



United Nations  
Educational, Scientific and  
Cultural Organization

## Capacity Assessment Study (*DRAFT*)

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An assessment of capacities, gaps and opportunities of Institutions involved in tsunami and other coastal hazards risk preparedness and response in the coastal areas

## **Acknowledgement**

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## Acronyms

DDMA	District Disaster Management Authority
GPA	Gwadar Port Authority
IFRC	International Federation of Red Cross
ISDR	International Strategy for Disaster Reduction
KPT	Karachi Port Trust
MSA	Pakistan Maritime Security Agency
NDMA	National Disaster Management Authority
NDMC	National Disaster Management Commission
NDRF	National Disaster Response Force
NIDM	National Institute of Disaster Management
NIO	National Institute of Oceanography
PCG	Pakistan Coast Guards
PDMA	Provincial Disaster Management Authority
PMDC	Provincial Disaster Management Commission
PMD	Pakistan Meteorological Department
PRCS	Pakistan Red Crescent Society
UNESCO	United Nations Educational, Scientific and Cultural Organisation
UNESCO-IOC	Intergovernmental Oceanographic Commission (IOC) of UNESCO

## Executive Summary

Effective early warning systems not only save lives but also help to protect livelihoods and reduce economic losses. If an effective tsunami early warning system had been in place in the Indian Ocean region on 26 December 2004, thousands of lives would have been saved.

The study documents the existing capacity and institutional arrangement of different Pakistani agencies involved in disaster risk preparedness and response in the coastal areas. The institutions involved in the exercise are National Disaster Management Authority (NDMA), Pakistan Meteorological Department (PMD), National Institute of Oceanography (NIO), Pakistan Navy-Hydrography Department, Provincial Disaster Management Authority (PDMA) Sindh, Gwadar Port Authorities (GPA), Karachi Port Trust (KPT), Pakistan Maritime Security Agency (MSA) and Pakistan Red Crescent Society (PRCS).

Based on President Clinton's initiative in 2005 as the former UN special envoy for tsunami recovery a consortium of UN agencies, coordinated through the United Nations International Strategy for Disaster Reduction (UN-ISDR), provided a framework for an effective Indian Ocean Tsunami Early Warning System that is people-centered and integrates four interrelated elements: (1) knowledge of risks faced, (2) technical monitoring and warning service, (3) dissemination of meaningful warnings to those at risk, and (4) public awareness and preparedness to act. Failure in any one of these elements can mean failure of the whole early warning system.

Even though PMD has recently completed a seismic hazard study, still within disaster management bodies in Pakistan, there is a lack of knowledge and information about hazard identification, disaster risk assessment & management, and linkages between livelihoods and disaster preparedness.

The Pakistan Meteorological Department is mandated by the Prime Minister of Pakistan as the National Tsunami Warning Focal Point and to operate the Tsunami and other sea-level related Hazards Early Warning Centre (NTWC). Since the devastating earthquake and subsequent tsunami on Dec 26 2004, PMD has achieved significant technical and personal capacities and progress in earthquake data monitoring, assessing tsunamigenic earthquakes and issuing related warnings to national disaster management authorities. This is generally known as the "upstream" part of an end-to-end warning system.

Following the National Disaster Management Ordinance (NDMO), Pakistan has integrated a disaster management structure. PMD as National Tsunami Early Warning Centre issues the warning to NDMA, PDMA and relevant DDMA. Warnings are also issued to the Pakistan Navy, KPT, MSA and media. PMD and NDMA have developed their draft standard communication and operating procedures for the Pakistan tsunami early warning system. The key challenge in national end-to-end warning systems maintains to be to timely alert endangered coastal communities while the best warning systems fails if people are not aware of the hazard and prepared to act accordingly.

Response to tsunamis has two components a) activating coping mechanisms (Safe evacuation of people from risk areas, seeking shelter and safely securing assets)

before tsunami strikes, b) post-disaster response implies recovery, rehabilitation and reconstruction efforts in the aftermath of disasters. Activating coping mechanisms is a weak area as DDMA's on ground are not established yet.

To meet the challenges in building a comprehensive early warning system and address the current gaps requires long term action and sustained political, institutional and financial commitment. Key recommendations are to

- Develop an integrated coastal hazards Early Warning System including storm surges and severe wind waves from Cyclones based on existing infrastructure
- Strengthen human and technical capacities for risk identification and analysis
- Ensure risk awareness and preparedness at district and local level for swift warning dissemination and response.

# Background on Capacity Assessment for Tsunami Early Warning System in Pakistan

## *History*

“Effective early warning systems not only save lives but also help protect livelihoods and national development gains. If an effective tsunami early warning system had been in place in the Indian Ocean region on 26 December 2004, thousands of lives would have been saved”<sup>1</sup>.

Pakistan’s coastal zone (Annex-I) is at risk from tsunami generated by earthquakes in the near-by Makran subduction zone. The November 1945 earthquake generated a 12-15 meter tall tsunami, killing at least 4,000 people in Pasni and surrounding areas. Karachi, despite being located approximately 450 km away from the earthquake’s epicentre, still faced 2m high tide-like waves that affected harbour facilities. Gwadar, the new port city, and Karachi, the commercial hub of the country, are most vulnerable to coastal inundation, and in the event of a tsunami, large segments of the population and economic infrastructure will suffer serious losses, thus an End-to-End early warning system is essential to avoid huge human and economic losses.

Two to three years ago the Pakistani early warning capacity was lacking basic requirements in terms of equipment, skills, and resources as detailed in the 2006 National Plan by NDMA. Thus the establishment of a Tsunami Early Warning System in Pakistan serves as a country-based early warning and response system and is needed not only for the protection of citizens and national assets but also to substantially contributing to the Indian Ocean Tsunami Warning System. To assist in this process and part of the UN-ISDR lead IOTWS Consortium Initiative, UNESCO-IOC initiated the project “***Strengthening the Tsunami Early Warning System in Pakistan***”. The overall objective of the project is to assist the Government of Pakistan in strengthening its national tsunami and other ocean-related hazards warning system, as well as the associated preparedness for disaster risks of the most vulnerable coastal areas of Pakistan.

## ***Scope and Methodology of the Study***

Documentation of existing capacity and institutional arrangement of different agencies involved in disaster risk preparedness and response in the coastal areas, in form of a capacity assessment report is one of the expected outcomes of the project.

The institutions involved in the exercise are the National Disaster Management Authority (NDMA), Pakistan Meteorological Department (PMD), National Institute of Oceanography (NIO), Pakistan Navy-Hydrography Department, Provincial Disaster Management Authority (PDMA) Sindh, Gwadar Port Authorities (GPA), Karachi Port Trust (KPT), Pakistan Maritime Security Agency (MSA) and Pakistan Red Crescent Society (PRCS).

Governmental authorities and institutions are assessed to document capacities, gaps and opportunities towards building an end-to-end tsunami early warning system. The

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<sup>1</sup> UN Secretary General Forward to The Global Survey of Early Warning Systems 2006

UN-ISDR framework for early warning systems (discussed in next section) served as the basis and cornerstone of the assessment.

The tools used for the study are desk top review and key stakeholder interviews (KII) (Annex-II). As a first step various national documents such as the National Disaster Management Framework, the Provincial Disaster Planning Guidelines, the District Planning Guidelines and the Provincial Disaster Risk Management Plan for Sindh and Balochistan are reviewed.

To involve the relevant organizations in the process, focal points of above mentioned institutions were interviewed to assess the mandate, capacities and their role in tsunami early warning in particular and in other coastal hazards in general.

## **Legal instruments and Institutional Roles and responsibilities for DRM in Pakistan**

### ***Legislation for Disaster Mitigation and Management***

Disaster Management has been extensively discussed at federal level in Pakistan especially after Kashmir earthquake 2005. The scale of disasters, and frequency of occurrence, has revealed an incompatibility between the existing institutions and the challenges. The legislative framework in this context remains very significant. A brief description of DRM relevant acts and ordinances is given below:

#### ***National Calamities (Prevention and Relief Act) 1958<sup>2</sup>.***

This Act appoints the Provincial Relief Commissioner (also member of provincial Board of Revenue) to be in charge and to ensure maintenance and restoration of law and order in areas affected by calamities and for extending relief to the affected population. It essentially allows for:

- Resource mobilization for handling calamities: hiring of vehicles, earthmoving machinery, requisition of premises or maintenance of relief camps etc.
- Survey of damages and losses occurred as a consequence of a calamity and compensate those affected by the calamities.
- Ensure preparedness for emergencies by setting up a system of alarm and undertake situation specific preventive measures.

National Calamities Act 1958 is more directed towards relief and compensation and does not respond to disaster management as a holistic effort. The Act essentially caters for recurring damages occurring from the flood hazard. It is implemented by the revenue staff, from province to district and down to tehsils (sub-district) level.

#### ***Emergency Services Ordinance 2002***

The ordinance creation of emergency services to deal with threats to the public from modern forms of warfare grouped under the term 'terrorism' and disasters. A national council has been set up to deal with it and to guide and monitor the performance of these services.

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<sup>2</sup> Disaster Management Policies and Systems in Pakistan, for WDCR 2005.

According to the ordinance, the provincial governments shall have the administrative powers during such emergencies. Likewise, the District emergency Officer has been made responsible for the functional management of the service. The Federal government will mainly be responsible for ensuring uniform standards for the service throughout the country, provide advance training to Officers through National Academy and oversee the performance of provinces. Under the Emergency Services Ordinance, the Federal, Provincial and District Governments shall set-up Emergency Service, which shall be responsible for preparedness and rapid response.

### ***Local Government Ordinance 2001***

The LGO provides governance guidelines for the devolved district government, headed by the Zilla (district) Nazim. It is reviewed from DM context, as follows:

#### ***District Governance***

- District Nazim is entrusted with organising relief activities and with land use zoning, and in ensuring implementation of bye laws dealing with public and private housing and construction standards.
- DCO has coordination functions to perform, which includes those for disaster management.
- Village/neighbourhood council deals with water supply, sanitation, watch and ward, tree plantation, care of handicapped and destitute.
- DPO is subordinated to the Nazim but he functions fairly independent of the district government.
- Governance at all levels is entrusted with land zoning, storm water drainage, sanitation and solid waste disposal

#### ***Governance at Tehsil (sub-district)***

- Tehsil Municipal Authority (TMA) has been made an independent entity.
- Tehsil must work in 3 areas: water supply, sanitation and drainage and provision of fire services, independent of the District and receives budget direct from the province.
- Tehsil Nazim has no clear disaster response and management functions.
- Tehsil Revenue Department responds to disasters under the district framework.
- DSP Police works independently under DPO.
- Tehsil governance structure is ill suited for DM

The LGO 2001 does not cover DM comprehensively though it alludes to its various components. The devolved governance structure that emerges is poorly suited for cohesive governance and quick decision making, both essential requisites for handling emergency situations.

### ***National Disaster Management Ordinance, 2006/2007***

The Ordinance provides a basis for legal and institutional arrangements for disaster management at federal, provincial and district levels. The Ordinance has attained permanency under the Provisional Constitution Order (PCO).

The aim is to enable the Federal Government to put in place a comprehensive disaster management system for the entire country, while the Provincial Assemblies of Balochistan, the NWFP, Sindh and Punjab under Article 144 of the Constitution,

passed resolutions authorizing the Federal Government to make legislation on the subject.

The Ordinance focuses on following four aspects

- a. National, Provincial and District Disaster Management institutions
- b. National Institute of Disaster Management (NIDM)
- c. National Disaster Response Force
- d. National Disaster Management Fund

***National Disaster Management Commission (NDMC)***

NDMC is the highest forum for disaster Risk Management chaired, ex-officio, by the Prime Minister. The members include leaders of the opposition in Senate and National Assembly, Federal Ministers for defence, health, foreign affairs, social welfare & special education, communication, finance and interior.

Membership also include the Governor NWFP (for FATA), Chief Ministers of 4 Provinces, Prime Minister of AJ&K, Chief Executive of NAs, Chairman JCSC, and representatives of civil society or any other person appointed by the Prime Minister. The Director General / Chairman of the NDMA acts as ex-officio Secretary to the commission

Key roles and functions of the NDMC are:

- prepare policies and regulations on disaster management
- approve the National Plan
- approve plans prepared by the Ministries/Divisions of the Federal Government in accordance with the National Plan
- develop guidelines for the Federal Government and Provincial Authorities
- arrange for and oversee provision of funds for the purpose of mitigation measures, preparedness and response
- provide support to other countries affected by major disasters, as the Federal Government may determine; and
- take such other measures for the prevention of disaster, or the mitigation, or for preparedness and capacity building for dealing with disaster situation considered necessary.

***National Disaster Management Authority***

The Chairman/Director General of the National Authority is appointed by the Federal Government. The National Authority shall consist of such number of members as may be prescribed and shall include as its Chairperson the Director General.

Key powers and functions of the NDMA are:

- act as the implementing, coordinating and monitoring body for disaster management
- prepare the National Plan to be approved by the NDMC
- implement, coordinate, and monitor implementation of the National policy

- Lay down Guidelines/ give directions to the concerned Ministries or Provincial Governments/Authorities regarding threatening disaster situation / disaster
- for any specific purpose or for general assistance, requisition the services of any person as a Co-opted Member
- promote general education and awareness in the context of disaster management; and
- perform such other functions as the NDMC may require it to perform.

***Provincial Disaster Management Commission (PDMC)***

PDMC is headed by the Chief Minister of the Province as the Chairperson, ex-officio. Membership includes the leader of the opposition and one member to be nominated by him. Other members are nominated by Chief Minister. The Chairperson may designate one of the members as Vice-Chairperson.

Key powers and functions of the PDMC are:

- To formulate the Provincial Disaster Management Policy
- To prepare provincial plan in accordance with guidelines provided by the National Commission
- To approve the disaster management plan prepared by the provincial departments
- To review the implementation of the plan
- To oversee provision of funds for mitigation and preparedness measures
- To review development plans of provincial departments and ensure that prevention and mitigation measures are integrated therein; and
- To review the measures been taken by provincial departments for mitigation, capacity building and preparedness, and issue necessary guidelines/directions.

***Provincial Disaster Management Authorities (PDMA)***

Each provincial government shall establish a Provincial Disaster Management Authority for the province. The Provincial Authority shall consist of such number of members as may be prescribed, and shall include as its Chairperson the Provincial Director General or Provincial Relief Commissioner. There shall be a Director General of the Provincial Authority, to be appointed by the Provincial Government.

Key powers and functions of the PDMA are:

- To formulate the Provincial Disaster Management Policy with the approval of the Provincial Commission
- To coordinate and monitor the implementation of the National Policy, National Plan and Provincial Plan
- To examine the vulnerability of different parts of the Province to various disasters, and specify prevention or mitigation measures
- To lay down guidelines for Disaster Management Plans by the Provincial Departments and District Authorities
- To evaluate preparedness at all Governmental or Non-Governmental levels to respond to disaster and to enhance preparedness
- To coordinate response in the event of disaster
- To give directions to any Provincial Department or Authority regarding actions to be taken in response to disaster

- To promote general education, awareness and community training in this regard
- To provide technical assistance or give advice to District authorities and local authorities
- To advise the Provincial Government regarding financial matters in relation to disaster management
- To ensure prescribed construction standards
- To ensure that communication systems are in order and disaster management drills are being carried out regularly; and
- To perform such other functions as may be assigned to it by the National or Provincial Authority.

***District Disaster Management Authority (DDMA)***

District Disaster Management Authority (DDMA) will be headed by the Nazim as chairperson ex-officio other members are the District Coordination Officer; the District Police Officer, ex-officio; the Executive District Officer Health; and such other district level officers, to be appointed by the District Government.

Key powers and functions of the DDMA are:

- To prepare a Disaster Management Plan including District Response Plan
- To coordinate and monitor the implementation of the National Policy Provincial Policy, National Plan, Provincial Plan and District Plan
- To 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
- To ensure that the Guidelines for prevention, mitigation, preparedness and response measures as laid down by the NDMA and the PDMA are followed by all Departments
- To give directions to authorities at the District level to take all such measures for the prevention or mitigation of disasters as may be necessary
- To lay down Guidelines for preparation of Disaster Management Plans by the Departments and local authorities in the District
- To set up, maintain, review and upgrade the mechanism for early warnings and dissemination of proper information to public
- To prepare, review and update District level Response Plan and Guidelines
- To coordinate with local authorities, and give them Guidelines to ensure that pre-disaster and post-disaster management activities in the District are carried out promptly and effectively.

***National Institute of Disaster Management (NIDM)***

NIDM is tasked to develop training modules, undertake research and documentation in the field of Disaster Management, and organize training programmes. The Institute will formulate and implement a comprehensive Human Resource Development Plan, covering all aspects of Disaster Management. The NIDM will also provide assistance in national and provincial level policy formulation in the field of Disaster Management.

NIDM will develop educational materials for Disaster Management including Academic and Professional Courses and will promote awareness among stakeholders, including

College or School Teachers and Students, technical personnel and others associated with multi-hazard mitigation, preparedness and response measures.

***National Disaster Response Force (NDRF)***

The Ordinance allows NDMA to establish a National Disaster Response Force for the purpose of specialist response to a threatening situation or disaster. The Force shall be constituted in a prescribed manner and the terms and conditions of service of the members of the Force shall be laid down. The general superintendence, direction and control of the NDRF shall vest in the NDMA.

***National Disaster Management Fund***

Under Ordinance, the Federal Government has a provision to constitute a National Disaster Management Fund through Notification, for meeting any threatening situation or disaster.

The Fund shall be financed from the following sources, namely:

- (a) grants made by the Federal Government;
- (b) loans, aid and donations from the national or international agencies;
- (c) donations received from any other source.

NDMF shall be kept in one accounts maintained in local or foreign currency, in scheduled banks in Pakistan and shall be operated in accordance with the directions of the by the NDMA. The Fund shall be administered by the NDMA towards meeting the expenses for emergency preparedness, response, mitigation, relief and reconstruction.

Each Provincial Government shall establish a Provincial Disaster Management Fund. It shall be financed through grants made by the Federal Government/Provincial Governments; loans, aid and donations from the national /international agencies. This Fund shall be used for meeting the expenses for emergency preparedness, response, mitigation, relief and reconstruction in the Province.

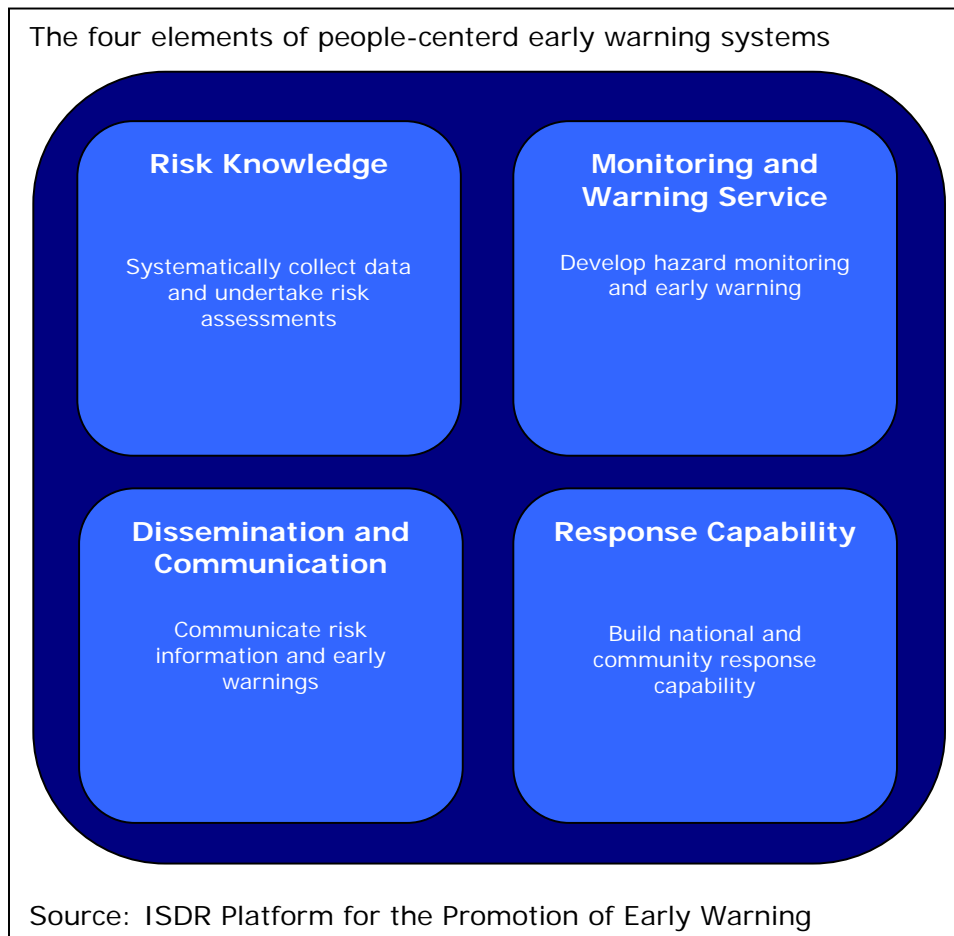
## People Centred Early Warning System-Key Elements

The objective of people-centred early warning systems is to empower individuals and communities threatened by hazards to act in sufficient time and in an appropriate manner so as to reduce the possibility of personal injury, loss of life, damage to property and the environment and loss of livelihoods.

The United Nations International Strategy for Disaster Reduction suggested a framework for an effective tsunami early warning system<sup>3</sup> that is people-centred and integrates four interrelated elements

- 1 Risk Knowledge
- 2 Monitoring and Warning service
- 3 Dissemination and Communication
- 4 Response Capability

A weakness or failure in any one part could result in failure of the whole system.



<sup>3</sup> Global Survey of Early Warning Systems-A report prepared at the request of the Secretary-General of the United Nations by UNISDR

## ***Risk Knowledge***

Risks arise from both the hazards and the vulnerabilities that are present; therefore, we need to ask what the patterns and trends in these factors are. Several activities have to be undertaken to gather knowledge of the communities and localities at risk.

- Hazard assessment:
  - Risk, exposure and vulnerability maps
  - Vulnerability and hazard databases
  - Source location
  - Tsunami scenario databases
  - Simulation, modelling
- Periodically re-evaluate community vulnerability and exposure
- Land use planning and strategies (no further development, redevelopment, open space uses such as parks and agriculture, keep development at a minimum level in hazard-prone areas)

Risk assessments and risk maps help to motivate people, prioritise early warning system needs and guide preparations for response and disaster prevention activities.

## ***Monitoring and warning service***

Warning services lie at the core of the system. They must have a sound scientific basis for predicting and forecasting and must reliably operate twenty-four hours a day. Continuous monitoring of hazard parameters and precursors is necessary to generate accurate warnings in a timely fashion. Warning services for tsunami should be coordinated where possible to gain the benefit of shared institutional, procedural and communication networks.

## ***Dissemination and communication***

Warnings must get to those at risk. For people to understand warnings, they must contain clear, useful information that enables proper responses. Regional, national and community-level communication channels and tools must be pre-identified and one authoritative voice established. The use of multiple communication channels is necessary to ensure everyone is reached and to avoid the failure of any one channel, as well as to reinforce the warning message.

## ***Response capability***

Communities must also respect the warning service and know how to react to warnings. This requires systematic education and preparedness programmes led by disaster management authorities. It is essential that disaster management plans are in place and are well practised and tested. The community should be well informed on options for safe behaviour and on means to avoid damage and loss of property.

## Effectiveness of Tsunami Early Warning Components Capacity and Gaps -

### *Risk Knowledge*

Basis for effective tsunami and coastal hazard early warning is accurate risk assessments showing the potential impacts of hazards on vulnerable communities along the Pakistani coastline. In case of tsunami early warning, sub-sea earthquake hazard assessments are pivotal along with geographic and demographic information.

### **Involved Institutions-Practices and Capacities**

Within disaster management bodies in Pakistan, there is a dearth of knowledge and information about hazard identification, risk assessment & management, and linkages between livelihoods and disaster preparedness.

For Seismic hazard, Pakistan Meteorological Department (PMD) conducted a study<sup>4</sup> and produced a seismic hazard map. The study area was divided into 19 zones in which 1 to 15 are seismic zones, 16 to 18 are faults zones and zone 19 is exclusively for Rann of Kachch (Allah Band fault)



Fig 2: Zone Map for Seismic study

<sup>4</sup> Seismic Hazard Analysis and Zonation for Pakistan, Azad Jammu and Kashmir by PMD and NORSAR Norway July, 2007

The seismicity was modelled through a spatial model and ground motion was computed for 8 frequencies including PGA. Seismic hazard maps in terms of PGA for the annual exceedance rates of 0.02, 0.01 and 0.002 (return periods of 50, 100 and 500 years) for stiff rocks were prepared. These maps are designed to assist in the risk mitigation by providing a general seismic hazard framework.

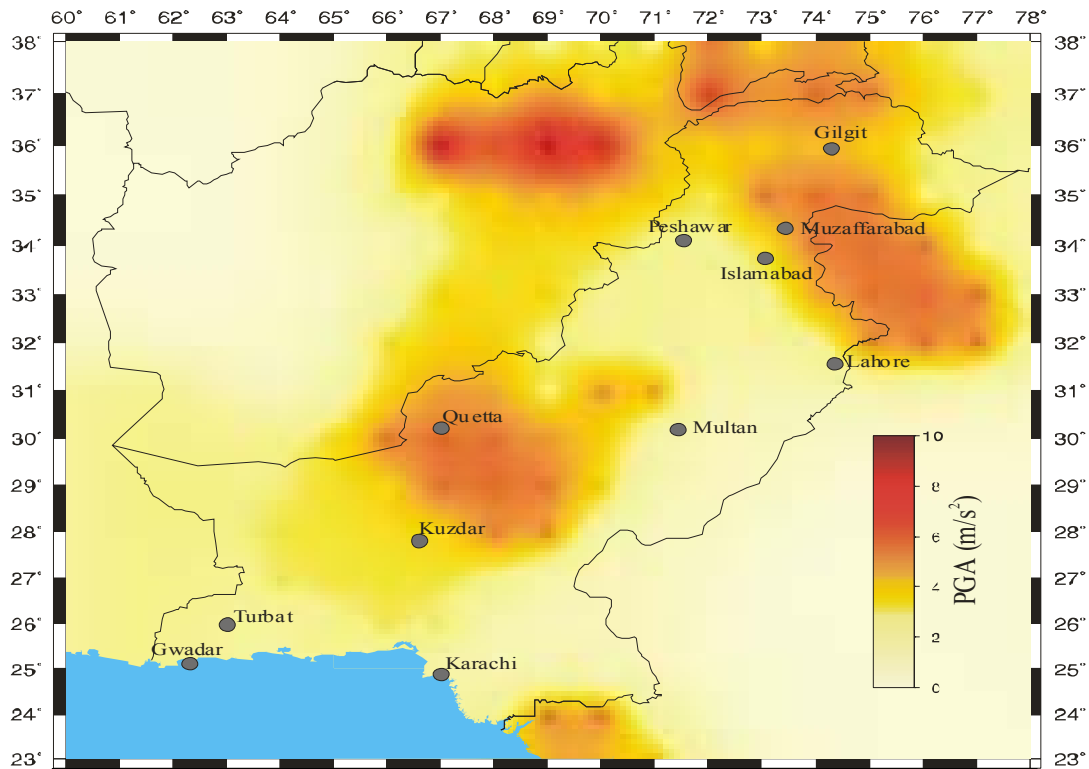


Fig 3: Seismic Hazard Map of Pakistan prepared for PGA for 500 yrs return period  
Source: Pakistan Metrological Department

For tsunami risk assessment along with seismic mapping, bathymetric mapping is also very important. In Pakistan following two institutions are developing bathymetric maps.

- a) Pakistan Navy-Hydrography Department
- b) National Institute of Oceanography

The Pakistan Navy-Hydrography department has high resolution bathymetric data and charts available. They are using both single and multi-beam echosounders for collection of data. Due to strategic and confidential nature of data, these maps are not available for public use, but governmental agencies like PMD, NDMA and PDMAs can access the data through official arrangements.

The National Institute of Oceanography (NIO) is in its early stage for developing bathymetric charts, and possess limited technical and human capacity to complete the task.

As per provincial disaster management planning guidelines, Provincial Disaster Management Authorities (PDMAs) are mandated to prepare risk assessments and provincial mapping. Balochistan Disaster Management Authority has included risk assessments and mapping as key strategy for disaster risk management in the Draft Provincial Disaster Risk Management Plan but very little work is carried out on the subject.

## **Major Gaps in Risk Knowledge**

### ***Data Gaps***

Although significant work has been done in Seismic hazard mapping of Pakistan, still there is a need of a detailed study for Makran subduction. Similarly limited/no work is done on the collection of topographic and demographic data of the Pakistan coastline. This data is very important especially to calculate tsunami inundation and for preparedness planning.

### ***Lack of technical and human capacity in disaster management bodies***

National, provincial and District level disaster management institutions are recently established and do not possess technical and human capacity to undertake risk and vulnerability assessments.

### ***Difficulty in information access and sharing***

Few local and international NGOs have conducted Community level vulnerability assessment on few coastal areas with different objective and perspective, but the integration of already completed assessment in ongoing work is a challenge to limited sharing.

As mentioned before Pakistan Navy-Hydrography department has high resolution bathymetric data and charts available for Pakistan coastal areas but due to strategic and confidential nature of data, these maps are not available for public use.

## Monitoring and Warning Services

For coastal hazards, especially for tsunamis, monitoring and early warning services are vital. The key operational components of a tsunami warning centre is to provide real-time monitoring, alert of seismic and tsunami activities, timely decision making, and dissemination of tsunami warnings, advisories and information.

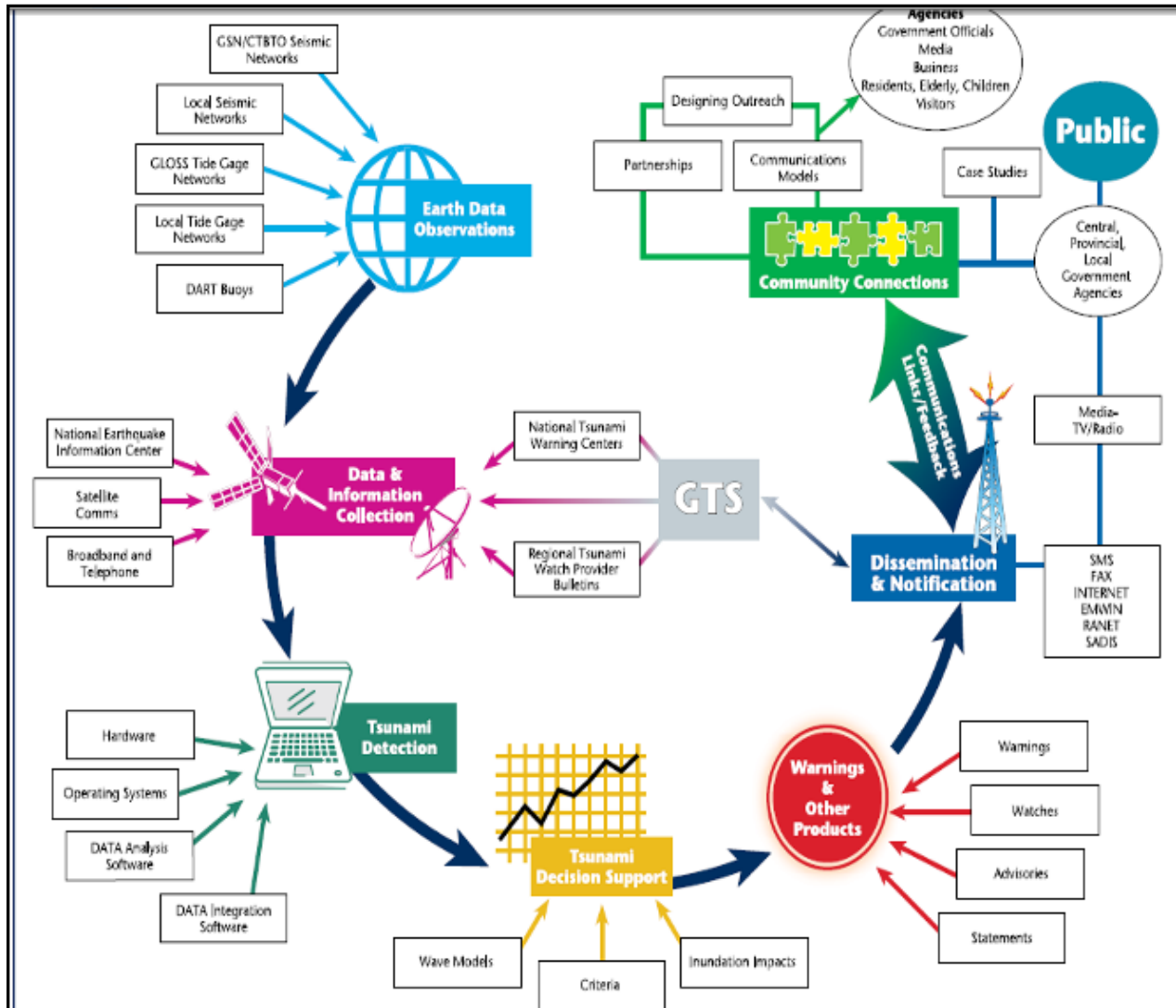


Fig 4: Key Components of a Tsunami Warning Center End-to-End Chain  
 Source: Tsunami Warning Center Reference Guide by USAID

## Involved Institutions-Practices and Capacities

The Pakistan Meteorological Department is mandated by the Prime Minister of Pakistan as National Tsunami Warning Focal Point and operates the national Tsunami Early Warning Centre in Karachi with a back-up centre in Islamabad.

**Earthquake data monitoring:** Earth data observations are part of the hazard detection and forecast component of an end-to-end tsunami warning system. The rapid detection and characterization of tsunami-generating earthquakes provides the first indication of a potential tsunami in an end-to-end tsunami warning system. Initial seismic-based warnings based on data from networks of seismic gages are subsequently refined by the detection of tsunami generated changes in sea level, measured by tide gauges.

The PMD has established a network of 10 Broad-Band land based earthquake monitoring stations at Turbat, Khuzdar, Quetta, Chitral, Muzaffarabad, Gilgit, Bahawalnagar, Umarmkot, Balakot and Zhob and plans to upgrade this national seismometer network to a total of 20 BB stations. Both centres in Karachi and Islamabad installed SeisComp3 as the main earthquake detection software, which will enable the PMD staff to determine the magnitude and location of an earthquake within 3-5 minutes. Similarly, the establishment of a Short-period Seismometers and Strong Motion Accelerometers network is also under way at various locations in Pakistan.

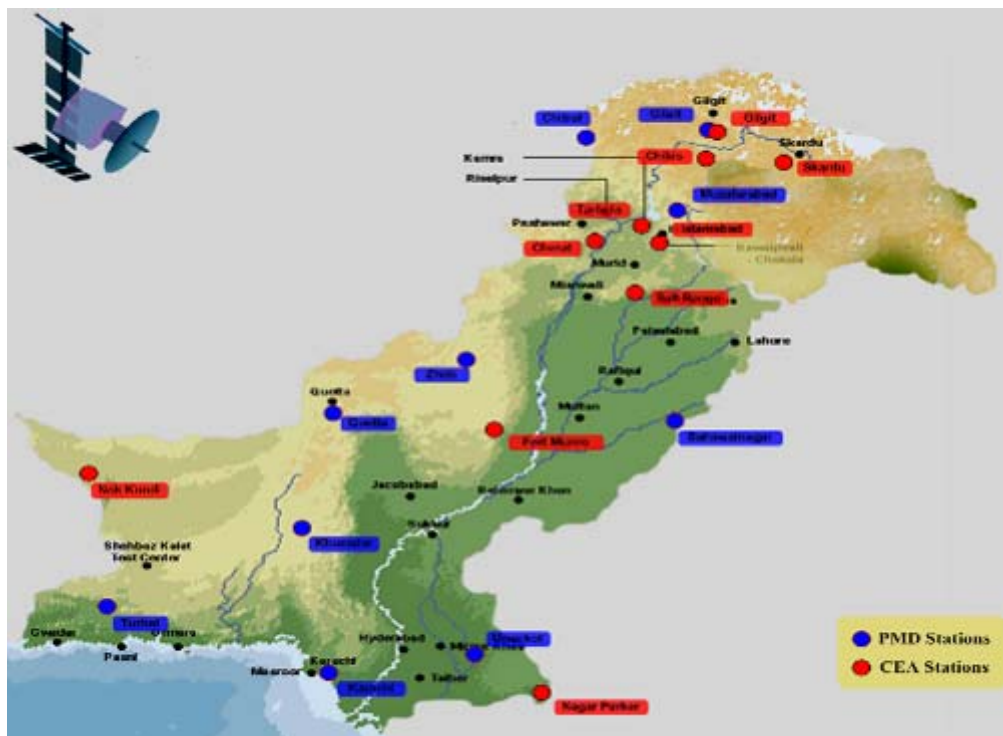


Fig 5: New Seismic Monitoring System of Pakistan Meteorological Department  
Source: Pakistan Metrological Department

***Tide gauge network:*** Currently the National Tsunami Early Warning Centres are connected to one tide gauge available at Karachi Port Trust. KPT has a well set-up and up-to-date Tidal Observatory at Karachi Port. The tide gauge was installed with the assistance of UNESCO-IOC in January 2007. The National Institute of Oceanography (NIO) is maintaining an outdated tide gauge at Gwadar, while the data are not available in real-time and thus can not be used for tsunami early warning purposes.

Funded through the *Strengthening Tsunami Early Warning System in Pakistan* project coordinated by UNESCO-IOC, three new sites i.e. Ormara, Gwadar and Keti Bandar are identified for the installation of new tide gauges. Once installed these tide gauges will be connected to NTWC and transmit sea-level data with a time delay of 1 minute.

The Pakistan Navy-Hydrography Department is the lead agency coordinating the installation of tide gauges in Pakistan. Tidal observatories developed at Gwadar will be managed by Gwadar Port Authorities (GPA) which employs a senior hydrographer to accomplish the task. Tidal observatories at Ormara and Keti Bandar will be operated by the Pakistan Navy-Hydrography Department.

***Analytical Capacity:*** The PMD operates specialized software programmes like SeisComp3<sup>5</sup>, to determine the location and the magnitude of an earthquake, and the Tsunami Decision Support Software GUITAR to predict the potential tsunami arrival time. For the operation of their warning centre PMD still needs more training and capacity building, especially for watch operators.

## **Major Gaps in Monitoring and Warning Services**

### ***No Scenario Data base and inundation models***

The NTWC is in a swift process of evolution, while they already have acquired basic capabilities in earthquake detection and tsunami prediction but they lack in more sophisticated instrumentation/information to confirm a potential tsunami generation. Besides using GUITAR which has the advantage of on-the-fly tsunami propagation modelling, it is advisable for PMD to develop an inundation scenario database for all sea-level related hazards as long as PDMA's do not have the capacity to do so within their mandate to assess the vulnerability and produce risk and evacuation maps.

Response Agencies like PDMA's and DDMA's actually do not possess any capacity for inundation modelling or risk assessment hence they have limited capacity for preparedness and response planning.

### ***Limited and untrained human resource***

Tsunami prediction and preparedness is coming up as a modern/new discipline in Pakistan, thus institutions like PMD, NDMA, PDMA and DDMA's still have limited and insufficiently trained human resources, even though these institutions are filling the gaps by on job trainings, but this is limited to managerial levels. Dissemination and Communication

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<sup>5</sup> SeisComP3 is a specialized software programme developed by scientists at the GFZ which, within minutes, determines the location and the magnitude of an earthquake. In this way several strong earthquakes and their individual parameters could be determined within less than 3-5 minutes.

The main purpose of any warning system is that alerts must reach those who are at risk in a timely manner so that evacuation or countermeasures can still be taken. For the stated purpose redundant dissemination and telecommunication mechanisms must be operational, robust, and readily available, tailored to the needs of a wide range of different user communities. Effective dissemination requires the establishment of a chain of command in advance in order to manage warning issuance and dissemination and ensure that the information provided can be understood by those who need it and reaches all locations affected in the country.

A typical warning dissemination chain involves channelling warnings from technical and scientific sources through government decision makers and the media to multiple receivers who may also function as onward disseminators. Such users include emergency services, security agencies, operators of utilities, information and communication services, other economic service providers and vulnerable communities.

### **aInvolved Institutions-Practices and Capacities**

A typical warning dissemination chain involves channelling warnings from technical and scientific sources through government decision makers and the media to multiple receivers who may also function as onward disseminators. Such users include emergency services, security agencies, operators of utilities, information and communication services, other economic service providers and vulnerable communities.

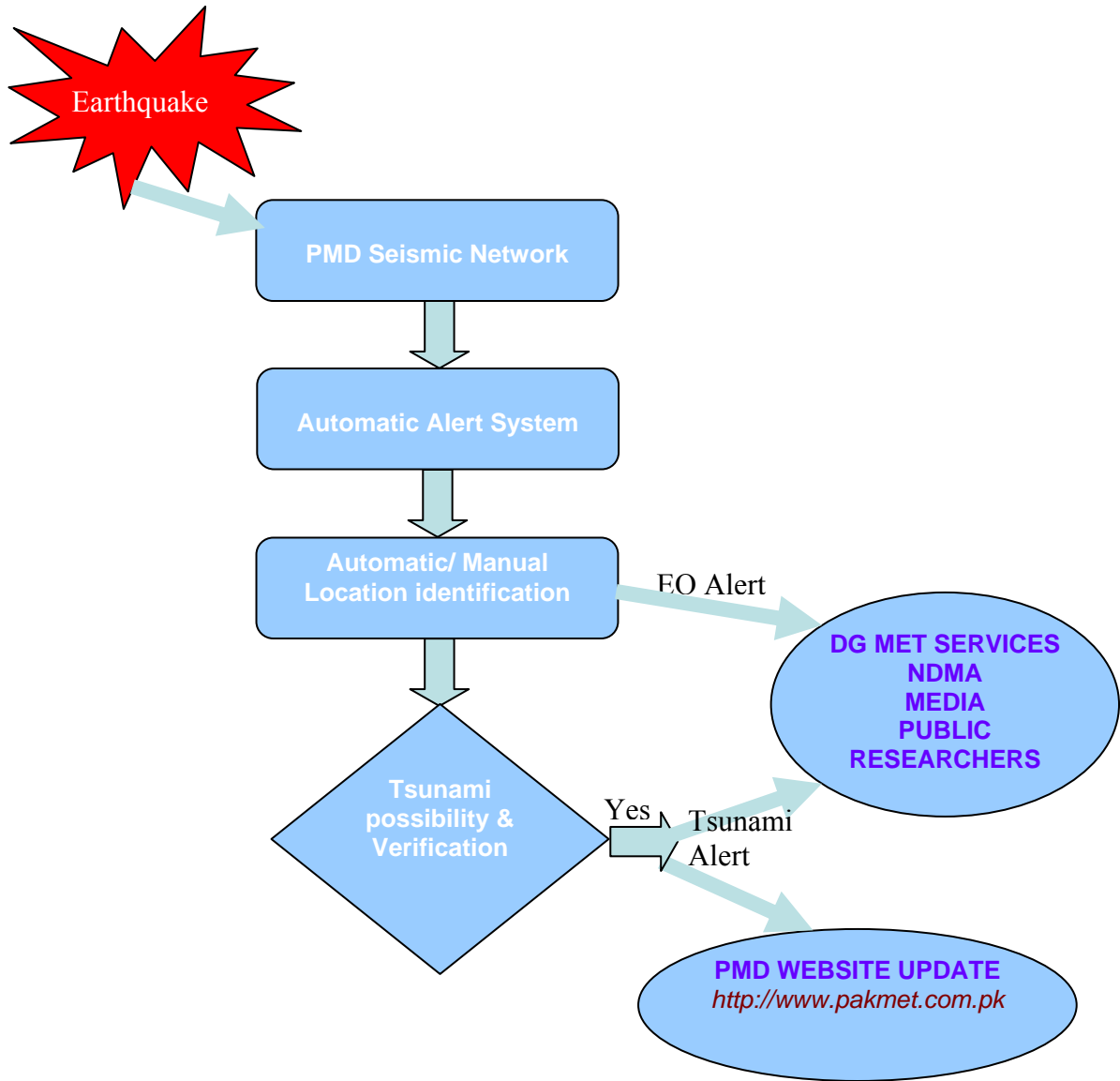
Following the National Disaster Management Ordinance (NDMO), Pakistan has an integrated disaster management structure. PMD with its National Tsunami Early Warning Centre issues the warning to NDMA, PDMA and relevant DDMA. Warning is also issued to Pakistan Navy, KPT, Maritime security agency Pakistan (MSA) and media. PMD and NDMA have developed their draft Standard Operating Procedures (SOP) for end-to-end tsunami early warning system. (Annex-III & Annex-IV)

As *Nav-area 9* coordinator, the Pakistan Navy Hydrography Department issues alert messages for vessels in the area and to MSA.

The District Disaster Management Authorities are responsible for the dissemination of warnings to community level and common public.

Currently the Pakistan Meteorological Department is using fax, email and Short Messaging Service (SMS) as main channels to transmit information and alerts related to earthquake and plans to replicate the practice for tsunami early warnings.

The Role of the media is also very important in dissemination of early warnings even though electronic media, especially private TV channels, are open to issue warning alerts but due to inadequate understanding and little training there is the risk of over-exaggeration and causing unnecessary panic in communities.



PMD early warning communication flow

## **Major Gaps in Dissemination and Communication**

### ***Weak and unreliable mean of communication***

The Pakistan Meteorological Department is using fax, email and Short Messaging Service (SMS) as main means to issue information on earthquakes and plans to replicate the practice for tsunami alert messages, but for the sake of redundancy and the possibility to get quick confirmation on the receipt of warning messages it is recommended to also look into other communication means like radio links.

### ***Lack of communication SOPs at District level***

The district level is the most important tier for action but unfortunately there are no Standard Operating Procedures for communication of Early Warnings in an efficient manner. Most of the disaster preparedness structures and communication means at District level have focused on floods in past, thus they have enough lead time for communication. As in case of tsunami fast and reliable communication is required, currently district authorities do not have SOPs for tsunami early warnings.

### ***Limited understanding of Media on Disaster Early Warning***

The actual warning dissemination from PMD lacks stronger engagement with the media. So far the media are mainly interested in reporting striking news and not necessarily in disseminating useful warnings. Thus, in some cases warnings are interpreted as intriguing news and eventually create even more chaos.

There is a need to carefully draft hazard warnings according to international standards, and to train media personnel on their role and responsibilities.

In this context there is still a need to clearly define roles and responsibilities between PMD and NDMA on informing the media and other governmental bodies in the warning chain.

## ***Response Capability***

Response to tsunami early warning has two components a) activating coping mechanisms (Safe evacuation of people from risk areas, seeking shelter and safely securing assets) before tsunami strikes, b) post-disaster response implies recovery, rehabilitation and reconstruction efforts in the aftermath of disasters. However, both are part of disaster preparedness and employ common emergency procedures. The success of early warning depends on the extent to which it triggers effective response measures and therefore warning systems should include preparedness strategies and plans to ensure effective response to warning messages<sup>6</sup>.

### **Involved Institutions-Practices and Capacities**

A number of government institutions currently working on disaster risk Response in coastal areas of Pakistan include:

<b>Phase</b>	<b>Agency</b>
<b>Response</b>	
	Armed Forces (Pakistan Navy & Coast Guard)
	Pakistan Maritime Agency
	Civil Defense
	Emergency Relief Cell
	Fire Services
	National Crisis Management Cell (NCMC)
	Police
	Provincial Communication and Works
	Provincial Food Departments
	Provincial Health Departments
	Provincial Relief Commissioners
	Provincial Agriculture and Livestock Departments
	Rescue 1122
<b>Recovery &amp; Reconstruction</b>	
	National Disaster Management Authorities (NDMA)
	Provincial Disaster Management Authorities (PDMA)
	District Disaster Management Authorities (DDMA)
	Local level NGOs and Civil Society

<sup>6</sup> Global Survey of Early Warning Systems-A report prepared at the request of the Secretary-General of the United Nations by UNISDR

The National Disaster Management Ordinance, 2006/2007 confirms the mandate to DDMA to coordinate with local authorities, providing guidelines to ensure that pre-disaster and post-disaster management activities in the District are carried out promptly and effectively. The Provincial Disaster Management Authorities Sindh and Balochistan are evolving but still they have to go a long way until full operational functionality. Similarly DDMA are weak entities yet and lack resources in both, in financial and human resources aspects.

Due to their capacities, outreach potential and presence in the area Pakistan Navy and Pakistan Coast Guards are two very important institutions in terms of response and early recovery.

The Pakistan Navy was successfully involved in the rescue and relief operation during cyclone YEMEN 2007. After the tsunami tragedy that struck on December 26, 2004 Pakistan sent Navy vessels to Sri Lanka and the Maldives to assist in the relief operation. The Pakistan Navy has its navel bases and installations in Karachi, Port Qasim, Ormara (Jinnah Navel Base), Pasni, Gwadar and Jiwani, and thus they have response forces all along the coast.

The Pakistan coast guard is basically responsible for executing the national maritime law, maintenance of seamarks, border control, anti-smuggling operations, and other related services. The agency has their field presence in areas of Uthal, Korangi, Gawadar and Pasni thus could be one of very first response agencies in the area.

Participation of local and international Non Governmental Organization (NGOs) is pivotal for response. Pakistan Red Crescent Society, Sindh is a member of PRCS and has a set-up for emergency response. It has offices in 18 districts and 4 District Management Cells in Thatta, Badin, Dadu and Khairpur Districts. Each Cell has one Disaster Management Officer, one Guard and an office equipped with a cell phone, a land-line phone and a computer. In addition, it has established an Emergency Response Team (ERT) comprised of local volunteers (min. 12) in all vulnerable districts. ERTs are in place at three levels: District, Union Council and City.

## **Major Gaps in Response Capability**

### ***Lack of Resources at local level***

The foremost challenge is financial resource need. The district governments have limited capacities to generate local resources to finance development schemes, such as on disaster management. They are dependent on budgetary allocations/grants from the Provincial Governments. On the other hand, the Provincial Governments are themselves faced with the challenge of huge budgetary deficits and finding it hard to spare enough resources for the District Governments for implementation of development schemes in the field of disaster management.

The second major challenge is the deficiency of institutional capacities and expertise at the local level to implement the Policies and Plans in letter and spirit. The local departments personnel lack requisite professional know-how, skills, equipment or

resources to plan or respond to the impending challenges of a disaster with a scientific approach<sup>7</sup>.

***Lack of multi-agency collaboration and clarity of roles and responsibilities at national to local levels***

NDMA and PMD are two agencies collaborating at National level and have developed their Standard operating procedures for Tsunami Early Warnings, but at the provincial and district level either response plans are not prepared or response plans often do not work due to lack of coordinated reaction among the main actors. The lines of responsibility and authority need to be clearly set to ensure effective coordination and implementation of response plans.

***Lack of public awareness and education for early warning***

There is a need to develop response plans in coastal districts but most importantly these plans need to be communicated to the public. Public information is limited on coastal hazards. Recently NDMA has conducted a sole evacuation drill for tsunami in the Gwadar area, while till date but there is a dire need to regularly practice these preparedness plans. This is a challenge to enhance effectiveness of early warning.

***Need for a participatory approach and inclusion of indigenous local knowledge***

There is a limited understanding in communities on the risk in case of any coastal hazard, even with local authorities and thus even a wide spread warning often fails to induce the required response. This is commonly due to lack of community participation which also explains why most plans miss indigenous knowledge and local survival and preparedness strategies.

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<sup>7</sup>

## **Towards End-to-End Tsunami Early**

### ***Conclusion***

Effective early warning systems are the basis for a most practical and cost effective disaster preparedness strategy. In case of the national Tsunami Early Warning System the Pakistani Government has progressed considerably, but for other coastal hazards such as Tropical cyclones, extreme waves and storm surges causing coastal inundation more work has to be carried out to ensure a multi-hazards framework for early warning in Pakistan.

The current status and progress in the four essential components, namely: risk knowledge, monitoring and warning services, dissemination and communication and response capability, of the tsunami early warning system is unevenly distributed. Recently good progress has been made in the identification; monitoring and prediction (risk knowledge phase & monitoring and warning phase) but warning communication methods and response activities are still areas for improvement.

To meet the challenge in building a comprehensive early warning system and address the gaps that are currently present requires long term action and sustained political, institutional and financial commitment. The development and maintenance of tsunami early warning systems is resource-intensive whereas the occurrence period of 70-100 yrs entails the threat that the current efforts may not be sustained over a period of time.

### ***Recommendations for Action***

#### ***Recommendation 1: Develop an integrated coastal hazard Early warning System.***

It is important to develop capacities for early warning on tropical cyclones as cyclones are a frequent threat mainly to Balochistan and Sindh causing lots of lives and damage. Thus an appropriate early warning systems for coastal hazards should be integrated into the existing NTWC so that efforts and resources for developing dissemination channels and technical information sharing are not duplicated.

#### ***Recommendation 2: Develop human and technical capacities for risk identification.***

1. Develop a systematic plan to strengthen human and technical capacities for coastal hazard early warning system
2. Conduct detailed study of the Makran Subduction zone to improve risk mapping of the area
3. Develop capacities in inundation modelling and prepare inundation maps of endangered coastlines for tsunami. This will help in preparedness and planning

#### ***Recommendation 3: Strengthen capacities at local level for warning dissemination and response.***

1. Develop clear warning dissemination SOPs at district level and conduct public information campaigns
2. Develop practical response plans at provincial and district levels
3. Develop a reliable communication network between NTWC (PMD) and response agencies

Annex I: Map of Pakistan Coastal Area



## Annex II: Capacity Mapping Matrix

	Sno	Mandate	Role	Capacity		Linkage
				Existing	Gaps	
	National warning Center					
1.	Pakistan Metrological Department					
2.	Hydrography Dept-Pakistan Navy					
	Disaster Management Offices (DMO)/Local Authorities					
3.	NDMA (including PDMAAs & DDMAAs)					
4.	Local Government (Zila & Tehsil Administration)					
5.	Crisis Management Center					
6.	Police Services					
7.	Pakistan Army					
8.	Maritime Security					
	Emergency Services					
9.	Local Hospitals					
10.	Pakistan Navy					

11.	Pakistan Army					
12.	Pakistan Police					
13.	Fire Brigade Department					
14.	Non government Organizations					
15.	Coast Guards					
16.	Pakistan Red Crescent Society					
17.	Civil Defence					
18.	Scouts Movement (Boy Scouts, Girl Guides)					
19.	White Scouts					
20.	National Volunteer Network					
	Media					
21.	Electronic Media (TV Channels, Radio)					
22.	PTCL, NTC					
23.	Mobile Telephone Network					
	Public					

**Annex III: Tsunami Warning Center SOPs-PMD**

Sr. No	Time (Min)	Activity	ACTION	COMMUNICATION
1	00	EARTHQUAKE ALERT	Duty staff Alert each person at disk. Each of the shift duty person is clearly defined of their work.	
2	05	EARTHQUAKE AND / OR TSUNAMI BULLETION NO-1 <b>(Preliminary analysis)</b> <i>ANNEX-2 FORMAT OF THE Earthquake BULLITION</i> <i>Annex-3Format of Tsunami bulletin</i>	Use criteria for evaluation of Tsunami threat which includes magnitude location depth etc 1- If below threshold Earthquake bulletin 2- In case of crossing threshold Tsunami Advisory  <b>Magnitude</b> $\geq 7.5$ <b>Depth</b> $< 50$ Km <i>Location in between</i> <b>Latitude</b> 22oN and above <b>Longitude</b> 55oE To 80oE	One staff member deputed to communicate the bulletin to the agencies NDMA, NAVY, KPT, MSA, MEDIA etc. <i>(ANNEEX-4 List of contact details of all the stockholders of disaster management and response agencies. Also Briefing to DG Met about issuance of preliminary bulletin.</i>
3	06	Tide gauge data would be received from tide gauge network.	This data will be used for confirmation of tsunami generation or otherwise.	
4	08	1- Re-evaluation of Parameters starts before issuance of 2nd bulletin. 2- Tsunami travel time estimation starts.	Duty personal are deputed to compute the revised earthquake parameters. Based on revised parameters 2nd bulletin will be for confirmation or cancellation.	

			One person is assigned special task to calculate the time to reach shoreline using tables accounting for location depth and magnitude criteria.	
5	10	Tsunami bulletin No-02 (Alert) Annex-4(A) And Annex -5 Or (Cancellation)	Automatic evaluation is revised and bulletin is issued. If parameters are above threshold level warning will be issued. As impact time is calculated above this bulletin defines impact time for all coastal cities If Parameters are not satisfying the threshold value a cancellation of the Tsunami Bulletin will be issued	Communicated to all agencies with clear message about warning and time of impact.
6	12	1. Numerical models 2. Sea level data	Numerical models are developed with pre-planned scenarios in order to compute arrival time. Continuous monitoring of sea level data obtained from tide gauge network.	
	14	Decision making for the issuance of Tsunami bulletin No-03	Revised magnitude, Depth, Location, Focal parameters are combined with sea level data to make decision about	Careful study of all the available parameters will enable the duty seismologist to make this decision of Upgradation or downgrading or even cancellation of the Tsunami Bulletin No-02

			upgrading or downgrading the warning.	
7	15	Tsunami bulletin No-03 (Warning) Annex-5	Contains the data of wave arrival time based upon tide gauge data and numerical models	To All agencies DG Met briefed about the situation and revised parameters or cancellation

**Annex IV: Tsunami Emergency Response SOPs-NDMA**

**Tsunami Emergency Response  
Standard Operating Procedures**

**1. Decision Making Process**

**Normal Situation**

	<b>National</b>	<b>Provincial</b>	<b>Districts</b>	<b>Means of Communication and Decision Making</b>
Activation of Emergency Operation Centre	Chairman NDMA	DG, PDMA	DCO	Phone, Fax, Wireless In consultation with members of DDMA
Evacuation Instruction	Chairman NDMA to advise/coordinate	DG, PDMA to advise/monitor DCOs	Concerned DCO makes decision	Direct Decision
All Clear Instruction	Chairman NDMA	DG, PDMA	DCO	Phone, Fax, Wireless After coordination meeting

**In the Absence of Head of Organizations**

	<b>National</b>	<b>Provincial</b>	<b>Districts</b>	<b>Means of Communication and Decision Making</b>
Activation of Emergency Operation Centre	Senior Member, NDMA	Acting DG, PDMA	Acting DCO	Phone Fax Wireless In consultation with members of DDMA
Evacuation Instruction	Senior Member, NDMA	Acting DG, PDMA	Acting DCO	Direct Decision
All Clear Instruction	Senior Member, NDMA	Acting DG, PDMA	Acting DCO	Phone, Fax Wireless After coordination meeting

## 2. Checklist for Use When Receiving Warning Messages

Checklist to use when receiving warning messages			
Events / Actions	Organizations Agencies Responsible:	Actions / Follow up Actions	Duration of Activity
Natural Warning (00:00)	DDMA	DCO activates emergency centers	+5 minutes
Confirmation of Location (00:03)	DDMA	Duty officer gets confirmation from PMD about the location of the earthquake	+3 minutes
Destructive Tsunami warning received from PMD (00:10)	DDMA	DCO to make a decision about evacuation	+12 minutes
Dissemination of information to relevant stakeholders about possible tsunami (00:12)	DDMA	Emergency Centre Incharge to disseminate warning about possible tsunami to Police, health, civil defense, revenue dept., agriculture, mosques, TMAs, Army, Navy, Air force, coast guard, MSA, Fisheries dept., port authorities, local FM radio, media	+12 minutes
Evacuation announcement (00:15)	Civil Defense	Civil Defense sounds siren Announcement for evacuation through notable and media Mosques	3 ~ .. minutes

### 3. Time Line Emergency Response

Minutes after Earthquake	Activities	Agencies Responsible	Comments	Actions to be taken
0 – Strong ground shaking felt	Take cover to a save place			
00:03 – 00:05	Activate Emergency Operation Centre	DCO DDMA	<ul style="list-style-type: none"> <li>○ Duty Personnel to follow SOP</li> <li>○ Call Contact persons of EOC</li> </ul>	
00:03 – 00:05	Try to get Confirmation of location of Earthquake to PMD	Officer on Duty	Get in touch with PMD to confirm if the earthquake has the potential to generate Tsunami	
00:07 – 00:10	Received formal information from PMD on Tsunami generation Information	PMD Officer on Duty DCO DDMA NDMA PDMA	Check SOP on Assembling EOC members	<p>DDMA to develop a standard warning message</p> <p>DDMAs to develop phone tree</p> <p>Need to develop FAQ's for use during emergency to respond to media.</p>
00:10	DCO makes decision on Evacuation	DCO	Follow SOP	
00:10 – 00:12	Evacuation plan activated	DCO DDMA Members of EOC	Follow SOP	
00:10 – 00:30	EOC member assemble in EOC Office	DCO DDMA EOC Members		
00:10 – 00:15	Evacuation Announcement	Civil Defense Media Mosques Notables	<ul style="list-style-type: none"> <li>○ Sound Siren system</li> <li>○ Loudspeakers</li> <li>○ Other means of public announcement</li> <li>○ Phones</li> </ul>	
00:15 -	Evacuation Process	Civil Defense, Police Revenue TMA Volunteer		
00:20 ~	Evacuation / Camp Management Activities	Camp Management		

<b>Minutes after Earthquake</b>	<b>Activities</b>	<b>Agencies Responsible</b>	<b>Comments</b>	<b>Actions to be taken</b>
----- XX:XX	Cancellation of tsunami impact	PMD DCO DDMA PDMA NDMA		

## 4. Evacuation Checklist

<b>Checklist to use when doing an evacuation</b>			
<b>Events / Actions</b>	<b>Organizations Agencies Responsible:</b>	<b>Actions / Follow up Actions</b>	<b>Minutes</b>
<b>Evacuation Announcement (00:15)</b>	<b>Civil Defense</b>  <b>DDMA and TMAs</b> <b>DDMA</b>	<b>Sound Siren</b>  <b>Announcement through available loud speakers</b>  <b>Same announcement is disseminated through media</b>	<b>3 minutes</b>
<b>Mobilisation of law enforcement agencies, community volunteers</b>	<b>Police</b>  <b>Revenue Staff</b>	<b>Traffic management and traffic diversion</b>  <b>Provide transport and guide the community to the safer location.</b>	
<b>Hospital evacuation if in inundation zone</b>	<b>LEAs</b>		
<b>School Evacuation (during school hours)</b>	<b>School Management</b>	<b>Principal/head master and teachers responsible for evacuation of the students to the safer location or vertical evacuation (if building is safe).</b>	
<b>Port authorities to move the ships</b>			
<b>Camp management activated</b>	<b>DDMA</b> <b>Army</b> <b>Navy</b> <b>NGO</b> <b>Red Crescent</b>	<b>Shelter</b> <b>Watsan</b> <b>Kitchen</b> <b>Mobile health</b>	

## 5. Roles & Responsibility

(“P” = Primary / Coordinating Role; “S” = Support Role)

AGENCY( SOP NDMA)	CONTACT INFO	EVACIATOPM	LAW ENFORCEMENT	FIRE SUPPRESSION	RELIEF CENTRE MANAGEMENT	MEDICAL SERVICES	COMMUNICATION	SEARCH AND RESCUE	SOCIAL SERVICES	TRANSPORTATION	HUMAN RELIEF	WARNING COORDINATION	PUBLIC INFORMATION	FINANCE AND ADMINISTRATION
														P
PDMA Sindh & Baluchistan	DGs	S	S	S	S	S		S	S	S	S	P		P
Pakistan Navy		S	S	S		S		S			S	S		
Pakistan Army		S	S	S		S		S			S	S		
Pakistan Air force		S				S		S			S	S		
Pakistan Coast Guards		S	S					S			S	S		
Pakistan Rangers		S	S					S			S	S		
Maritime Security Agency								P			S	S		
Police		S	P		S			S		S	S	S		
Civil Defense, Sindh		S	S	S	S			S	S		S	P		
Health Dept					S	P			S		S			
Fire Section & TMA		S		P	S	S				S	S			
Social Welfare Dept.									P					
DG Ports and Shipping			S											
KPT		S		S		S		S				S		





## Annex V: Institutional Capacity Mapping

Institution Name	Mandate /Capacities	Gaps	Recommendation
National Disaster Management Authority (NDMA)	NDMA is responsible for coordinating and facilitating the implementation of strategies and programmes on disaster risk reduction, response and recovery, Its mandate covers the coordination and management of the whole spectrum of disaster risk management; i.e. mitigation, preparedness, response and recovery. NDMA provides technical guidance to national and provincial stakeholders about formulation of plans, strategies and programmes for disaster risk management. NDMA also works to build capacity of national, provincial and local stakeholders.	<p>Given the structure of NDMA, it does not have field presence and have minimal control over PDMAs and DDMA's.</p> <p>NDMA and PMD both are interacting with media to disseminate warnings, it is important there is a single focal point for warning dissemination.</p> <p>Limited human resource is a key issue, most of the staff of NDMA is on deputation from other departments, if that staff may go back to their relevant departments, NDMA will face serious capacity and knowledge gaps.</p>	<p>NDMA has to work more closely with PDMAs and DDMA and can formulate technical/coordination committees at national level for various hazards involving PDMAs.</p> <p>NDMA and PMD have to coordinate on their SOPs with each other and duplication can be addressed and single focal point can be agreed.</p>
Institution Name	Mandate /Capacities	Gaps	Recommendation
Pakistan	Pakistan Meteorological Department is both	PMD staff needs trainings and	PMD should map current and

<p>Metrological Department (PMD)</p>	<p>scientific and a service department, it functions under the Ministry of Defense. After 2004 Indonesian Tsunami, PMD is mandated by Govt. of Pakistan as National Tsunami Early Warning Center. Pakistan Metrological Department has established two national tsunami centers one in Islamabad and other in Karachi. The warning center in Karachi is 24x7. PMD has draft SOP for tsunami early warnings.</p> <p>The PMD has established 10 Broad-Band land based earthquake monitoring stations at Turbat, Khuzdar, Quetta, Chitral, Muzaffarabad, Gilgit, Bahawalnagar, Umarnkot, Balakot and Zhob. SeisComp 3 software is installed at both centers in Karachi and Islamabad, which will enable the PMD staff to detect and analyze seismic events to determine the magnitude, epicenter, etc. of an earthquake. Establishment of a Short-period Seismometers and Strong Motion Accelerometers network is also under way at various locations. PMD has also installed Tsunami Decision Support system GUITAR, which is linked with SeisComp3 and can calculate Tsunami arrival time.</p>	<p>exposure, because current staff has different academic background like Seismology, Physics, and computer sciences especially on duty operations needs specialized trainings as they are 1<sup>st</sup> recipient of any information.</p> <p>Week linkages with relevant response and dissemination channels and institutions</p>	<p>future needs for the efficient operations of National Tsunami Warning Centers especially in terms of human and technical resource. For development of HR should initiate a comprehensive training programme with emphasis on training of duty operators.</p> <p>Regular testing and up gradation of dissemination SOPs is required, it is also recommended that PMD invite dissemination and response related stakeholders (like media, PDMA's and DDMA's) to National Warning Center to build long term institutional linkages.</p>
<p><b>Institution Name</b></p>	<p><b>Mandate /Capacities</b></p>	<p><b>Gaps</b></p>	<p><b>Recommendation</b></p>
<p>National Institute of Oceanography (NIO),</p>	<p>The National Institute of Oceanography (NIO) is located in Karachi. It was established in 1981 by the Ministry of Science and Technology, Government of</p>	<p>National Institute of Oceanography has limited funds and human resources. There technical capacities in</p>	<p>NIO should map current and future needs as a stakeholder of Tsunami Early Warning Chain in terms of human and</p>

	<p>Pakistan (MoST). The main area of research of the Institute is the north Arabian Sea and beyond. Oceanographic research brings together all the scientific disciplines needed to study the ocean: physics, chemistry, biology, geology &amp; geophysics, ocean technology, coastal hydraulics &amp; coastal zone management. NIO is also one of the key institutions who will manage tide gauge network on Pakistan coast line. They are operating a tide gauge at Gwadar but it is not GLOSS type.</p>	<p>physical oceanography are very weak. Currently NIO did not possess the capacity to operate, manage and upgrade tide gauge network along coastline of Pakistan.</p>	<p>technical resource. For development of HR should initiate a comprehensive training programme with emphasis on training of tide gauge managers.</p> <p>Develop strong linkages with Pakistan Navy-Hydrography department to work jointly on bathymetric data of Pakistan Coast.</p>
<b>Institution Name</b>	<b>Mandate /Capacities</b>	<b>Gaps</b>	<b>Recommendation</b>
Pakistan Navy-Hydrography Department	<p>Pakistan Navy Hydrographic Department as a National Hydrographic Organization is primarily responsible for conducting hydrographic surveys of coastal and offshore waters of Pakistan and publishing nautical charts and relevant publications. Pakistan is an active member of</p>	<p>Weak Linkages and less information and data exchange with civilian institutions.</p>	<p>Develop better institutional linkages with all stakeholders of end to tsunami warning chain through technical cooperation and information exchange.</p>

	<p>International Organizations, such as IHO and IMO who are dealing with subjects related to Hydrography, Oceanography and safety of life at sea. Pakistan Navy Hydrographic Department has the following components: a) Hydrographic Offices at Islamabad and Karachi b) Survey Vessel BEHR PAIMA c) Hydrographic School d) Charting Center and Hydrographic Press e) Chart Depot f) Headquarters Navarea-IX g) Electronic Charts Division</p> <p>To ensure the highest possible levels of maritime safety, the world is divided into sixteen broadcast areas, called NAVAREAs. The responsibility of coordination of NAVAREA IX was assigned to Pakistan. Hydrographer of the Pakistan Navy (HPN) is the area Coordinator. All information relating to navigational safety is received in HPN office at Karachi from 16 National Coordinators of Area IX and from other sources. This information is analyzed, processed and promulgated in the form of navigational warnings to mariners at sea.</p>		
<b>Institution Name</b>	<b>Mandate /Capacities</b>	<b>Gaps</b>	<b>Recommendation</b>
Provincial Disaster Management Authority (PDMA) Sindh,	The Government of Sindh established Provincial Disaster Management Authority (PDMA) through a notification issued on 01 August 2008. The authority was established under section (i) of section 15 of the National Disaster Management Authority (NDMA) Ordinance, promulgated by the President in December 2006.	<p>PDMA Sindh is in its infancy and facing the problems of a newly established institutions like limited human resource, lack of funds, weak linkages.</p> <p>Limited Human resource is the major gap, currently PDMA Sindh has only 4 staff</p>	PDMA Sindh has prepared Provincial Disaster Risk Management Plan (PDRMP), which also discuss costal hazards and its response plan, PDMA Sindh should concentrate on implementation of PDRMP.

	<p>The PDMA is mandated to coordinate a complete spectrum of disasters in the province and formulate a provincial disaster risk management plan in addition to continuous monitoring of hazards, risks and vulnerable conditions within the province. It will also prepare guidelines and standards for provincial and local stakeholders regarding their role in disaster risk management besides ensuring preparation of disaster risk management plans by all districts in the province.</p> <p>The Provincial Disaster Management Authority (PDMA) has also been entrusted with the task of promoting education, awareness and training on disaster risk reduction and response and provide necessary technical assistance and advice to local authorities for carrying out their functions effectively</p>	<p>members, even though authority has requested for adequate budgets to address the issue.</p> <p>Weak linkages with other institutions and District Disaster Management Authorities are also witnessed.</p>	
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