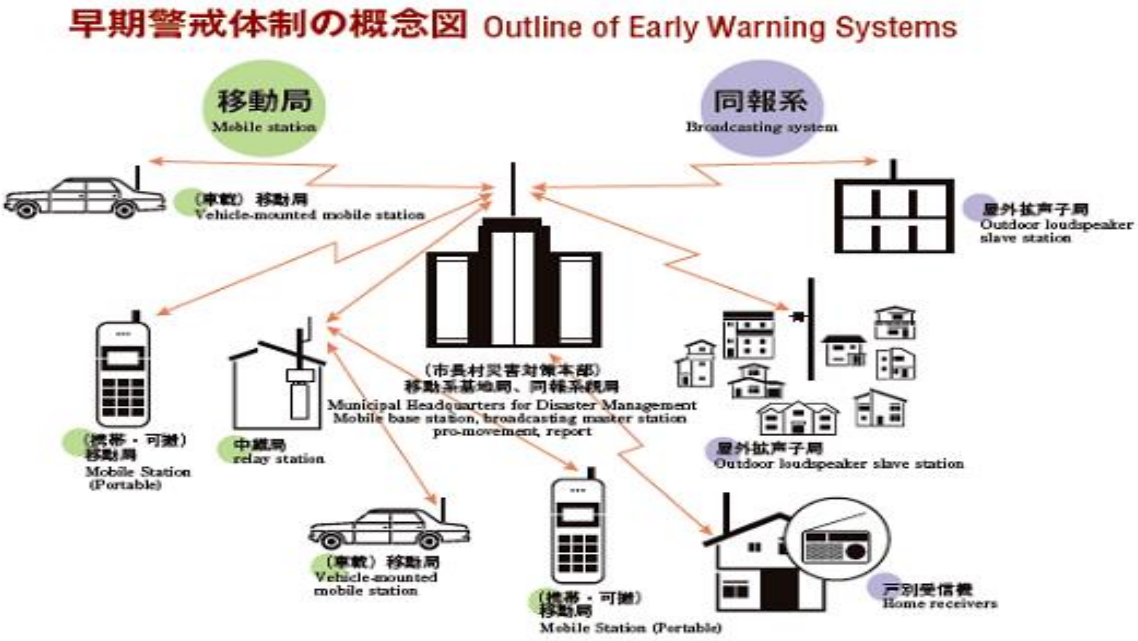


Figure 2-5. Outline of Early Warning System in Japan

(Source: Japan Meteorological Agency)

Japan Meteorological Agency JMA

The Japan Meteorological Agency (JMA) is the national organization that manages all the affairs related to the issuance of the disaster early warnings. The organization is mandated for the provision of accurate and real-time disaster and hazard information to the governmental organizations, prefecture governments, municipality and the residents for the purposes of avoiding the disaster affects. In its structural framework with the central government of Japan, the Japan Meteorological Agency works as an extra-ministerial institution with the Ministry of Land, Infrastructure, Transport and Tourism (MLIT). The organization, with its own capability and through joint ventures with other national organizations, issues almost all the early warning messages about the hazards and disasters.

The Japan Meteorological Agency for its part of the Disaster Response Mechanism provides appropriate and exact disaster information to various disaster management authorities of Japan that aims at delivering such information to the masses through governmental organizations. Such disaster information effectively comprises of warnings, advisories that include:

- Warnings and advisories on weather, high tides, high waves and flooding
- Earthquake Early Warnings
- Tsunami Warnings and Advisories
- Volcanic Warnings
- Proving timely information about typhoons, heavy rain, tornadoes, earthquakes, tsunamis, volcanic eruptions et
- The Japan Meteorological Agency is also mandated with monitoring, forecasting and development of warnings for various kinds of risk and natural hazards like earthquakes and changing pattern of weather conditions.

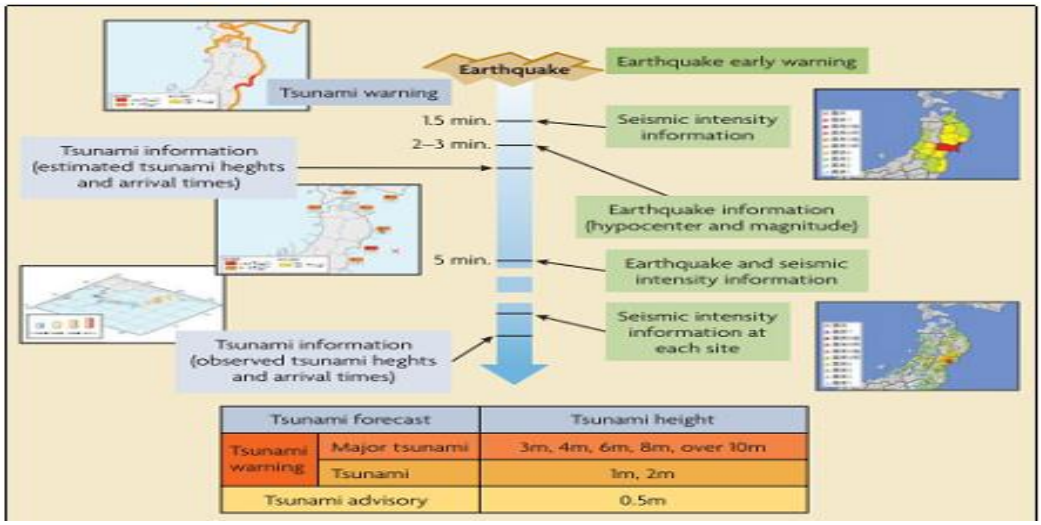


Figure 2-6. Shows Earthquake Early Warning system in Japan

(Source: Japan Meteorological Agency)

Tsunami Early Warning

During the outbreak of earthquakes, the Japan Meteorological Agency through its capability estimates about the possible occurrence of the tsunami. The organization issues warnings and advisories to evacuate in case of the threat of tsunami. The Japan Meteorological Agency in such a situation issues tsunami early warnings information and alerts shortly within a time of three minutes following an earthquake.

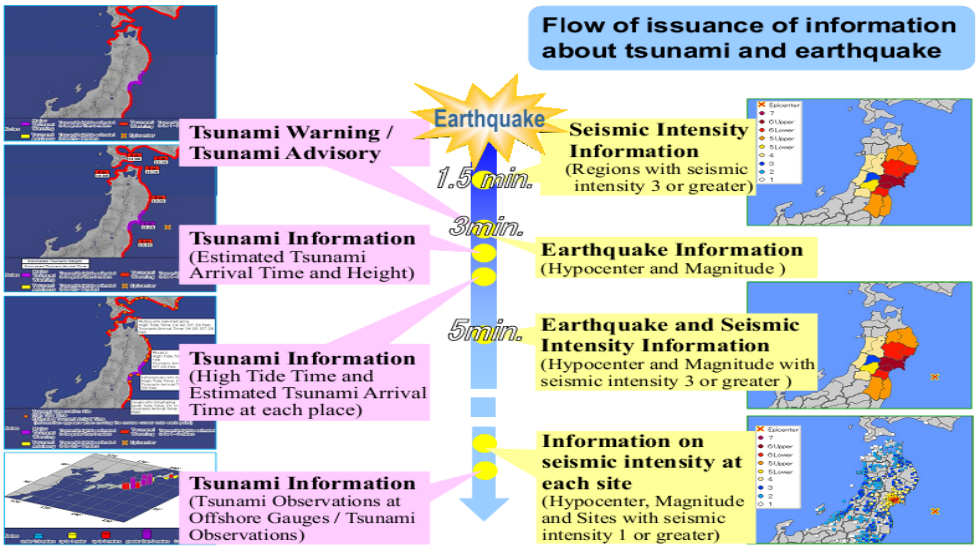


Figure 2-7. Shows flow of information for Earthquake and Tsunami in Japan

(Source: Japan Meteorological Agency)

Earthquake Early Warning System

The Japan Meteorological Agency along with various national organizations working for weather-related issues has installed and maintained seismometers for analysis of the epicenter location and the magnitude level of the earthquake and forecast about the possible tsunami. The seismic intensity meters installed at various places, measure the intensity according to the ground motion and constantly monitor the developments and the seismic activities.

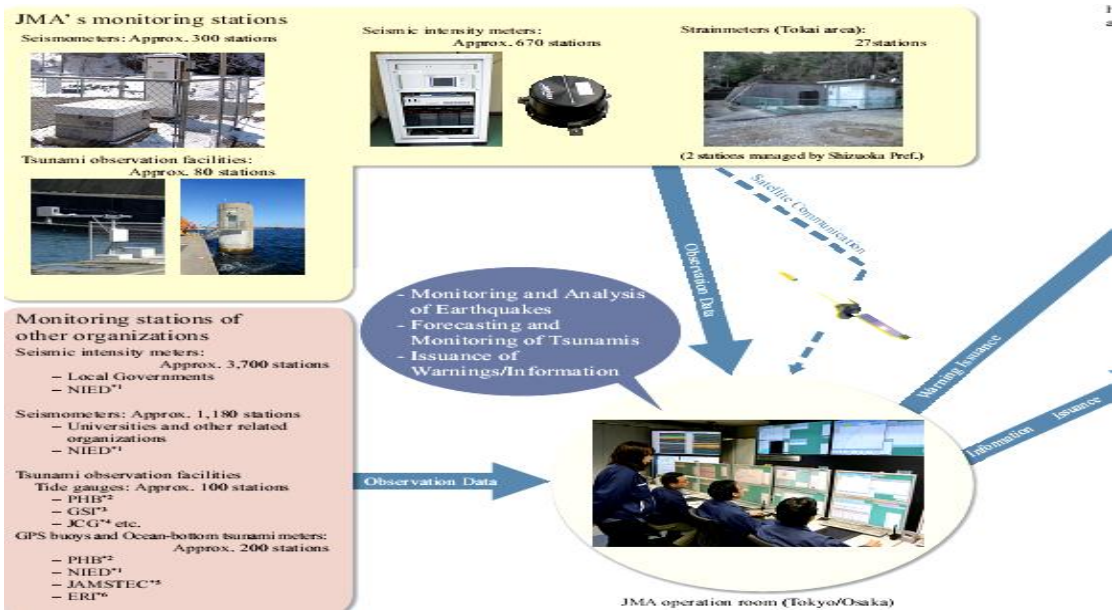


Figure 2-8. Japan Metrological Agency Seismic Monitoring Station

(Source: Japan Metrological Agency)

The Earthquake Early Warning (EEW) information is used for the announcements of the predictable hypocenter and magnitude of an earthquake as well as the possible reaching period of the S-waves of any earthquake including the level of seismic intensity in the area. This accurate analysis is based upon the calculated information through detecting the P-waves near the epicenter that follow a procedure of prompt data analysis keeping in view the speed differences of the P-waves that are comparatively quicker than the S-wave and result into high destructions.

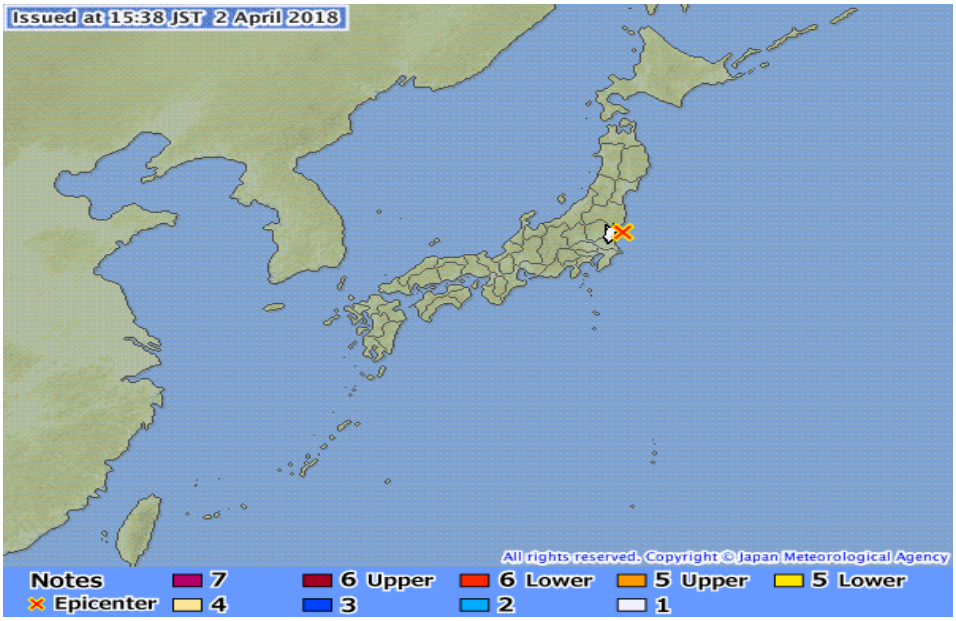


Figure 2-9. Epicenter of Emergency Warning system installed by JMA

(Source: Japan Metrological Agency)

Emergency Warning System

From 30 August 2013, the Japan Metrological Agency has also launched an Emergency Warning System. The Emergency Warning is used to provide information about likelihood of catastrophes and other types of emergencies. The alert helps communities to take necessary measures and observe precautionary measures.

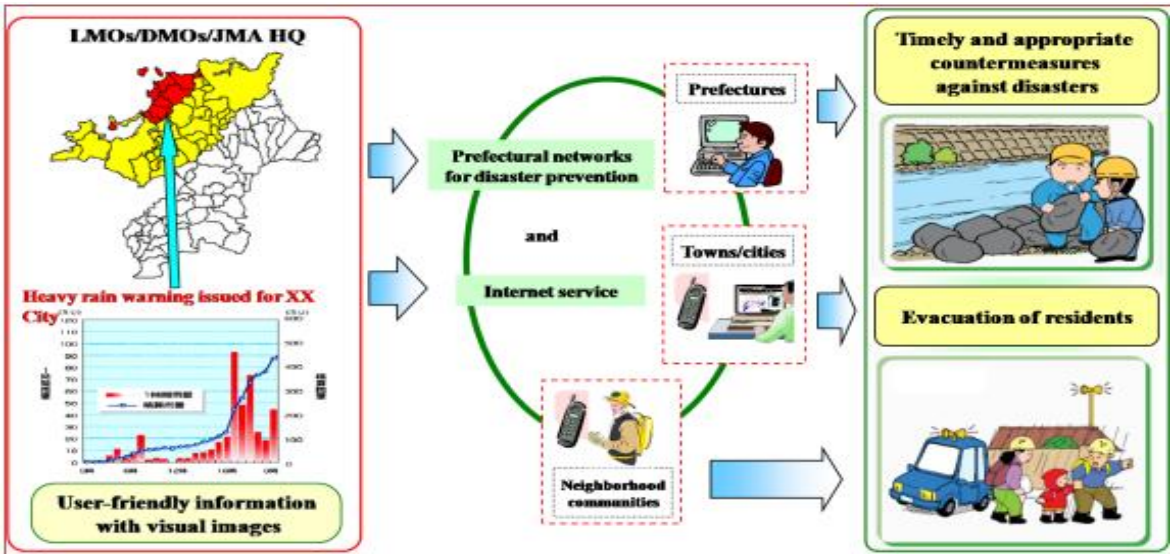


Figure 2-10. Describe the method of communication for precautionary measures to community

(Source: Japan Metrological Agency)

3. Current DRR activities in Pakistan

3-1. Effectiveness of Tsunami Response Plan for coastal areas in Pakistan

Pakistan is moving from disaster prone country to resilient state by adopting various mitigative approaches. The Government has comprehended the value of Disaster Risk Management for a long term social, economic and environmental progress embarked by working applicable policies, legal arrangements and implementing strategies to minimize the risk. Additionally, the proper disaster management system is promulgated in Pakistan in the shape of National Disaster Management commission and Authority (NDMC)/ NDMA, led by Prime Minister of Pakistan a superior body for making rules of law, act, plans and strategies for reducing the risk while implementing the policies.

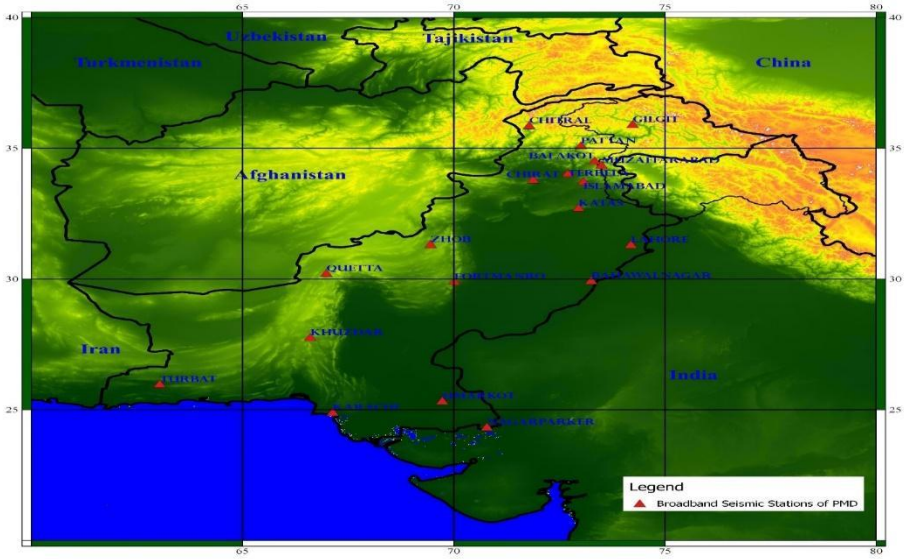
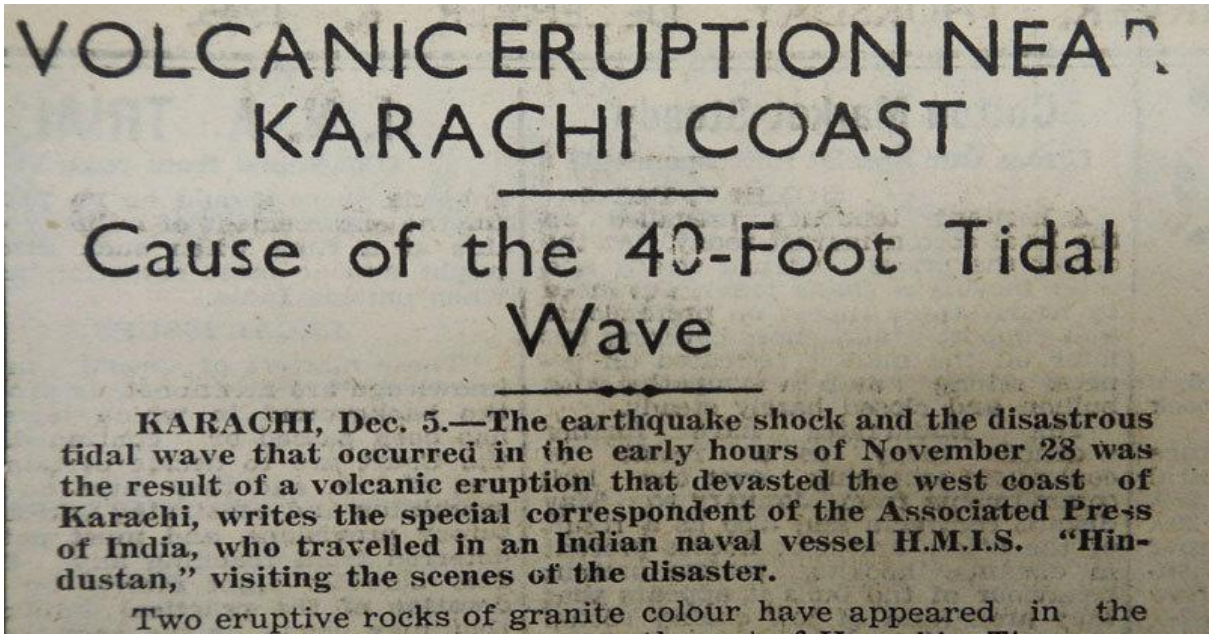


Figure 3-1. Seismic Monitoring Network, Pakistan
(Source: Pakistan Metrological Department, Karachi)

Accordingly, the Provincial Disaster Management Authorities has been established across the country to frame and implement relevant policies for reducing the impacts of disasters and the District Disaster Management Authority has the bottom level/ first responder to chalk out the emergent situation within the local level. However, a coastline of 1026 km consists on Sindh and Balochistan province including the well-known areas for regional trade Gwader the shortest way to connect with central Asian countries but the 28th November, 1945 earthquake/ Tsunami cannot be ignored which killed more than 4000 people and left a devastating impact on economy.



VOLCANIC ERUPTION NEAR KARACHI COAST

Cause of the 40-Foot Tidal Wave

KARACHI, Dec. 5.—The earthquake shock and the disastrous tidal wave that occurred in the early hours of November 28 was the result of a volcanic eruption that devasted the west coast of Karachi, writes the special correspondent of the Associated Press of India, who travelled in an Indian naval vessel H.M.I.S. "Hindustan," visiting the scenes of the disaster.

Two eruptive rocks of granite colour have appeared in the

Figure 3-2. News for volcanic eruption during 1945 tsunami by Dawn Newspaper agency (Source: 1945, Tsunami strikes Karachi cost, killing 4000, DAWN.Com)

Further, being a seismic prone country and located near to Makran Subduction Zone (MSZ), requires developing a comprehensive early warning system for earthquake and tsunami. The Tsunami which came in 2004 into the Indian ocean resulted in huge human and economic loss and attracted the attention of the state and Government of Pakistan initiated to chalk out the work on tsunami near coastal areas to ensure the safety of the public. In this regard Pakistan signed an agreement with the United Nation Educational, Scientific and Cultural Organization (UNESCO) to support it technically. The basic theme of the pregame was to assess and strengthen the government agencies in terms of ocean-related warning systems as well as to work out on mitigation. However, project studies were carried out in the coast of Pakistan and different loopholes identified by the experts, i.e lack of installation of tide gauge, protection walls, Siren, etc. Initially four places were pointed out for installation of tide gauge named as Karachi, Ormara, Ketti Bunder and Gwadar. Among these four areas only 2 tide gauges have been provided to the Government of Pakistan for fixing the items at Jinnah Naval Base- Ormara and Karachi while the other areas are still awaited. These instruments will monitor the ocean waves and can facilitate the actual data for further planning.

Mr. Mutahher Abbas & Mr. Ghulam Dastageer (Karachi team), standing next to the Tide Gauge *Building*.

Figure 3-3. It is the tide Gauge Building near to Karachi coast

(Source: UNESCO, Gauging sea level rise in Karachi)

Currently 15 officers/officials of Pakistan Metrological Department have been trained on SeisComp and GUITAR software. Every year a drill on Tsunami preparedness and response is conducted by PMD at Gwadar and Karachi including relevant agencies. The brochures are being translated into Urdu language for easy understanding of the local community. In connection with the above, the 3 automatic Sirens have also been installed at Gwadar, Karachi and Pasni port for early warnings. Now, the PMD team can rectify the epicenter of an earthquake with magnitude along with the real time of tsunami arrival at the coast and can disseminate a tsunami alert within 7 minutes.

3-2. Community Based Response Mechanism for Tsunami in Pakistan

As mentioned earlier, the MSZ can still have the potential and is posing a high risk of earthquake followed by tsunami in the coastal areas of the country as most areas along the coastline are situated at a distance of more or less 100km from the fault line. However, it is believed that the generated tsunami will take minutes to reach the coastline which can be very devastating to the coastal areas of Gwadar, Ormara and Pasni. Further, a community base tsunami response Plan is in progress but Standard Operating Procedures have been designed in NDRP 2012-2022 in a slight manner. Most of the population are under threat due to their housing near the coast. It is the primary responsibility of the state to provide a pleasant and safe environment to the coastal community for living a peaceful life. In this regard, the Government has taken many positive steps to ensure the safety of the public and with the support of the United Nation Devolvement Program has installed two automatic sirens at Gwadar and Pasni under administrative control of Pakistan Metrological Department PMD.

Accordingly, Gwadar District Disaster Management Plan 2008, there are few steps taken for community response during tsunami and earthquake which can help and support local people during

emergency. Further, to encourage community level disaster risk management programs, the DDMA will facilitate to community-based organizations (CBO) for conduction of mock exercises/ drills. In case of non-availabilities of CBO, the District Government will initiate community awareness activities including all the relevant department and community leaders for ensuring the maximum participation in the program. However, CBOs/ local community will be trained in terms of early warning systems, identification of evacuation sites, first aid, Search and Rescue, firefighting trainings etc. It is also necessary to build a strong coordination mechanism in between CBO and relevant stakeholders for sharing of experiences, skills, mobilization of financial and human resources in times of untoward situations. Other organizations and institutions present in communities such as religious leaders and groups farmers associations, parents and teacher associations, etc. shall likewise be drawn, enhanced and coordinated to support DRM. Moreover, DDMAs initiatives for awareness about tsunami are as under;

- Dissemination of District Disaster Risk Management Plan to all Government agencies.
- To the Tehsil, Union Council and Village leadership.
- Through mass media to the public in the district.
- To all CBOs and existing NGOs at district level.

Orientation to conduct a mock drill for safe evacuation

Subsequently, is it essential to set some goals and objectives for conduction of mock drill, here are some proposed step for the conduction of mock exercise/ drill;

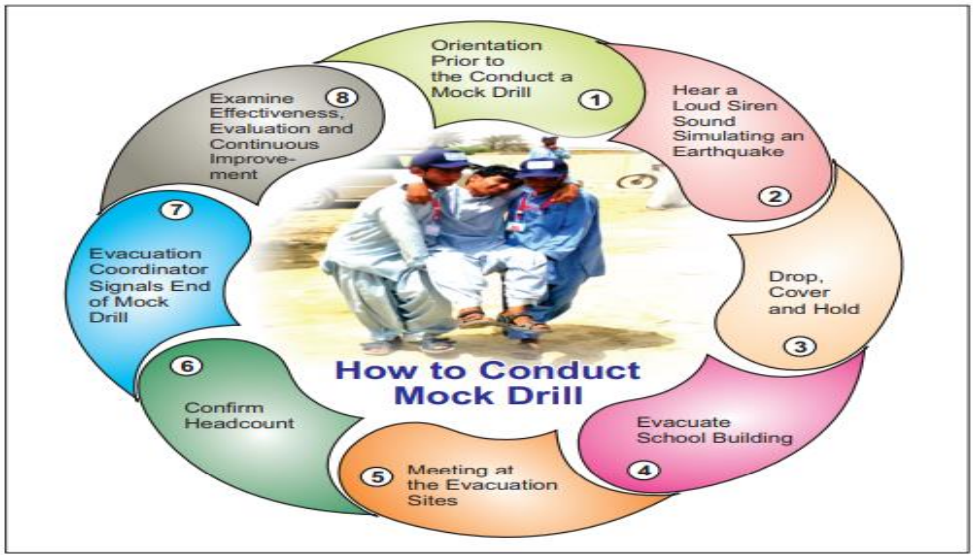


Figure 3-4. Shows process/stage for conduction of mock drill

(Source: Gwader DDRMP, 2008)

- Organizing the Drills
- Monitor all the levels of drills
- Ensure enrolments of community leaders along with local people for successful event

- Ensure maximum participation of government personal
- Designate any Government officer/officials to monitor and evaluate the gaps and improvement areas
- Agencies and departments should also conduct drills based on the hazard scenarios and areas of competence

Figure 3-5. Some local instruments for early warning system

(Source: Pakistan Metrological Department, Islamabad)

However, the DDMA will also ensure that disaster preparedness and response drills are conducted by the other Department on a regular basis, especially in the disaster-prone areas to maintain the readiness of communities and departments, about operational procedures, personnel and equipment and orderly response. It is further decided by DDMA Gwader that at least two drills on tsunami will be carried out in a calendar year by local Government under the supervision of DDMAs and lesson learned experiences and other incidents should be discussed and included in next DDRMP.

Figure 3-6. Tsunami Temporary Camp during conduction of mock exercise/drill in Gwadar

(Source: Evacuation site during mock exercise/drill, photo by Rehan Dashti)

3-3. Tsunami Early Warning System in Pakistan

As per Standard Operating Procedure of Pakistan Metrological Department, Karachi office, it is the mandate of PMD Karachi office to issue warning bulletins for tsunami in the country. Moreover, PMD is equipped with the latest seismic instruments along with two automatic sirens installed in Gwadar and Pasni and have capabilities to issue warnings and can disseminate the information within 13 minutes.

Figure 3-7. Showing the Automatic sirens installed by PMD neat to Gwadar Cost

(Source: PMD installed automatic sirens at Gwadar port supported by UNDP, Pakistan)

However, only need to revise SOPs for settling down the tsunami, which are not enough to do more at municipal level to ensure the safety of the public. Some initiatives of PDMA Balochistan for DDMAs are designed as under;

- Establish UC level early warning system committees working under the UCDRMCs and TDRMCs in the coastal areas of the district.
- Arrange light equipment used by the early warning system committee for detection and dissemination.
- Arrange training for the members of such committees.
- Prepare resource inventory of available communications equipment with user location / addresses based on individual agency inventories and plan for purchasing new equipment used for the such cause.
- Develop school safety guidelines to prepare for earthquake and tsunami hazards and conduct mock drills on it at school level.

Figure 3-8. Evacuation Sites at Gwadar

(Source: Dealing with local Tsunami on Pakistan Coast)

4. Country Profile in Pakistan

4-1. Disaster Context & Risk Profile of Pakistan

Pakistan is the second biggest Islamic republic state in the world covering almost 881,913 sq. km with 243 .9 million populations. It lies between 24 and 37 latitudes and 62 to 75-degree longitude in the east. Pakistan comprises five provinces namely, Sindh, Punjab, Balochistan, Khyber Pakhtunkhwa and Gilgit- Baltistan. However, Azad Jammu & Kashmir has been declared as a state of the country. Pakistan has a border with India in the east, Afghanistan in the north-west, Iran in the west and China in the north. There is a Parliamentary Government system and the Prime Minister as the executive Head and the President of the country as constitutional head. The coastal belt is about 1,026 km.

Figure 4-1. Map of Pakistan sharing the border with other countries

(Source: https://www.welt-atlas.de/map_of_pakistan_5-758#:~:text=%C2%A9-,2023%20Welt%2DAtlas.de,-All%20maps%20are)

Pakistan comprises on five portions including, Northern high mountain ranges (the Himalayas; the Karakorum and the Hindukush), the Balochistan Plateau along western bordering, the Indus River plains in the east, the Salt range across the northern portion of the Punjab province and the Deserts (Cholistan in Punjab and Thar in Sindh province).

Pakistan is the country which is prone to a number of Natural disasters and most frequent disasters are Floods, Flash floods, Earthquake, Drought, GLOF, Avalanches in northern parts, typhoons and tsunami in the coastal areas of the country. Some of the prevailing disaster condition along with areas has been shown in attached map for further clearance /understanding;

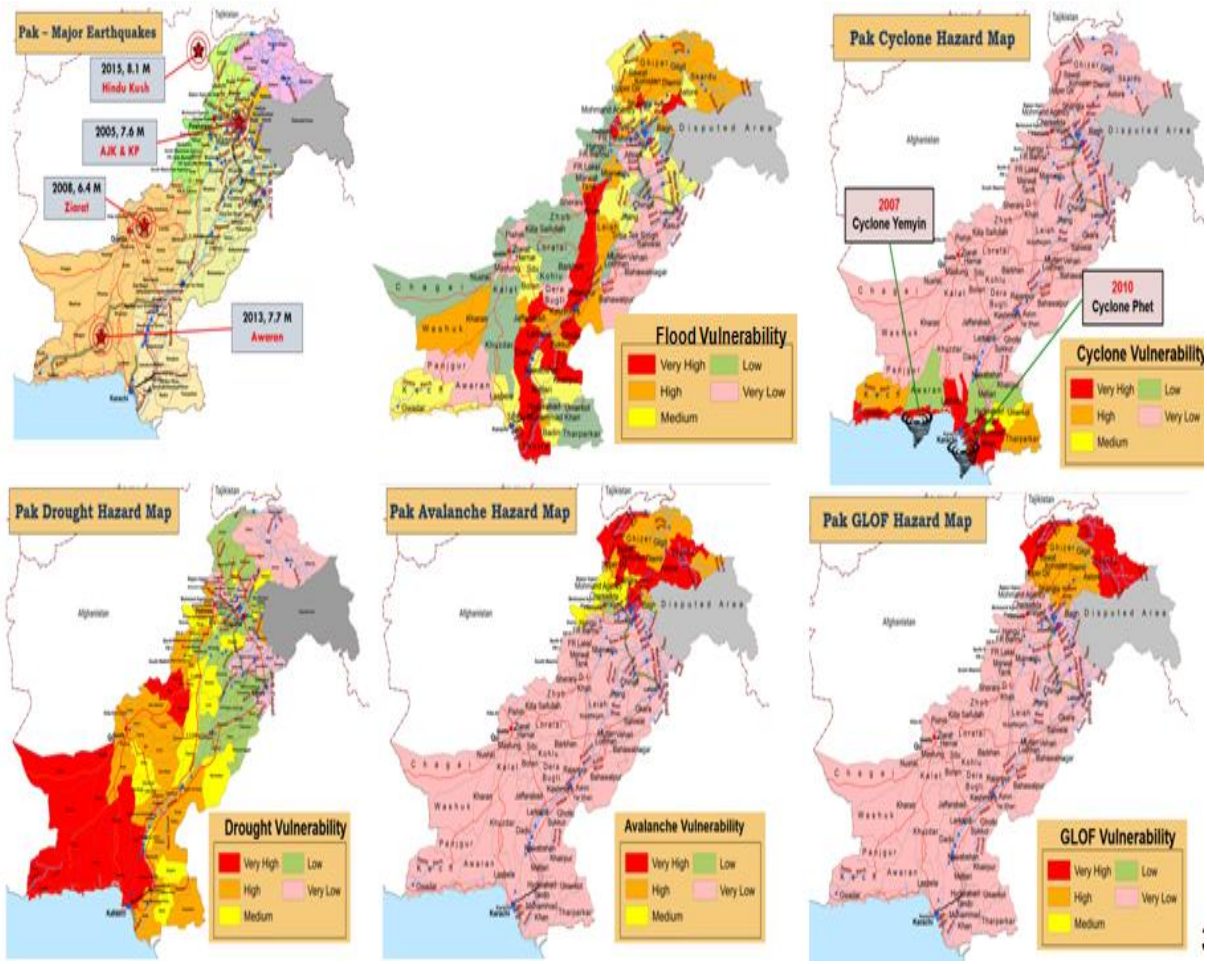


Figure 4-2. Hazards map of Pakistan

(Source: National Disaster Management Authority, Pakistan)

According to Historical Background of the country in terms of disaster, several events occurred in the past which resulted Approximately 1 million casualties and left behind more than 9.5 million people homeless with an economic loss of 2.8 billion dollars. The following pie chart will describe the clearer pictures of past event occurred in Pakistan since 1945 to 2017;

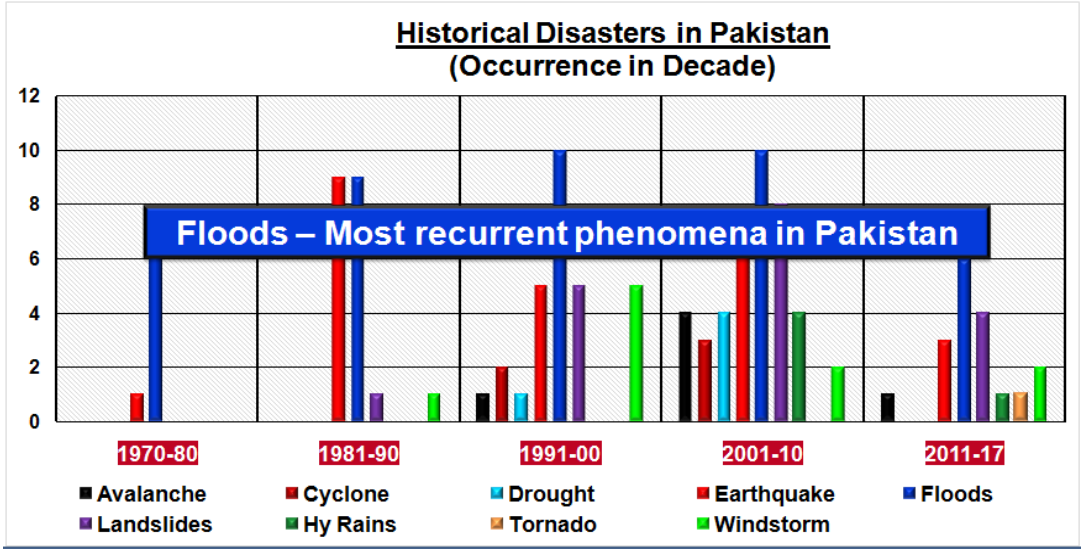


Figure 4-3.the pie chart showing the history of different disasters occur in Past

(Source: National Disaster Risk Reduction Policy, 2013, NDMA, Pakistan)

4-2. Disaster Management System in Pakistan

Prior to Earthquake 2005, the West Pakistan National Calamities Act of 1958 was the available legal remedy that regulated the maintenance and restoration of order in areas affected by calamities and relief against such events. An Emergency Relief Cell within the Cabinet Division has been serving since1971 as an institutional disaster relief support at the national level. Similar institutional arrangements existed at the provincial level in the form of relief commissioners.

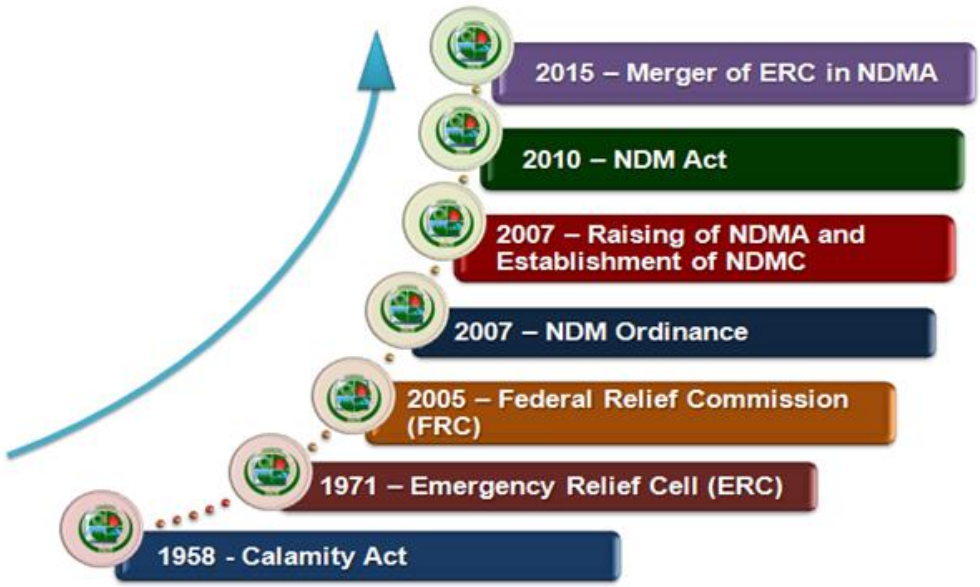


Figure 4-4. Describe the evaluation of Disaster Management System in Pakistan

(Source: NDMA Act, 2010, Pakistan)

The National Disaster Management Authority Act of 2010 will provide the further comprehension in terms of making an effective Disaster Management system in Pakistan along with bottom to top approaches for countering any mishappaens. Additionally, the major earthquake of 2005 and climate change conditions laid down the Government to establish a well-managed and comprehend Disaster Management system in the country. Initially, an ordinance was passed in 2006 to create Disaster Authorities and later it became an Act after soughting approval from Parliament in 2010.

However, this legislation works as a principal law in the ground of Disaster Management and to enact the policies with regards to Disaster Management. Similarly, the Provincial Disaster Management Commission was formed under NDMC, for combating a worst-case scenario and to regulate the various strategic policies across the country in the subject matter.

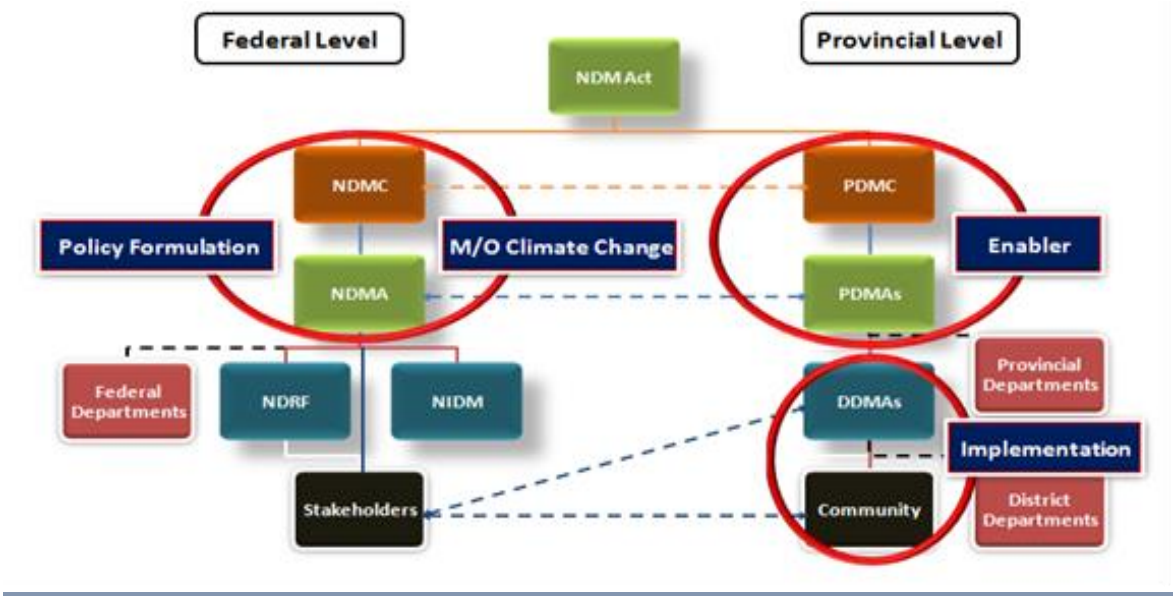


Figure 4-5. Describing the NDMC at National Level and PDMC at Provincial level

(Source: NDMA, Act, 2010, Pakistan)

National Disaster Management Commission NDMC

The National Disaster Management Commission (NDMC) is the highest body to establish the overall strategy and implement the disaster relevant policies in the country. The composition of National Disaster Management Commission for Pakistan and the Key members of NDMC are as under:

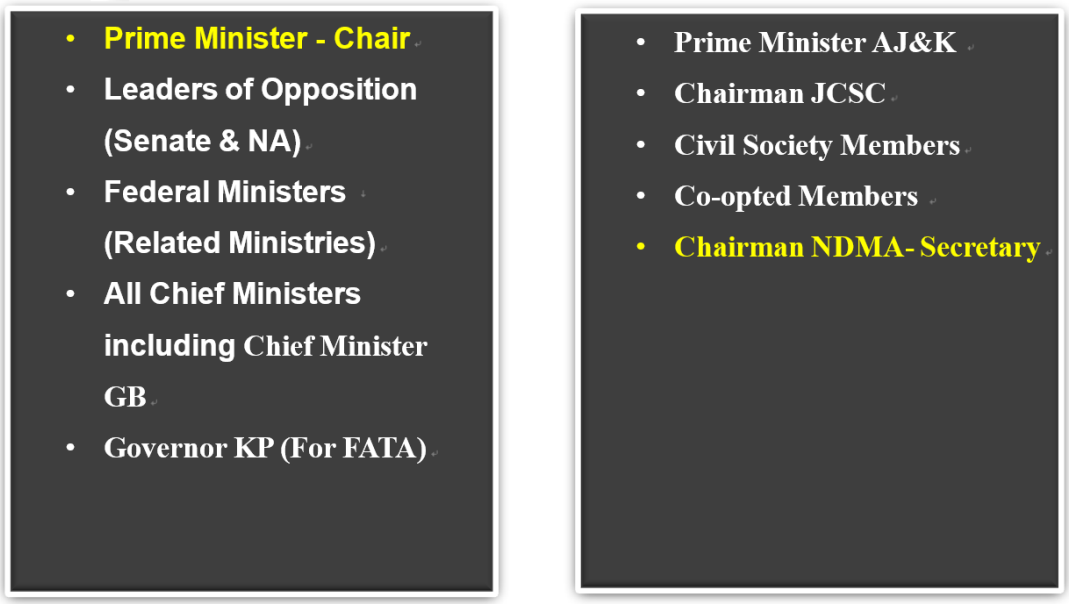


Figure 4-6. Describe the composition of NDMC in Pakistan

As per NDMA Act, 2010 the following powers and function of NDMC have been assigned;

- Lay down the policies, plans and guidelines for disaster management
- Approve the National Plan
- Approve plans prepared by the Ministries or Divisions of the Federal Government in accordance with the National Plan
- Arrange for, and oversee, the provision of funds to mitigation measures, preparedness and response
- Provide such support to other countries affected by major disasters as the Federal Government may determine.

National Disaster Management Authority (NDMA)

According to NDMA Act, 2010, the National Disaster Management Authority (NDMA) was formulated in 2007 as a lead agency for the entire band of Disaster Management pregame in the country. Further, in case of any untoward situation in the country all the Ministries, Divisions, Organizations, including Armed forces, International, National and Local NGOs will work together to counter the emergent situation.

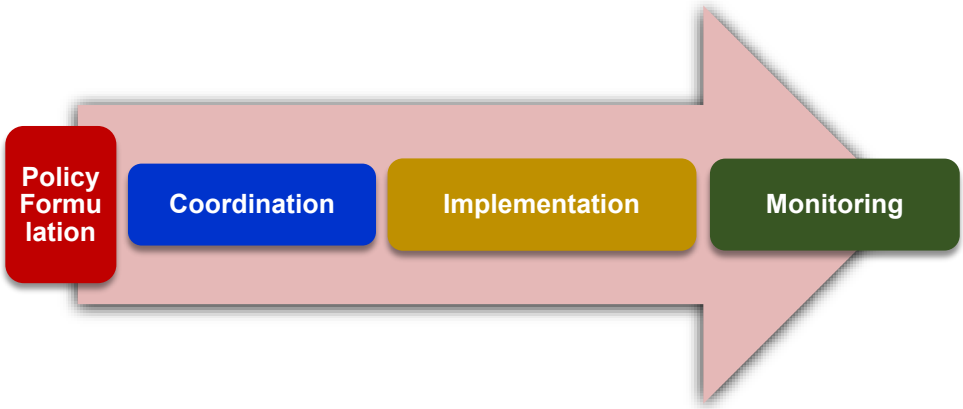


Figure 4-7. Disaster Management Spectrum in Pakistan

(Source: National Disaster Risk Reduction Policy, 2013, NDMA, Pakistan)

A) Act as the implementing, coordinating and monitoring body for disaster management;
B) Prepare the National Plan to be approved by the National Commission;
C) Implement coordinate and monitor the implementation of the National policy;
D) Lay down guidelines for preparing disaster management plans by different Ministries or Departments and the Provincial Authorities;
E) Provide necessary technical assistance to the Provincial Governments and the Provincial Authorities for preparing their disaster management plans in accordance with the guidelines laid down by the National Commission;
F) Coordinate response in the event of any threatening disaster situation or disaster;
G) Promote general education and awareness in relation to disaster management;
H) Pay down guidelines for, or give directions to the concerned Ministries or Provincial Governments and the Provincial Authorities regarding measures to be taken by them in response to any threatening disaster situation or disaster.

Provincial Disaster Management Authority (PDMA)

The Provincial Disaster Management Authorities have been established at each province as well as in Azad Jammu & Kashmir as State Disaster Management Authority under Ministry of Interior as an administrative department. The powers and other disaster relevant functions of the Provincial Authorities mentioned below:

- To Conduct Multi-Hazard Vulnerabilities Risk Assessment (MHVRA) for all districts of the province with technical support of NDMA.
- Responsible for implementing policies and plans for disaster management in the Province.
- Formulate the provincial disaster management policy obtaining the approval of the Provincial Commission.
- Coordinate and monitor the implementation of the National Policy, National Plan and Provincial Plan.
- Examine the vulnerability of different parts of the Province to different disasters and specify prevention or mitigation measures.
- Lay down guidelines to be followed for preparation of disaster management plans by the Provincial Departments and District Authorities.
- Promote general education, awareness and community training.
- Ensure that communication systems are in order and disaster management drills are being carried out regularly.
- Coordinate response in the event of disaster
- Evaluate preparedness at all governmental or non-governmental levels to respond to disaster and to enhance preparedness.
- Directions to any Provincial department or authority regarding actions to be taken in response to disaster.
- Provide necessary technical assistance or give advice to district authorities and local authorities for carrying out their functions effectively.
- Advise the Provincial Government regarding all financial matters in relation to disaster management.

District Disaster Management Authority (DDMA)

The District Disaster Management Authority, DDMAs have been established in each district which will be the leading body for Planning, Coordination, and implementation of disaster relevant policies in its territory. Being a first responder to cater the disastrous situation into normal the various powers have been assigned to district administrations;

- Coordinate and monitor the implementation of the National Policy, Provincial Policy, National Plan, Provincial Plan and District Level Plan along with program
- Ensure that the areas in the district vulnerable to disasters are identified and measures for the prevention of disasters and the mitigation of its effects are undertaken by the departments of the Government at the district level as well as by the local authorities;
- Ensure that the guidelines for prevention, mitigation, preparedness and response measures as laid down by the National Authority and the Provincial Authority are followed by all departments of the Government at the district level and the local authorities in the district
- Organize and coordinate specialized training programs for different levels of officers, employees and voluntary rescue workers in the district
- Facilitate community training and awareness programs for prevention of disaster or mitigation with the support of local authorities, governmental and non-governmental organizations;

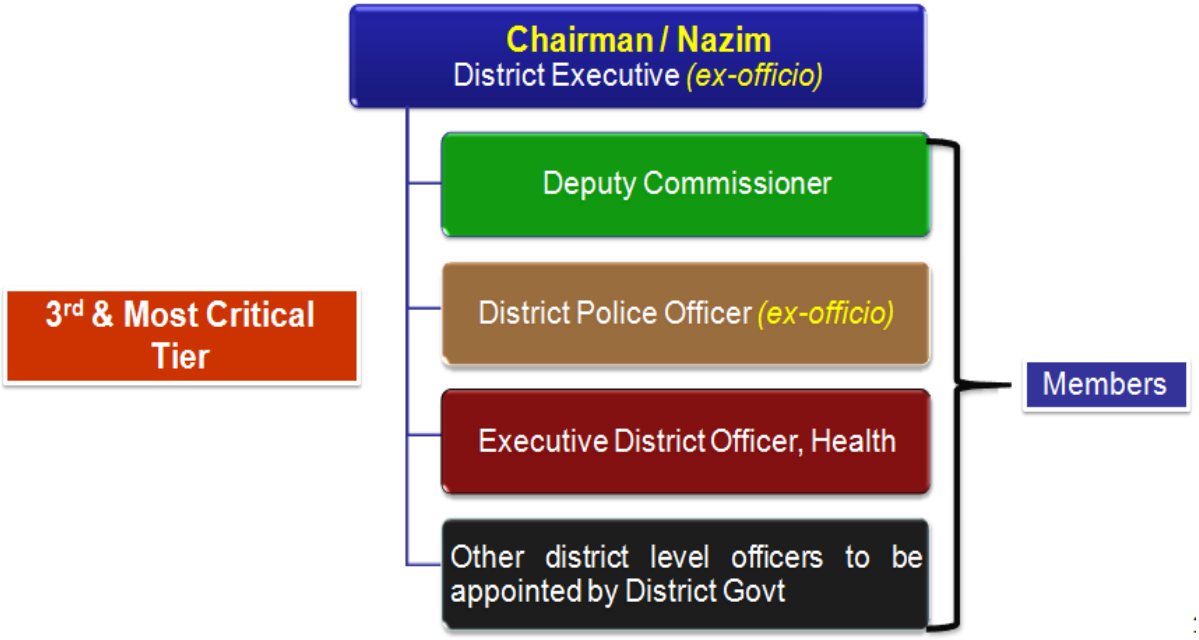


Figure 4-8. DDMA composition at district/local level

(Source: PDMA Balochistan Rules of Business 2012)

National Institute of Disaster Management (NIDM)

The National Disaster Management Institute NIDM, Pakistan has promulgated in 2008 as to promote disaster relevant program, research activities with close coordination of academia. Further, some of core functions of NIDM are as followed;

- To Develop curriculum on various factors of Disaster Management
- To undertake training, research and other related activities on disaster management
- To develop linkage, and build partnership with national and international academic insinuations
- To develop network of disaster management professionals and master trainers working in different disciplines in the country and abroad
- Publish newsletters, books, research journals and audiovisuals to raise disaster risk awareness among public
- Liaison with NIDM and NDMA and engage them in various activities, capacity building, workshop and technical assistance
- Establish and maintain database on disasters in the country and gave regular through NIDM website

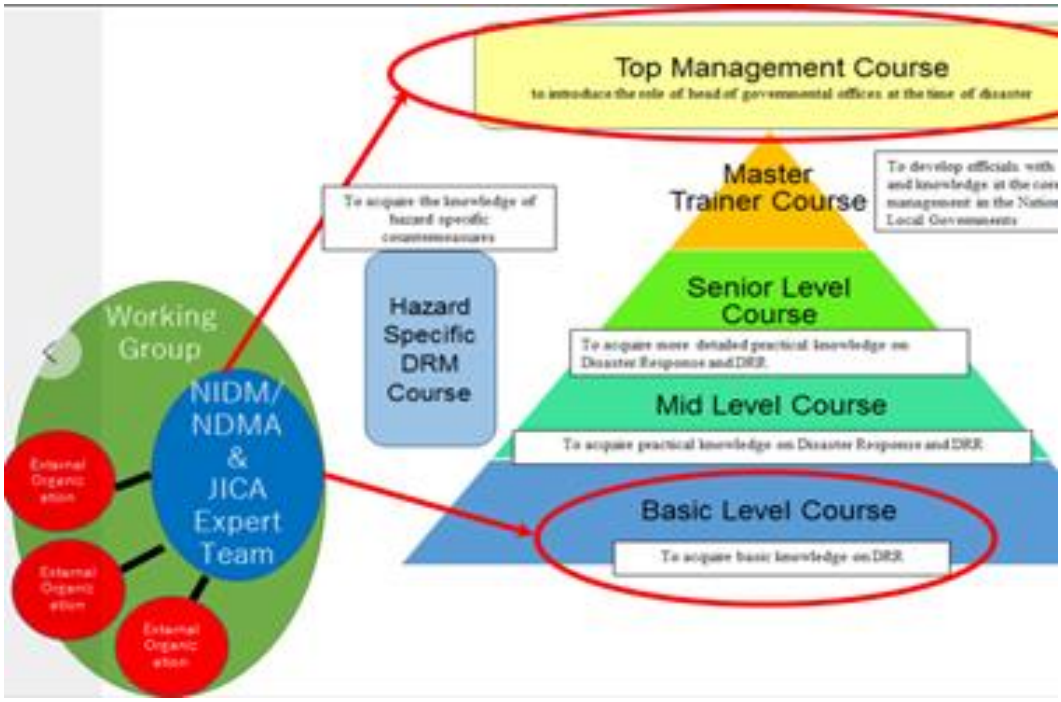


Figure 4-9. Level of training courses for disaster management in PAkistan by NIDM

(Source: National Institute for Disaster Risk Management, NIDM, Pakistan)

National / Provincial Funds for Disaster Management

The NDMA Act, 2010 provided the clause to establish the National Disaster Management Fund at national level to fill the gap of financial resources as the resource plays pivotal roles in the management of disasters in the shape of preparedness, Response and rehabilitation. The Government of Pakistan has established the National Disaster Risk Management Fund (NDRMF) to settle down the issues relevant with financial constraints. There are some key functions of NDRMF;

1. Agreement with International /National Banks for receiving donations, Loans etc.
2. Loans, aid and donations from the UN agencies, International /Local NGOs.
3. Donations received from any other source with close coordination of federal Government
4. Support to the National/ Provincial government to settle down the Disaster related projects.
5. Mostly, provide loans to civilian administration for retrofitting, construction of flood protection walls etc.

Provincial Disaster Management Funds

Subsequently, NDMA Act, 2010 also provides that all Provincial Governments shall create Disaster Management Fund and should be under the administration of the Provincial Authority, to meet the expenses and extend its cooperation towards civilian governments for management of financial resources to mitigate the disaster risk and to put the state on a resilient path. The PDMF shall be created at provincial level accordingly;

1. Grants made by the Federal Government or Provincial Governments; and
2. All the PSDP schemes shall keep at least 2% for disaster relevant activities in case of emergencies.
3. All the credits, financial assistance and donations from the national or international agencies provided in accordance with prescribed procedure.
4. It should be made essential for National and Provincial Government to allocate some fixed amount for retrofitting of buildings
5. Provide subsidies to the public for retrofitting of their homes etc.

5. Pakistan Disaster Management & International Obligations

5-1. Pakistan's Participation in International Cooperation & Commitments

To live in a peaceful, present and resilient environment is the dream of every human being. Further, to achieve the target, is a time taking process and needs to take a lot of initiatives from bottom to top and standardized as per experts. The most valuable part is to create awareness among the public, comprehended strategies from all domains incorporating societies, Provincial and National level. The country has been significantly facing hydro-metrological hazards, and specially the recent floods which killed more than 6,000 people and more than 1 million people became shelter less, so such challenges need to be addressed accordingly;

Figure 5-1. Some hydrological Hazards of Pakistan

(Source: National Disaster Risk Management Plan 2012-2022, NDMA, Pakistan)

Pakistan's Participation in International Cooperation & Commitments

Pakistan always left a positive gratitude towards international laws specially on disaster risk Reduction. It is essential to get the attention of international organizations towards disaster risk reduction awareness programs. Many worldwide organizations are playing a vital role in eradication of disaster risk through awareness and educating the different programs, events etc. Such global level platforms and networks can do much more aiming to reduce the disaster risk across the border to build a safer and pleasant environment. It is important to enhance the effective coordination among all countries in terms of financial/ technical, as the world becomes a global village and all countries are connected. It should be the priority of every state to contribute and stop affecting ozone layers as it damages the consequences that will be faced by the entire world. Pakistan is contributing much to make the world as a resilient town, by progressing the Tsunami billion tree program and making a record with more than 1 million trees in a day.

5-2. Sendai Framework for Disaster Risk Reduction (SFDRR -2015-2030)

The Sendai framework was adopted at third United Nation World conference on Disaster Risk Reduction in Sendai, Japan, on March 18, 2015 with certain objective to achieve the substantial reduction of Disaster risk and to minimize the losses of life, livelihood, to improve health, economic, physical and environmental assets of persons, business community and state over the next 15 years. Subsequently, Pakistan, has made so much efforts to achieve these goals, specially focused with community awareness, conduction of mock drills for relevant stakeholders is the part of annual work plans, and media which is considered the most informative source of knowledge have been the part of this agenda. Further, the DRR policies have been reviewed to further extend the awareness session at gross root level towards building back better concepts.

5-3. The Hyogo Framework for Action (HFA)

The Hyogo Framework was the five-priority action plan (2005-2015), which was endorsed by 168 countries. Mainly, two actions were related to Governance and risk identification. Aftermath, this conference Pakistan established a designated Disaster Management system in the country from top to bottom in the shape of National, Provincial and District Disaster Management Authorities. However, it also shaped DRR/DRM plans including Disaster Management Response Plan DRMP-2012-2022. These initiatives were positive gratitude towards action and achievement of Hyogo Framework and appreciated at various forums. Pakistan lies in disaster prone areas where many faults lines are passing and to cater such phenomena, the state has revised and developed a building code plan and implemented in the country, specially focusing on earthquake prone areas. Initiated various awareness programs to reduce the impacts of disaster through community education at the state level.

National DRR Policy Perspective

The Plan sets out several implementation strategies such as; advocacy, information, capacity building, community education on disaster risk reduction/ management, climate change and its institutionalization, mainstreaming, involving research, technology development and knowledge management, as well as monitoring and evaluation, networking and partnership building among relevant stakeholders. Additionally, NDRMP, leads and implementing partner agencies were identified. The main objective of NDRMP is ensuring the implementation and monitoring of national disaster risk reduction plans accordingly. The NIDM has an important role to play in advising on the design of such campaigns but also in creating capacity within NDMA, PDMAs and DDMAs to design, conduct and evaluate public awareness campaigns in the appropriate regional languages.

The intervention in the field on DRR has played a significant role by promoting DRR education into curriculum at all levels and should be revised and focused. It helps to reduce the DRR/DRM by adopting

various interventions through capacity buildings. The development of DRR as a principal discipline and technical education is in dire need to put forward at national and provincial level.

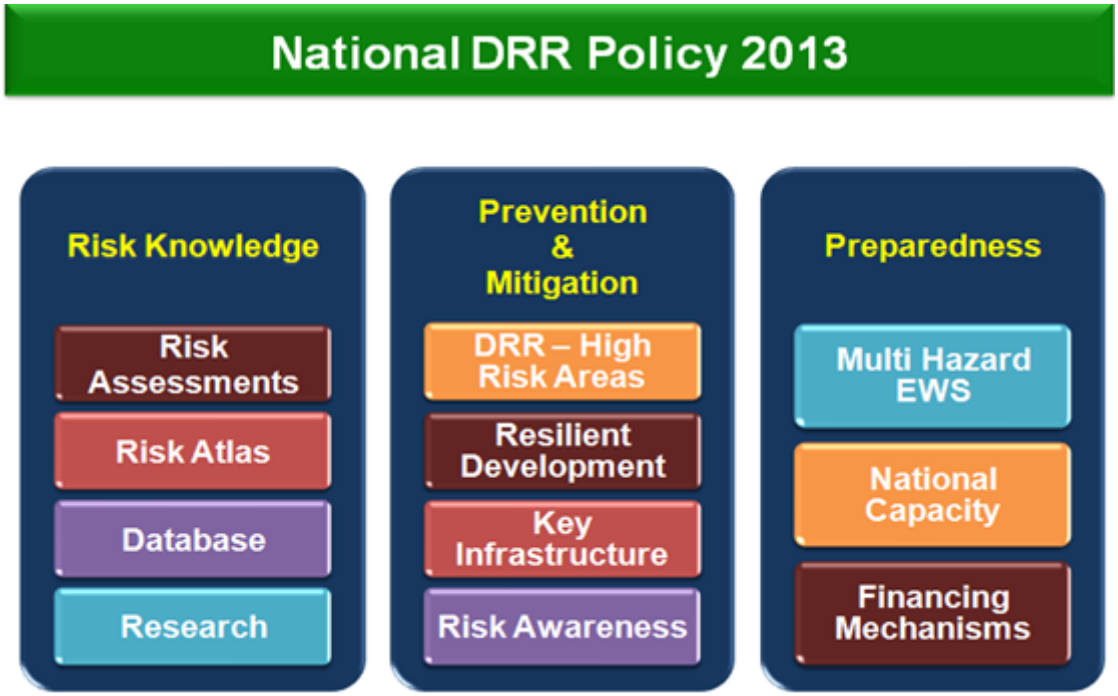


Figure 5-2 The National Disaster Risk Reduction Policy 2013, stages for reducing the risk of disasters by adopting the policy with above mentioned way

(Source: National Disaster Risk Reduction Policy 2013, NDMA, Pakistan)

6. Community Based EWS in Pakistan

6-1. Institutional Commitments for Community Capacity Building

The National Disaster Management Act- 2010 specifies the roles and responsibilities of NIDM, its primary objectives are creating community education, sponsoring the research, training and establishment of fundamentals principles in the field of disaster management. The Major functions of NIDM are describe as under;

- Inclusion of disaster management chapters into basic courses of educational institutions.
- Conduction of mock drills/ in schools.
- Promotion of disaster reduction systems in all Government departments.
- Holding of awareness programs at national level.
- Organizing national disaster management workshops, conferences, training, celebration of national disaster day, exhibition etc.
- Launching of awareness campaign through electronic and print media.

Figure 6-1 Disaster Management Cycle

(Source: NDRMP, 2012-2022, NDMA, Pakistan)

Organizing training of NDMA/ PDMA/ DDMAs staff.

- Training of Staff of Federal Ministries, academic staff etc.
- Establishment of effective coordination among all stakeholders who organize the capacity building in the field of disaster management.
- Provision of technical assistance for deployment of human resource, for conduction of drills/ trainings.

6-2. The NDMP Perspective

Under the National Disaster Management Plan (NDMP), Pakistan has chalked out a well comprehended Human Resource Devolvement Plan and that could perform as the national cause for disaster Management during emergencies.

Figure 6-2 Conduction of mock drill at school level
(Source: School Safety Framework, 2022-2030, NDMA, Pakistan)

The HRDP Plan under the Priority Actions and Programs starting from 2012 to 2022 has initiative some numerous activities for disaster planning, management and on disaster education:

i. To establish NIDM (National Institute of Disaster Management) to encourage human resource development in the field of disaster management.
ii. Develop the capacity of government leading agencies working in the field of Disasters.
iii. Improve DRR through capacity building of governmental officers/officials.
iv. To initiate a community awareness education program.
v. To facilitate, Disaster Risk Reduction program at Local Level:
vi. Identification and notify of safer places in times of emergent situations.
vii. To ensure implementation of CBDRM plan and activities.
viii. Disseminate self-help and mutual help efforts in disaster management.
ix. To develop preventive measures including ongoing programs in the field of disaster management, the Disaster Information Resource Center shall be established for providing disaster related data/information.
x. To enhance the capacities of Disaster Managers through training/workshop etc. for mainstreaming the DRM programs for implementation at gross root level.

xi. To conduct the search & rescue training program for emergency responders. Create awareness among individuals through DRM for reducing the impacts of any untoward situation while adopting latest techniques for countering the disasters. It is further submitted that a close coordination shall be developed among academia for conduction of research studies, practices on different model, publishing of magazine, report, articles etc. in the field of disasters which is quiet cheaper way to create awareness among community responders.

Figure 6-3 Showing the safety measures taken by school children during earthquake
(Source: School Safety Framework, Pakistan,2022-2030)

7. Disaster Context & Management System in Japan

7-1. Disaster Management Structure in Japan (National and Prefecture)

Japan is covered by the ocean and geographically it lies near to different fault lines which is the cause of various disaster events. Further, it is also known as the ring of fire where all seismic volcanic activity takes place. It is said that more than 7% of the world's energetic volcanoes are present in Japan. Due to its topography and metrological condition, the state also receives various devastating events like, Typhoons, torrential rains, floods, flash floods, snowfall, earthquake and tsunami etc. The earthquake of 1923, typhoons of the 1960s, and great Hanshin Awaji earthquake and Tsunami of 2011, caused a huge loss of human's life and left a bad impact on the economy of Japan. It is said that the great Hanshin Earthquake gave a more than 40% economic loss of annual budget of Japan.

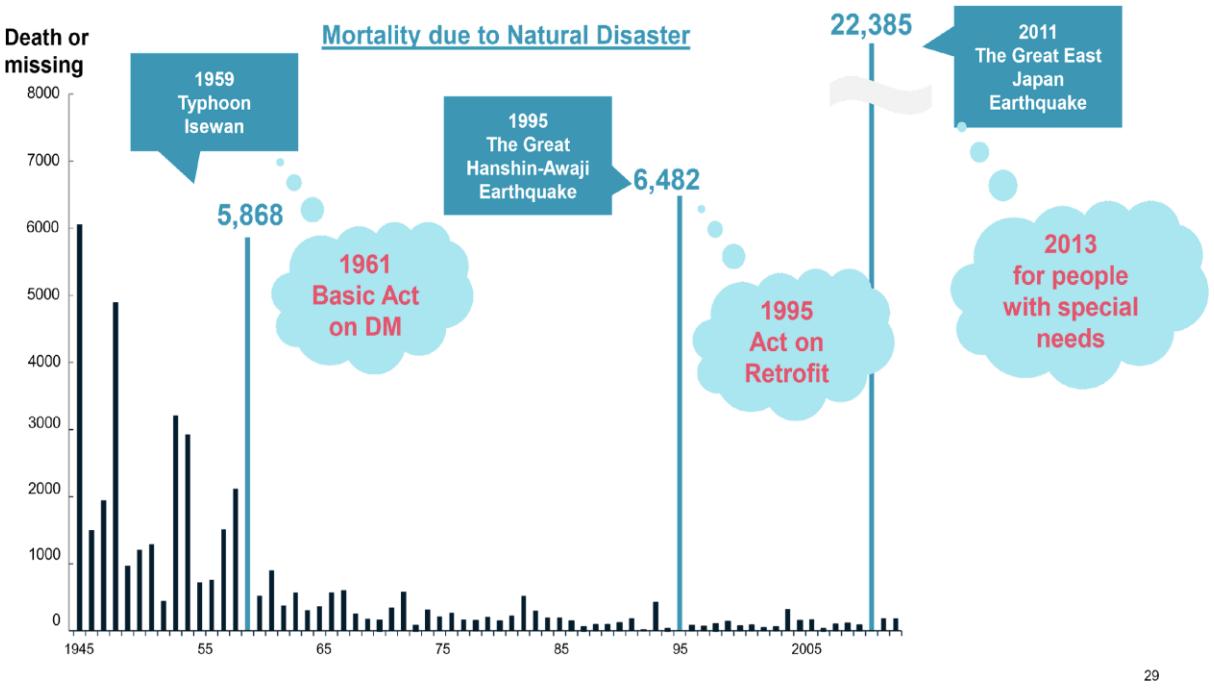


Figure 7-1 Disaster Management Structure in Japan (National and Prefecture)

(Source: Basic Act on Disaster Management of 1961, Japan

The Disaster Management Structure in Japan has a bottom to top approach and has perpendicular partitions as well as the strong bounding among local to municipal Government influences. The Government system in japan has three vertical stages and a 4th layers was added to structure aftermath of 1995 Great Hanshin Awaji Earthquake as mentioned in below table;

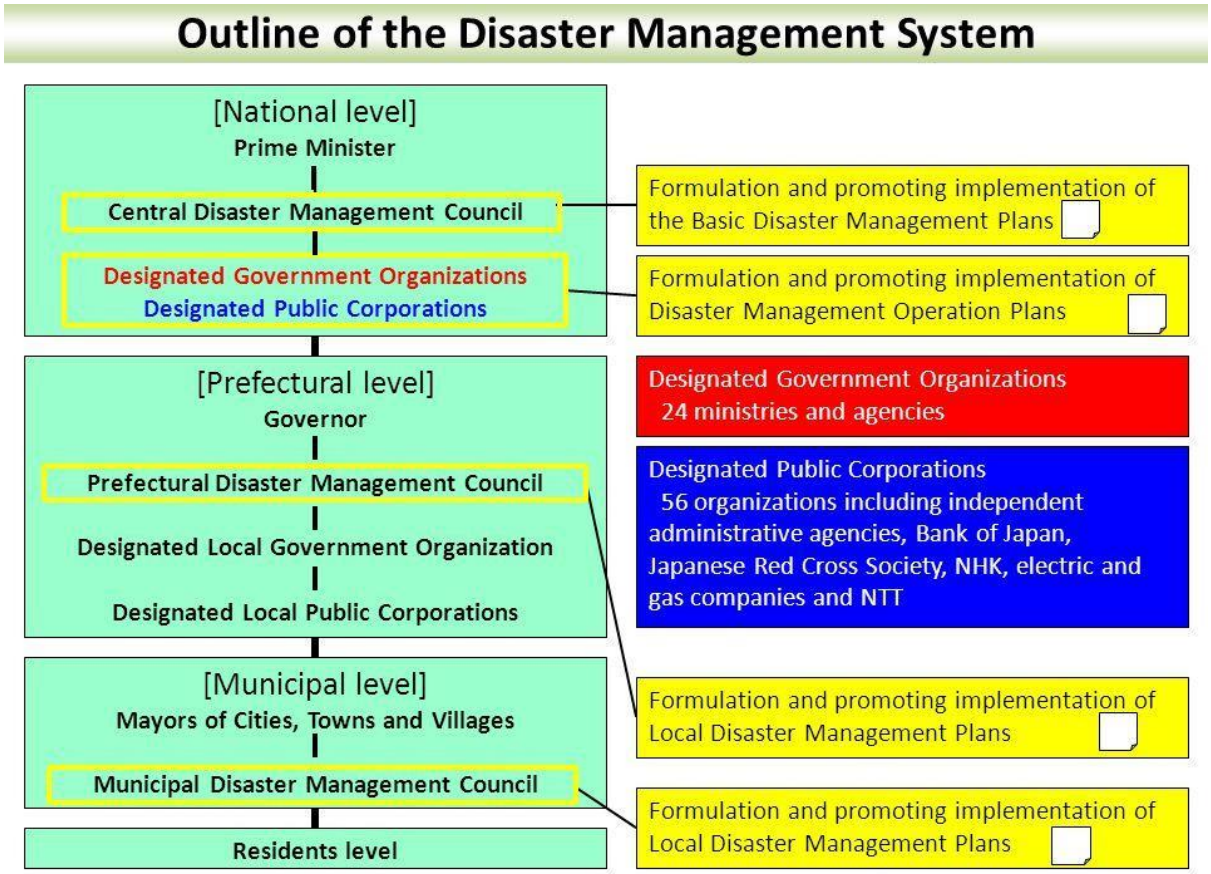


Figure 7-2 Disaster Management System of Japan

(Source: 1961 Basic Disaster Management Act, Japan)

The disaster management system came into force after 1959s typhoons in the shape of Basic Act on Disaster Management 1961, a well comprehend plan with dedication of specific role and responsibilities for combating the systematic disaster management in the country. This Act clearly defines the entire stages for prevention, mitigation, response and recovery along with duties of every level. The act had been revised and got few amendments after the great Awaji Earthquake of 1995 and 2011 Tsunami with adaptation of latest techniques to reduce the incidents of unattended cars for clearing the roads in case of emergency. The rules were also got slight change for evacuation sites along with information and rules were framed for smooth evacuation in times of disaster event. After the dominant government system in Japan, the minister for state was appointed in 2001 for better coordination, ensuring the DRR policies inclusion in all sectors and monitoring of all developing projects for further strengthen of disaster management system in japan.

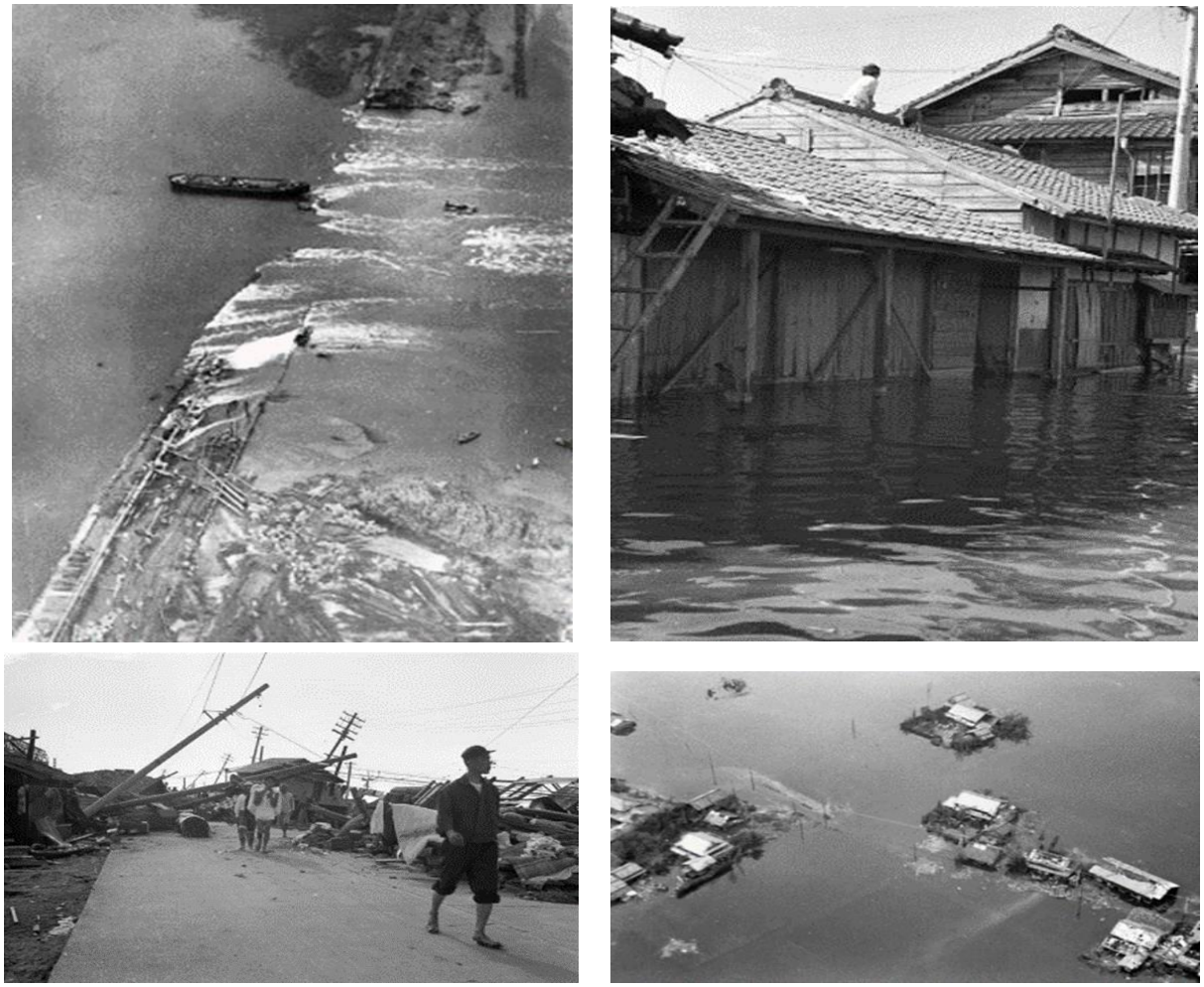


Figure 7-3 Destruction after Ise bay Typhoon in Japan

(Source: Nagoya City Port Disaster Risk Reduction Center Ise Bay Typhoon Library)

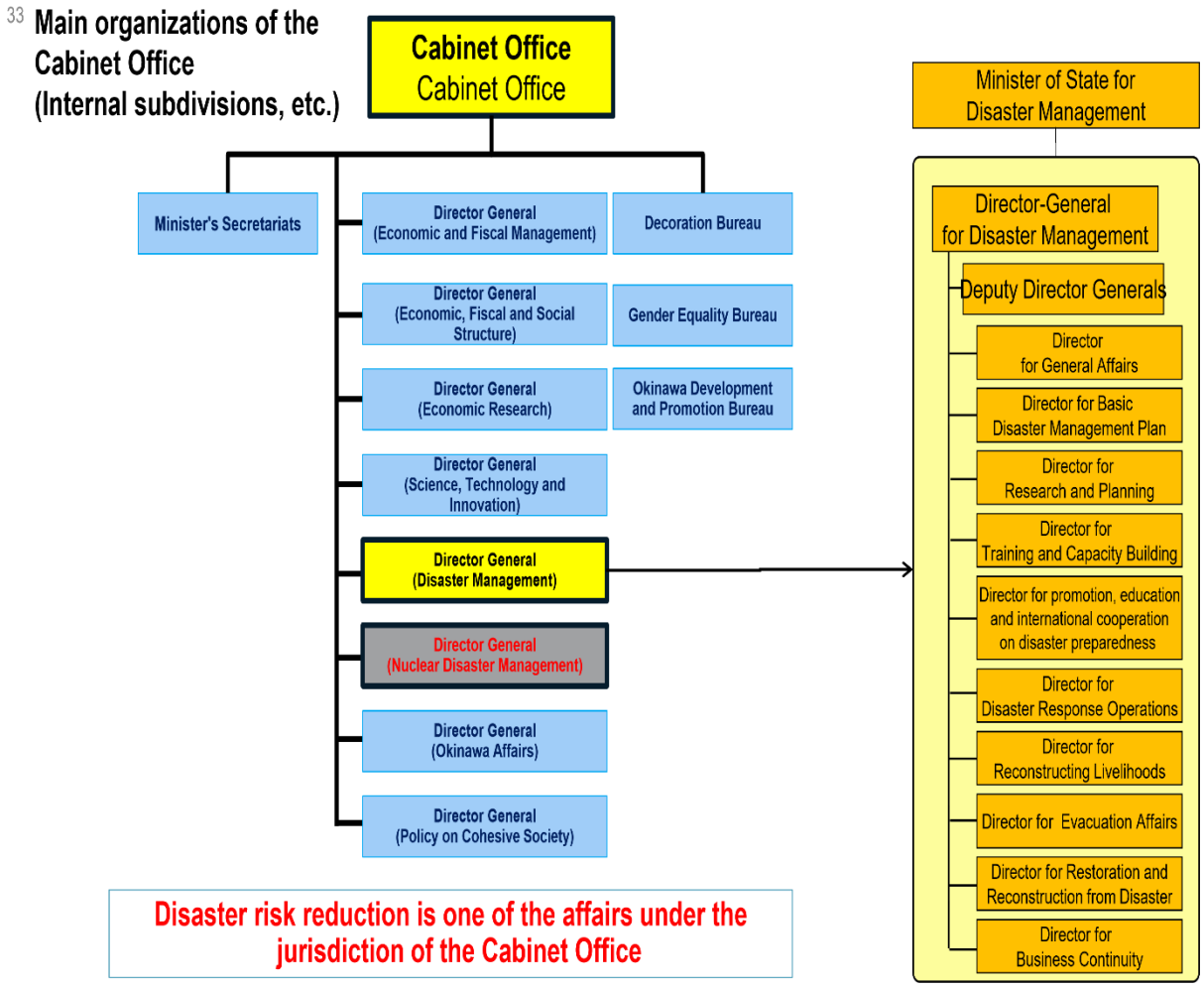


Figure 7-4 Organizational Structure of Cabinet Office , Japan

(Source: Cabinet Office Japan, 2017, White Paper Disaster Management in Japan 2017)

The Director General of the cabinet office is fully authorized to compile the initial response plan in case of major disaster event and also coordinate with relevant agencies. However, in terms of preparation of National Disaster Management Policies the national disaster management council holds the special session and promulgate further course of action on strategies.

Central Disaster Management Council

Based on Basic Disaster Management Act, the central disaster management council was formulated and the Prime Minister of Japan is designated as chairperson of this council, including all ministers, Deputy Chief of Cabinet Secretariat for Crises management, Chief of public authorities like BOJ, JRC, NHK, NTT and academic experts etc.

According to Act the following role and responsibilities have been assigned to central disaster management council;

- Development and effective coordination in terms of Basic Disaster Management Plans
- Promulgation of disaster management basic policies, contingency planning etc.

- Briefing and advice to Prime Minister and Minister of state for disaster Risk reduction and disaster Risk Management

Figure 7-5 Define the Central Disaster Management Council of Japan

(Source: Asian disaster Reduction Center, ADRC, Japan)

7-2. Disaster Management Plan in Japan (National and Prefecture)

The Basic Disaster Management plan is considered as a master program and the base for DRR activities in Japan. Further, based on BDMP. The Central Disaster Management Council promulgated this plan with clearly defined the role and responsibilities of Government, public partners, community-based organizations and municipalities as first responders. Subsequently, all the government institutions from center to bottom fabricate their disaster management operation plans and each prefecture and local government disaster management council prepare its plans for dealing with any untoward situation. Above in view, the council is authorized to constitute a special committee on facts and findings of the report whether it requires some sort of changes in the basic act of 1995 or not. Even though, expert team was constituted in connection with earthquake and tsunami facts and findings from the great east japan earthquake later the report of experts the Government brought some changes in the Basic Disaster Management Plan. The following figure will help to understand the Disaster Management plans along with executing agencies in Japan;

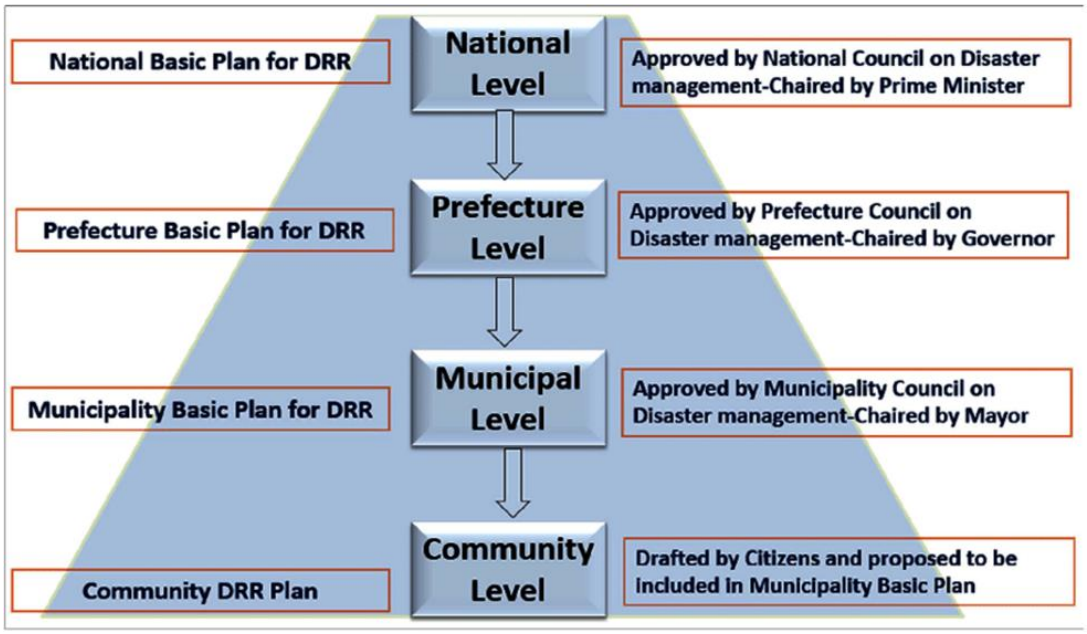


Figure 7-6 Basic Disaster Management Plan along with roles at National/Prefecture/local level (Source: Basic Plans for Disaster Management in Japan, cabinet office, Japan)

Additionally, each prefecture has a different chief for leading the emergency /disaster management system likewise, Governor, Deputy Governor, minister of State, etc. but similar roles and responsibilities have been assigned to each prefecture. The main roles are to formulate, implement the local disaster management plans with close coordination of the municipal disaster management council for effective coordination and response.

Subsequently, the third stage for formulation, implementation of disaster management plans is the municipal disaster management council under the supervision of city Mayor including other relevant stakeholders, ministries etc. Mostly, it depends on the scale of disaster events, if the scale is large and the municipal government doesn't have resources to manage then the Prefecture will come forward to respond to that emergency and similarly, the national government will support the prefecture & affected area accordingly.

The fourth level plan is known as Community Disaster Risk Reduction Plan developed by the community and endorsed by local authorities. This plan was included in Basic Disaster Countermeasures law June, 2013 after the Great East Japan Earthquake with the aim of encouraging community participation in town planning and management even during the initial phase of reconstruction. Later on the community disaster risk reduction SOPs developed with the technical support of experts, incorporation of local people, traders, educational institutions and Governmental officials. The theme of CDMP is to provide knowledge to the public in terms of disaster events, save evacuating methods among business and local communities. However, information sharing is the key component before disaster events as people will have the time to evacuate themselves and such acts will lead towards reducing the risk index. Further, to encourage the community, award system has been

recognized by the Japanese to get attention and ensure maximum participation of residents in preparation of CDMP.

7-3. Early Warning System in Japan

Japan Metrological Agency has installed more than 1700 seismometers across the country and almost every 60 km, which provide intensity of earthquake information to approximately 3900 local stations. Further, this seismometer frequently notices the shaking of earth through online data sources. However, JMA has also installed 4332 seismic intensity meters in every municipality for measuring the ground motion. In addition, the Geographic Survey Institute (GSI) has established almost 1200 GPS stations throughout Japan, which facilitate monitoring purposes and can be used for analyzing the data from different seismometers and seismic intensity meters. If earthquake occurred the JMA team start analyzing the data from all resources specially rely on seismic intensity meters and within two minutes generate seismic intensity information report for earthquake of intensity 3 or greater, and within five minutes issues a report with location of epicenter along with its magnitude to local responders where earthquake exactly occurred.

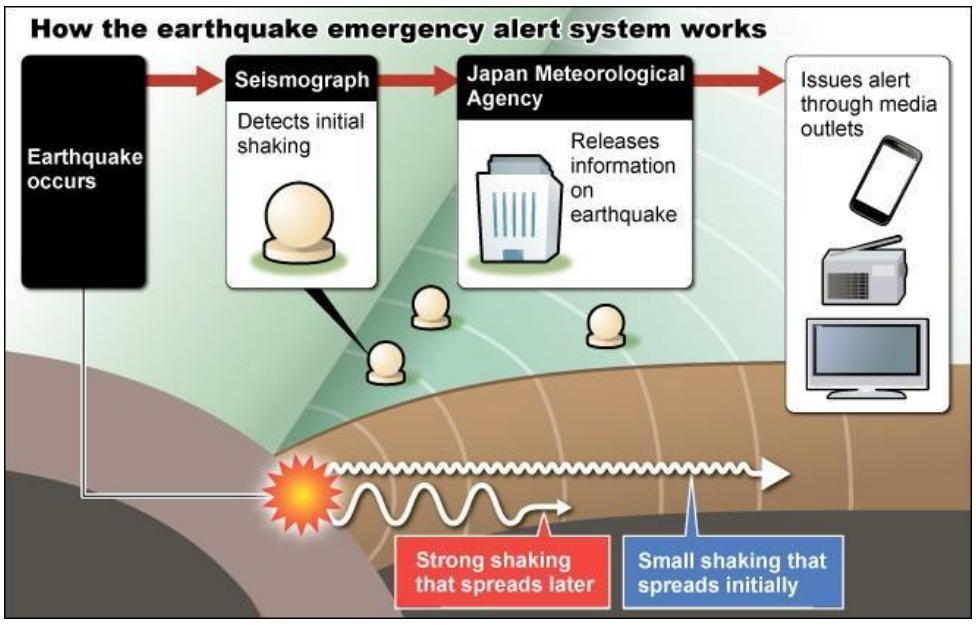


Figure 7-7 Early earthquake alert system remains flawed but tolerated

(Source: Asahi Shimbun)

Accordingly, the JMA within three minutes not only issued an alert for tsunami based on wave heights but also arrival time of high-tides on regions. When such values are used, estimated maximum tsunami heights are expressed in qualitative terms such as "Huge" and "High" rather than as quantitative expressions. Once the exact magnitude is determined, JMA updates the warning with quantitatively estimated maximum tsunami heights, which are included in subsequent tsunami information.

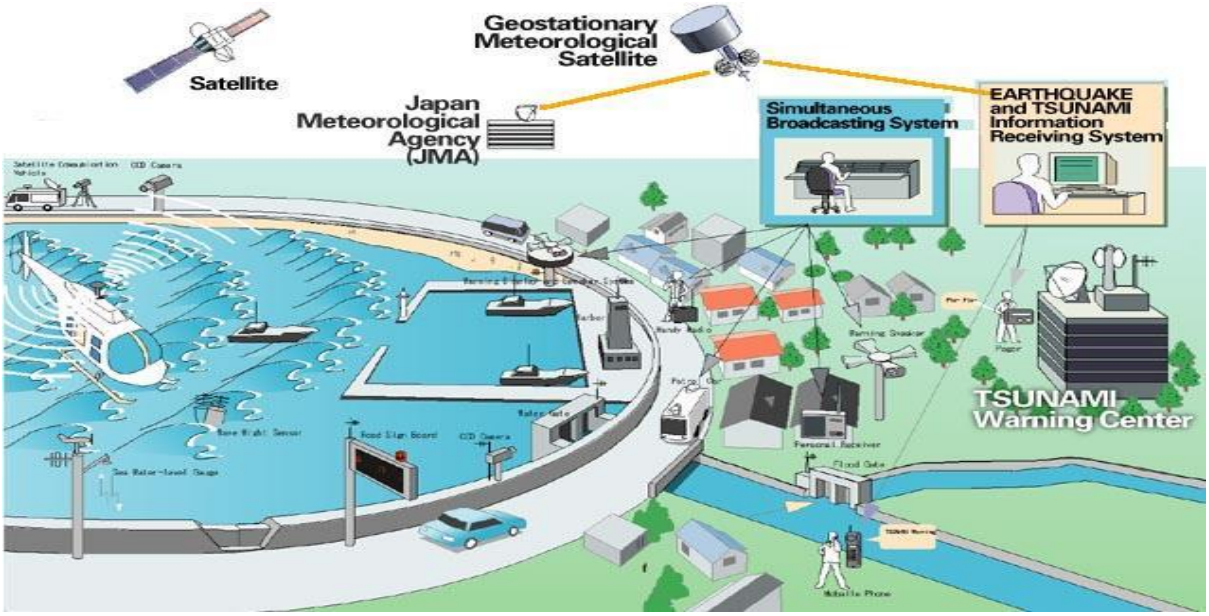


Figure 7-8 Earthquake and Tsunami Information Receiving and Warning System

The tsunami information receiving system get data of earthquake and tsunami within a few minutes while JMA receives the information on actual time through Geostationary Meteorological Satellite GMS and at the same time a threat alert and buzzer start sound to the administrator of the system to notify. The computer/system highlights the first information on screen and prints out the data of tsunami occurrence along with actual arrival time to different areas.

Figure 7-9 Open ocean buoy - Source JMA

7-4. CBDRM against Tsunami in Japan

Community plays a vital role in handling any type of disasters because everybody would look to one another for help, support and care specially to disabled and old age people who require more support in times of evacuation and emergency situations. Japan received a major disaster in the shape

of a tsunami on 11th march, 2011 which killed so many people and caused nuclear calamities from Fukushima. According to JMA, the waves hit the coast with 40.5-meter height along with 9.0 magnitude. The severity of the damage incurred was enormous. As per the report of Japan's National Policy agency more than, 2561 people are still missing and 15894 lost their lives and 6152 got injuries. However, 121,805 buildings were affected/ damaged. The area was witnessed for its physical destruction and submerged land under water after the devastating tsunami of east Japan.

Volunteer DRR Organization/ BOKIMI

The disaster Management planning of Japan is facilitating to volunteers in terms of disaster education to build their capabilities for supporting other during emergent situation. In case of any major event these volunteers put forward their services to participate in search and rescue, relief activities. The Japanese Government not only provides the basic equipment for rescue and response activity but also provides some stipend to these volunteers on an annual basis i.e. 140,000 yen and encourages them to take part in mock drills, awareness campaigns etc. Additionally, these organizations are known as BOKOMI and Japanese name is "BOSAI". In Kobe, there are some 191 BOKOMI institutions and every organization has been provided the first aid box, firefighting materials etc. by Kobe city Government to meet any challenges in times of disaster. Volunteers also join the DRR activities and yearly more than 800 drills, rescue exercise, different training course, lectures, making of hazard map, flood control room visits of government institutions within the city.

The "Iza! Kaeru Caravan!" is a disaster prevention education event that combines local disaster drill program and "Kaekko Bazaar," a toy exchange bazaar, created by artist Hiroshi Fuji. In this event, children learn about disaster prevention as a 73 continuation of play. Started in 2005, this event has been held nationwide in cooperation with various enterprises and organizations. It is basically a disaster drill program, where participants can obtain the knowledge and skills necessary for disaster preparedness, while enjoying the program. It was first conducted as an event in the Message from Kobe-Ten Years after the Earthquake project commemorating the recovery from the earthquake, which was carried out over six months from April 2005, with Hyogo Prefecture and Kobe City as the secretariat. More than 3,000 parents and children came to the Green Arena Kobe Stadium, one of the venues for the program, to participate. The number of participants exceeded the expectations of those involved, and there were large crowds of people even outside the stadium. The Iza! Kaekko Bazaar is a system in which children bring toys that they do not want any more to an event venue and exchange them for "Kaeru points", which are a kind.

CBDRM in Hirono-town, Iwate prefecture

The community-based disaster risk management system considers the main source in combating the disaster risks. Further, CBDRM, is a proactive approach that helps communities to reduce the risk and enhance the ability of special groups to combat and decrease the risk for loss of life, property

and climate impacts. The concept of CBDRM was introduced in 1990-1999 at United Nation International decade of Natural Disaster Reduction. Later, different approaches, concepts and techniques were adopted to minimize the effects of disasters. However, Sendai Framework (2015-2030) also emphasized investment money on mitigation which not only help in reducing the losses but also decrease the budget spender on response after havoc disasters.

In Japan, the CBDRM is an active approach and the community is always supported by the Government for adopting the latest techniques for reducing the impacts of disasters. Further, the community of Hirono Town-Iwate prefecture is well known and actively organize the DRR session in their area because of 2011 tsunami which destroyed everything and left a devastating impact on their life. Community of Hirono town has formulated its town leader's committee which conducts the mock drills for creating awareness against tsunami. The town committee has built an evacuation site by themselves which shows great contribution and coordination among residents.

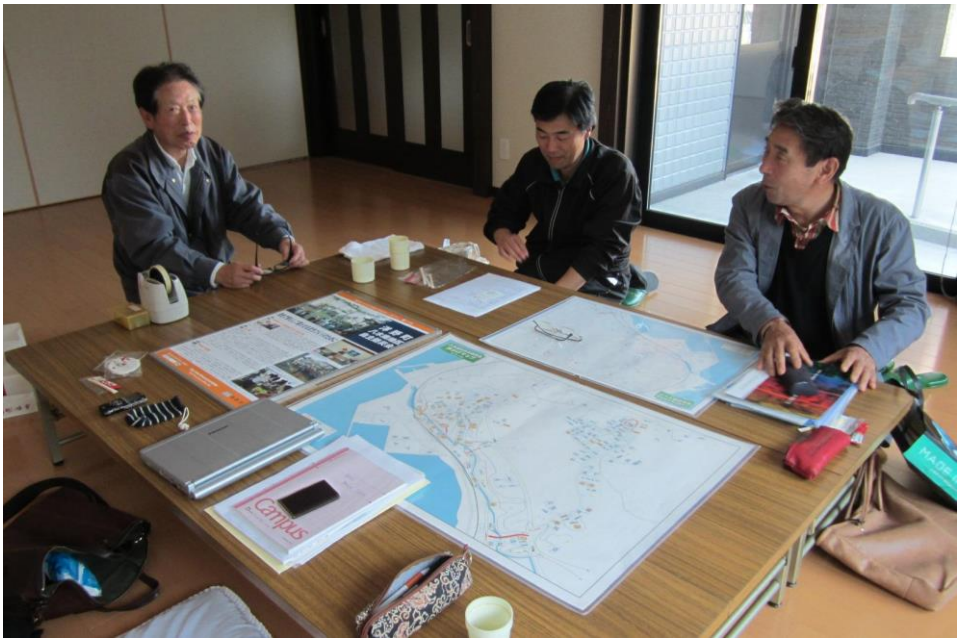


Figure 7-10 Community leaders in Hirono-town
(Photo by ADRC)

Further, the committee has developed a risk hazard map of their town with the consensus of the community, especially the old age people who have faced various disasters in this town. The risk map supports them to find the exact location of a safer place as more than 80% people of this town are 60 years old which requires the help/ support of other during the evacuation in case of an emergency.

Figure 7-11 Tsunami Hazard Map in Hirono-town

(Photo by ADRC)

Moreover, the map of Hirono town, describes the resident area along with evacuation sites located in the town. However, the yellow dots in the map show houses of old age people, the red line shows evacuation sites and the red circle identified as shelter/ temporary community hall for the people during an emergency.

8. Comparison between Pakistan and Japan

Pakistan and Japan are the most prone countries in terms of disasters by location. Further, three major faults are crossing Pakistan, among two major plates are near to cost of Pakistan like, Makran Subduction zone and Quetta –Chaman fault line. However, the great Tsunami of 1945, with 7.6 magnitude occurred at Makran subduction Zone (MSZ) and killed more than 4000 people.

Subsequently, Japan has got major subductions zone specially the Itoigawa-Shizuoka Tectonic Line (ISTL) which cuts across Honshu from north to south and just west of Tokyo and Median Tectonic Line (MTL) which is an east-west trending strike-slip fault that parallels the Nankai Trough from the KII Peninsula into the heart of Kyushu and Kobe earthquake of 1995 occurred on Rokko-Awaji Shima Fault Zone, known as the branch of Median Tectonic Line to the south. Japan is more prone to Tsunami as, Pakistan received only 1945 as a major earthquake/Tsunami while Japan has received major events in the shape of Kobe Earthquake of 1995, and 2011 Tsunami which left a devastating impact on the economy of Japan.

Pakistan has installed 05 automatic Sirens on the coastal areas which not only help in early warning systems but also support evacuation of communities during earthquakes and tsunamis. Below mentioned table shows a slight comparison between Pakistan and Japan towards monitoring network for Earthquake and Tsunami.

Table 8-1 Comparison between Japan and Pakistan in terms of monitoring mechanism for earthquake and Tsunami

(Source: JMA & PMD)

	Japan	Pakistan
Seismometer	1700	147
Seismic Intensity Meters	4332	157
Tide Gauge	11	188
Ocean gates	29,798	Not installed yet
Automatic sirens	173	10

Time Frame for issuance of Earthquake & Tsunami Early Warning information system in Japan and Pakistan

Japan frequently receives earthquakes and Tsunami as compared to Pakistan. Now, Pakistan is moving from Disaster prone to disaster resilient country after adopting international policies to counter the disaster Risk from the state. However, JMA/PMD had been given the mandate to monitor and issue advisories/alerts for earthquake /tsunami and evacuation advisory in case of major events. Below is the time of Japan and Pakistan for issuance of information about earthquake /tsunami hazards is worth mentioning here to compare the mechanism for alerts and dissemination of information; mechanism for

alerts and dissemination of information;

Table 8-2 Describe the timeline for dissemination of earthquake/Tsunami early warning to relevant stakeholders and community

(Source: JMA & PMD)

	Japan	Pakistan
Seismic intensity/ Magnitude	1.5 to 2 minutes	03 minutes
Earthquake	Within 5 minutes	5-10 minutes
Tsunami Warning	2 to 3 minutes	7 to 11 minutes
Earthquake Early Warning	1 minutes	3 to 5 minutes

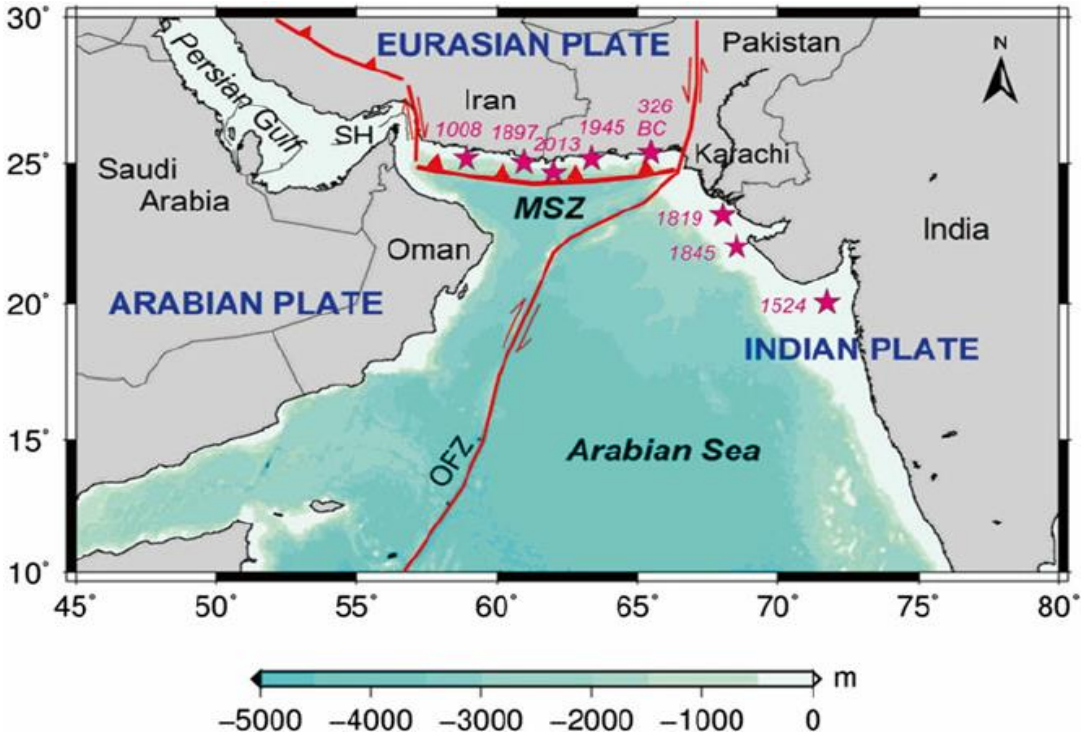


Figure 8-1 Define the historical seismic activity on MSZ

(Source: DRR Plan for Gwadar-2008)

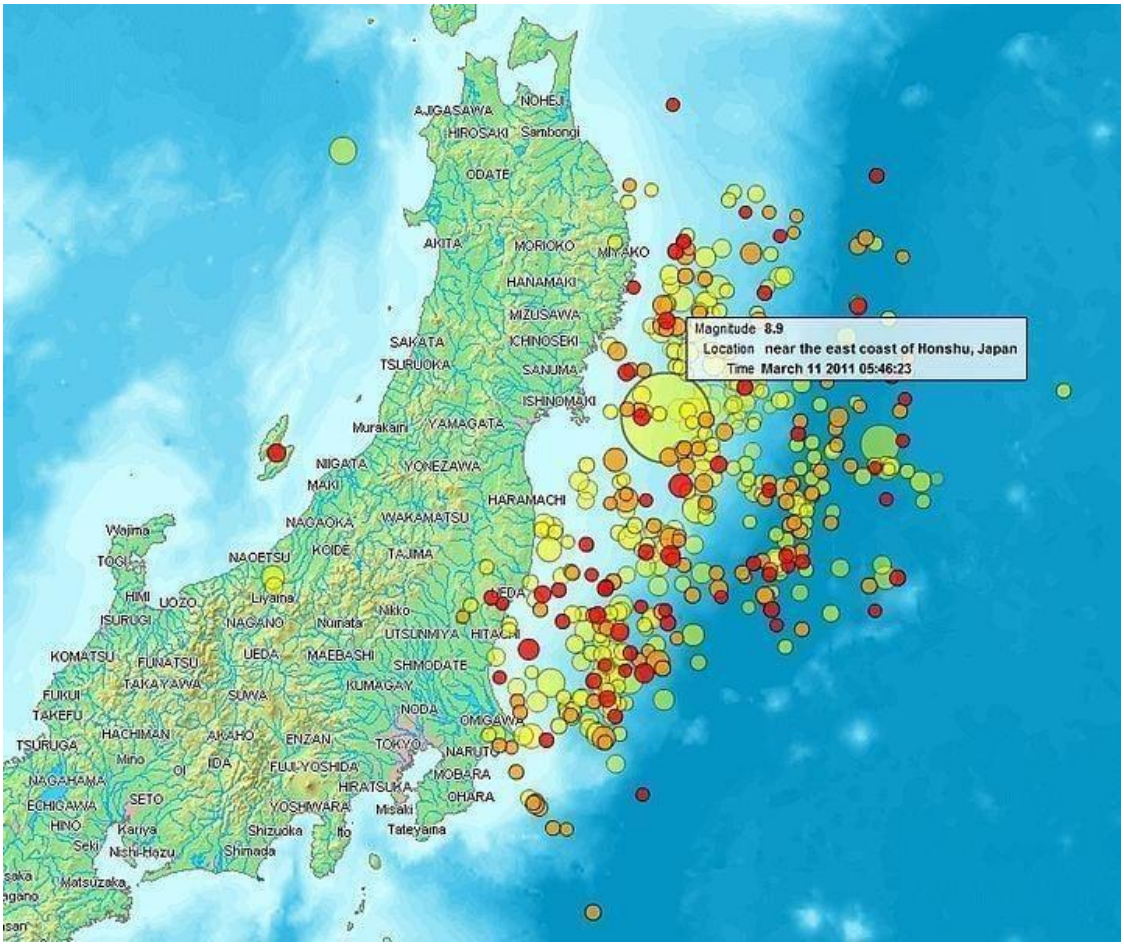


Figure 8-2 Show the seismic occurrence in Japan

(Source; Document Reality. The 2011 Tohoku Earthquake and Tsunami, Japan)

The above-mentioned picture clearly defines the frequency of seismic activity occurring in both countries. However, Japan and Pakistan have four bulletins for early warning from bottom to top but only time differences have been noticed. Pakistan should reduce the time frame for early warning as it is the only source to secure the community in time of earthquake/tsunami warning.

Generally, few different mechanisms have been set for both countries for ensuring the safety of their people. Pakistan has established the special industrial zones which are away from coastline and as well as from city areas, while the Japanese Government has constructed its industries near to the coast which can cause a huge damage during disasters as experienced in past specially, Fukushima Nuclear Power plants. In Japan the resident areas are near to the coast while in Pakistan the public is not allowed/ construct the house near to the coast.

- Japan has constructed protection walls near its coast but in Pakistan protection walls can be in a few areas.
- Pakistan has identified the evacuation site near to its coast which are for limited populations but in Japan in every town/coast area they have constructed the evacuation site with symbols.
- Japan has installed a flood gate on different points of its cities while no flood gate has been constructed by Pakistan on its coastal areas.

- Pakistan has only installed limited tide gauges while Japan has done much more.
- For evacuation Japan has made a single board on government/ public places while Pakistan has done only in Government buildings and needs to do more.
- After the Earthquake of 2005, Pakistan has declared 8th October as National Disaster Day but celebrated only in government offices but Japan has designated different disasters with various dates and celebrated it on both public or Government level.
- Japan has a BOKKIMI festival to educate the school's children while Pakistan established school safety Guidelines and accordingly initiated work on different programs.
- Japan has a different education system to educate its public while Pakistan has launched a Community Based Disaster Risk Reduction Program in all provinces.
- Mostly, Japan disaster relevant literature is in Japanese while Pakistan has translated it into English + local language for better understanding of community and international visitors.
- The Japanese Government has signed a contract with a private company to supply food in times of emergency while Pakistan has established warehouses in each locality to ensure timely supply of all relief goods to the community.
- On a yearly basis, national mock drills are conducted at NDMA while twice at Provincial level and according to vulnerabilities different program/ activities are conducted at district level in Pakistan while in Japan days are designated for different program/activities.

9. Recommendations

Earthquake and flooding are the most common phenomena of Pakistan but cannot ignore the tsunami of 1945 which left a bad impact and swallowed more than 4000 human lives. Further, the local population of coastal areas of the country have significantly faced several disasters, in the shape of earthquake, tsunami, typhoons of 2004-2007 and Yemyin Cyclone which brought huge destruction on the coast of Balochistan and Sindh. Due to presence of Arabian Sea, Indian ocean and Gulf of Oman near to Makran subduction Zone (MSZ), and past events in this region are predicting the big earthquake and tsunami can hit the coastal belt of Pakistan at any time. As per the expert, the fault line is only 100 km away from Gwadar, and a huge amount of energy has been stored in this fault line which can abruptly reach to the coast and can bring a huge amount of destruction.

After the 2004 tsunami in the Indian ocean, the government has taken some serious initiatives for tsunami hazards and risk mitigation. Pakistan has fabricated the Disaster Risk Reduction policy and developed guidelines for responding to the earthquake and tsunami in the coastal areas of the country but it requires more focus as the Japanese government is dealing with the tsunami. This section recommends earthquake and tsunami risk assessment and proactive measures for making the coast as disaster resilient. Being a prone state for earthquake and tsunami, Pakistan is in process of making policy towards earthquake and tsunami with the support of UNDP which will be further implemented at national/provincial and district level. It will also enhance the resilience of coastal communities to livelihood opportunities. The policy will cover Gwadar, Lasbela, Malir, Keamari, Ketti Bander and Karachi district. The following are some remedial measures which can be helpful / supportive to reduce threats and impacts of earthquake and tsunami vulnerabilities in the coastal areas of Pakistan;

- To detect the earthquake and subsequent local tsunami vulnerabilities in between hazards and risk assessment along the coastline in a well-defined manner.
- To ensure the usage of tide gauge, deep ocean buoys and other capabilities (International/ National information system to gather more data in terms of tsunami).
- Later, the data should be used by the experts for analyzing and forecasting the tsunami threat in the region.
- It is also very important that accurate warnings should be disseminated among all stakeholders including community and all line enforcement agencies for a quick response.
- Identification of mitigative measures which involve long term action that reduce the risk to human life and property from tsunami hazards.
- A well-defined plan with clear objectives to make the community resilient against earthquake and tsunami be launched and awareness sessions must be increased in the said region.
- Scientific approaches, research-based studies along with social efforts for improving the better understanding of tsunami risk assessment, predictions, warnings and reducing the tsunami hazards must be appreciated at all levels.
- The most important thing is to strengthen the coordination among all stakeholders, counterparts' organizations and sign an agreement to reduce the common threats & impacts of earthquake and tsunami. a

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[Acknowledgement]

Disaster Risk management is not a stand-alone process, rather it's a collaborative effort. Disaster Risk Reduction is the most challenging task in the disaster management process. Prevention and Preparedness must be imbibed as a culture in the society, if disaster risk management must be successful. However, in most cases it's an uphill task for disaster managers who try to build a culture of safety in the society despite adversity and challenges. The task is more tedious when the target group is large. Japan is known for its disaster management practices and most of the global DRR frameworks have been adopted in this country. Therefore, it is quite exciting for me to be a part of the Visiting Researcher Program of ADRC, Japan for the FY-2022. I sincerely thank the Ministry of Climate Change, Govt. of Pakistan, Govt. of Japan, Govt. of Balochistan and the Asian Disaster Reduction Centre, Japan for accepting my research topic and giving me the opportunity for doing the research.

I would like to convey my deep sense of gratitude towards the Cabinet Office, Japan, Hyogo Prefecture Government office, IRP, Educational institutions (Kyoto & Nagoya University), the private entities and the other DRR organizations of Japan that helped me in fruitful conduct of my research. During my stay in Japan, I had an opportunity to visit different cultural heritages, DRR structural, non-structural materials, Tsunami tide gages, various waves gates installed in different ocean to counter tsunami, drills/ mock exercises etc. which provided a learning experience for me as I was a part of the community of Chuo ward and could discern how warnings are disseminated in case of emergencies, how disaster is managed and the way people cope with the disaster as well as resilience of infrastructures (communication, electricity etc.) are striking examples for me.

Last but not the least, I am grateful to the ADRC staff who arranged several site visits and facilitated my learning. Special thanks to Mr. Sashara Akio as Executive Director, Mr. Arakida Masaru, Ms. Miki Kodama, Ms. Nakamura San, Dr. Gerald Potutan, Mr. Yamaguchi Naoki, Mr. Ikeda Makoto as Mentors, and Mr. Kawahara san, without their efforts it won't have been possible for me to complete the program and compile this report.

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