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Final Research Report

"MAKING GWADAR A SUSTINABLE CITY OF PAKISTAN"
(A CASE STUDY FOR EARTHQUAKE AND TSUNAMI)

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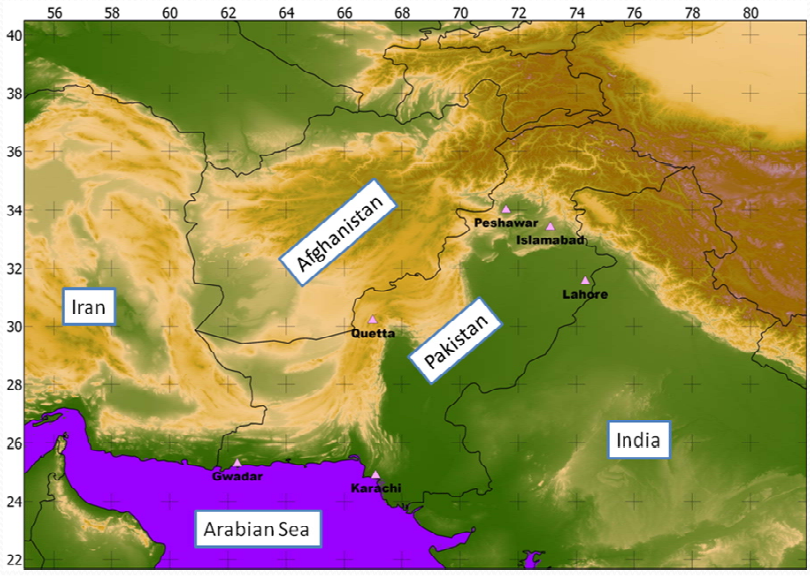
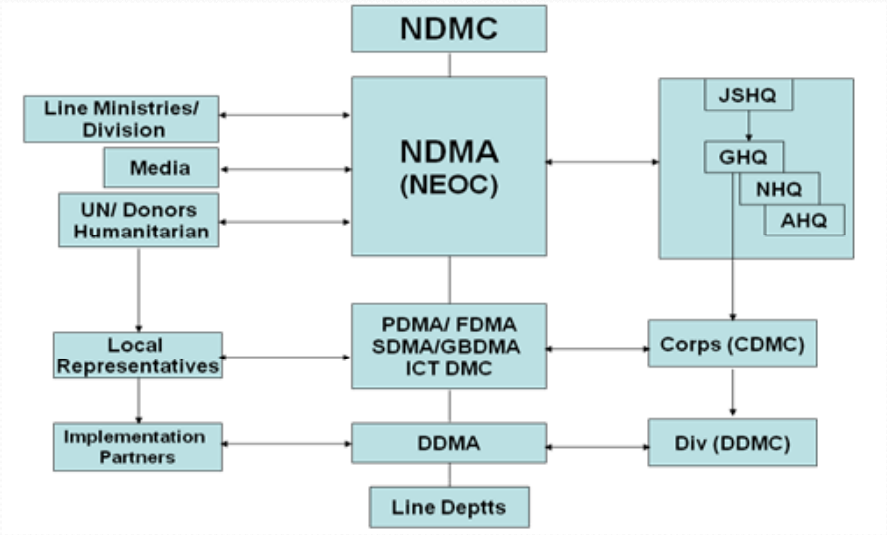
Visiting Researcher (August-November), ADRC Kobe, Japan

Pakistan's Location and Its Main Cities including Gwadar



- Gwadar is located at coast of Pakistan in Balochistan province
- It is situated near to Persian Gulf , Eastern European and Western Asian countries
- It is expected that Gwadar will become economic hub, modern port and modern city in near future.
- Opportunity to develop Gwadar a safe city

Disasters Management in Pakistan



Structure of Disaster Management of Pakistan

Role of Pakistan Meteorological Department (PMD) in Disaster Risk Reduction

- PMD established **Specialized Early Warning Centers**
  - National Weather Forecasting Center Islamabad (NWFC)
  - Marine Meteorology & Tropical Cyclone Early Warning Center Karachi (TCWC)
  - National Drought Monitoring Center Islamabad (NDMC)
  - National Seismic Monitoring and Tsunami Early Warning Center Karachi (NTWC)
  - Flood Forecasting Division Lahore (FFD)
  - Flood Forecasting and Warning System for Lai Nullah Basin Islamabad
- PMD providing guidelines for hazards, risks and vulnerability assessment , seismic hazard analysis of various cities, tsunami modeling , created flood hazard maps.
- PMD launched District-wise Phone Based Weather Information Service in August, 2015.

Disasters Management in Japan

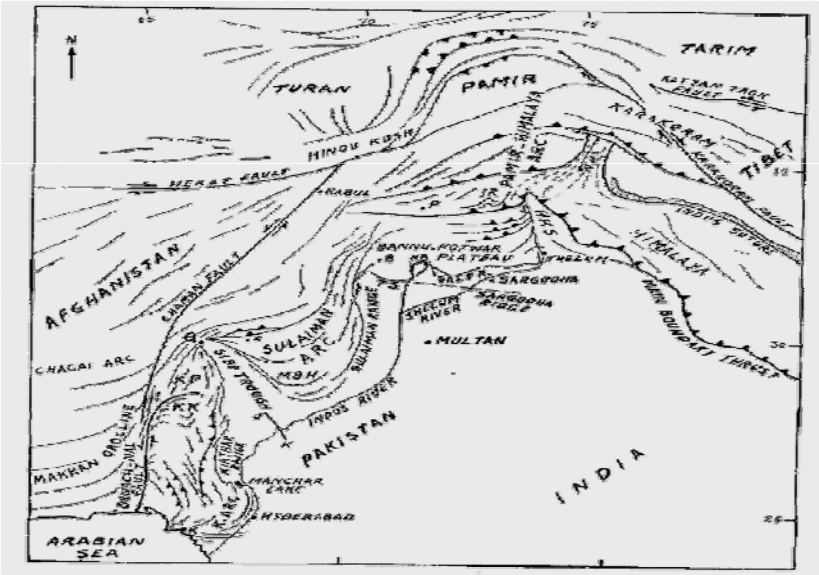
Disaster Management System of Japan

Role of Asian Disaster Reduction Center (ADRC) in Disaster Risk Reduction

ADRC established in Kobe Hyogo Prefecture in 1998

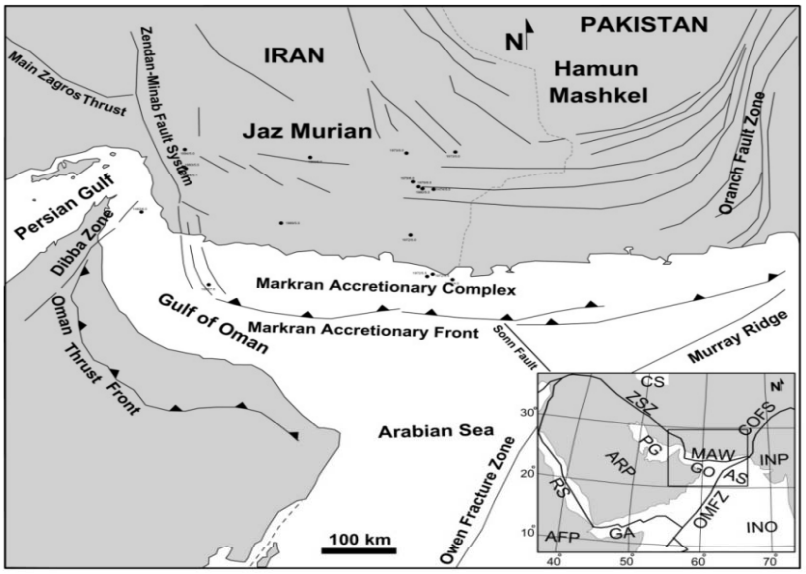
- **Main Functions**
  - Enhance disaster resilience of the member countries
  - Build safe communities
  - Create a society where sustainable development is possible
  - Addresses DRM, DRR issues with international cooperation
- **Main Activities**
  - Information sharing
  - Human resource development
  - Building community capabilities
- **Visiting Researcher Progrramme**
  - Through VR program ADRC polish skills of researchers from member countries in the field of disaster management and provide opportunities for member countries to learn more about DRR and DRM and to incorporate DRR concepts into the policies of their countries.

Seismotectonic Framework of the Pakistan Region



- Chaman Fault (1 km wide) is considered responsible for famous Quetta Earthquake 1935 (Mw=7.7).
- Sulaiman Lobe or Sulaiman Arc is broad (> 300 km) belt and it is tectonically active.

Seismotectonic Framework of the Pakistan Region

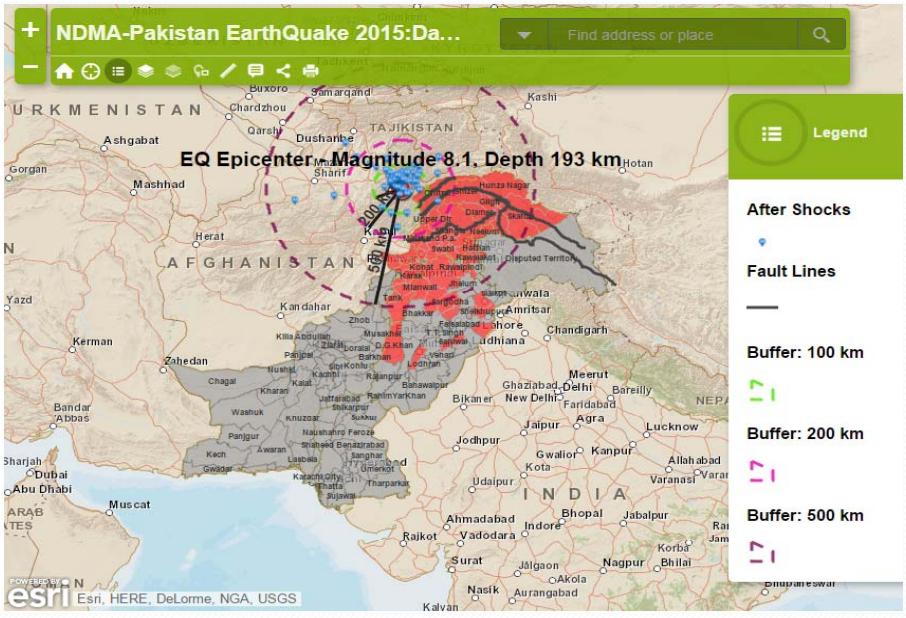


- Makran Subduction Zone lies between Eurasian and Arabian plates with a triple plate junction. It is capable of generating tsunami.
- Murray Ridge is low to moderate seismic zone lies in the Northwestern Arabian Sea and is nearly 420 km long and 20-50 km wide.

Destructive Earthquakes Affected Pakistan During Past Decade

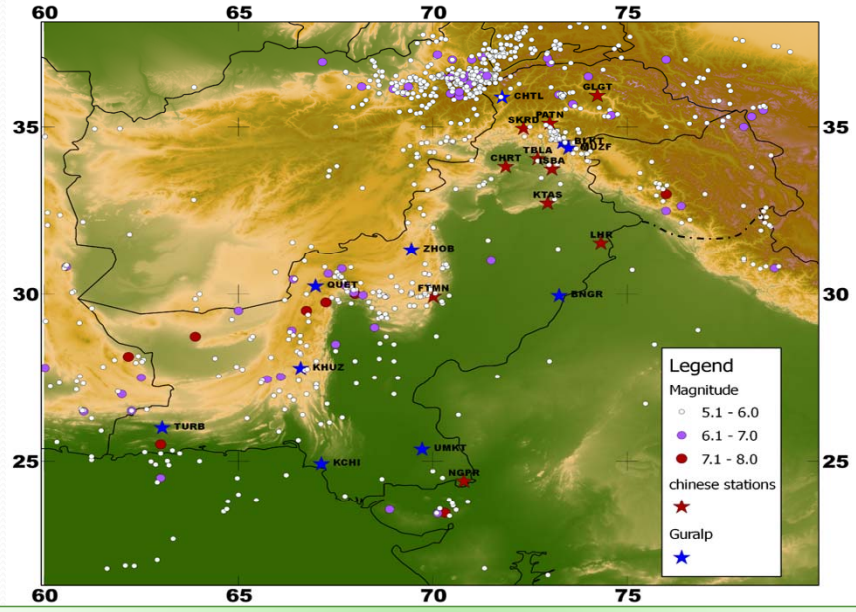
Earthquake	Magnitude	Intensity	Dead
26th October 2015 Earthquake	8 .1(As per PMD)	VI	279
Awaran Earthquake 2013	7.7	VII	386
18th January 2011 Earthquake	7.2	IV	-
Balochistan Earthquake 2008	6.4	VIII	215
Kashmir Earthquake 2005	7.6	VIII	87,350

26th October 2015 Earthquake



Death: 279 Injured: 1,820 Houses damaged: 1,04,067 (completely, partially)
(As per updated by NDMA on 14th November, 2015)

General Seismicity of the Region
Seismicity and Tsunami Monitoring in Pakistan



Seismicity and seismic monitoring stations in Pakistan
(PCSN and Guralp Networks)

National Seismic and Tsunami Monitoring Center

The Center equipped with:

1. The Guralp Network
2. Pak China Seismograph Network (PCSN)
3. SeisComP
4. Tsunami Early Warning System


Jopen Processing Servers

- Quick dissemination of earthquake and tsunami information
- Research activities
- Mutual collaboration with research organizations

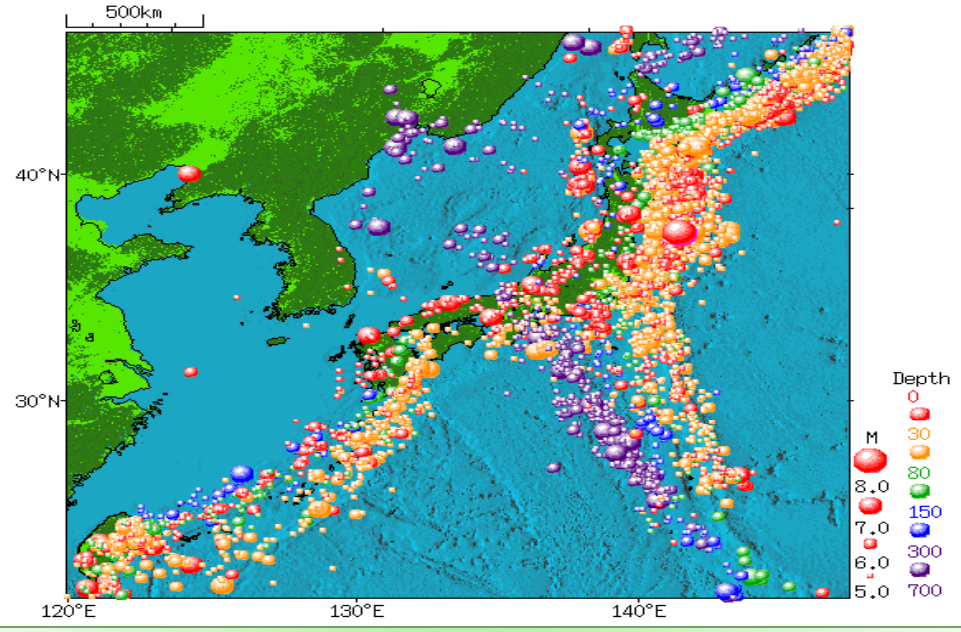

SeisComP System

Destructive Earthquakes in Japan During Past Decade

Earthquake	Magnitude	Intensity on Japan Shindo Intensity scale	Dead
Great East Japan Earthquake 2011	9.0	10	18,000
Iwate-Miyagi Inland Earthquake2008	6.9	6	12
Niigata Earthquake 2007	6.6	6	11
Niigata-ken-Chuetsu Earthquake 2004	6.8	7	40

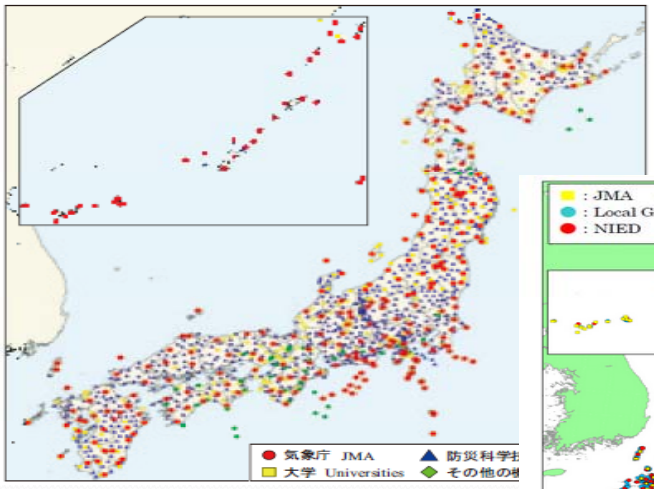
***Great Hanshin-Awaji Earthquake 1995.** Magnitude: 6.9, Intensity:7, Dead: 6,400
Houses Damaged: 249,000 (completely, partially)

Earthquake Distribution around Japan

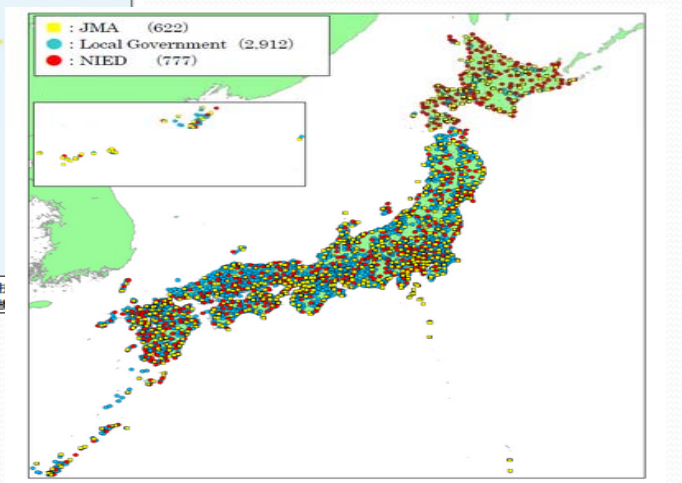


- 20% of world 's earthquake of magnitude 6 or greater occurred in or around Japan.
- Reason for earthquakes in Japan is that 4 tectonic plates (North American Plate, Philippine Sea Plate, Eurasian Plate and Pacific Plate) crushed each other.

Earthquake, Tsunami Observation Network of Japan

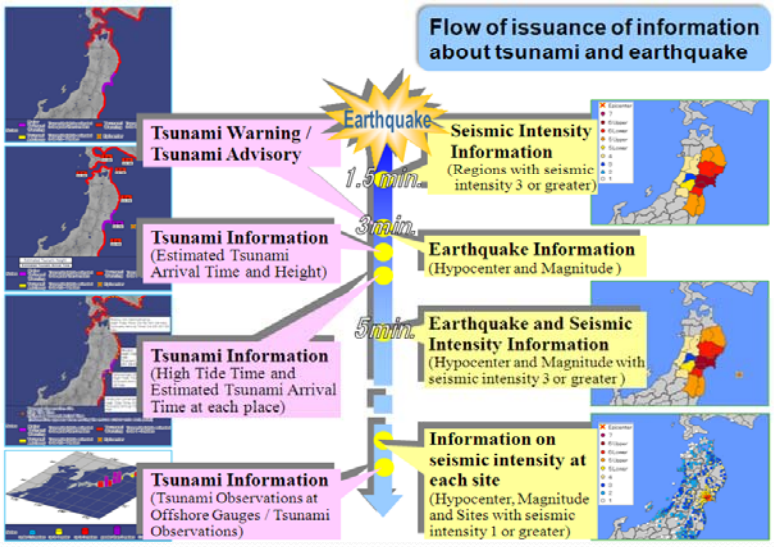


Seismograph Network (about 300 stations)



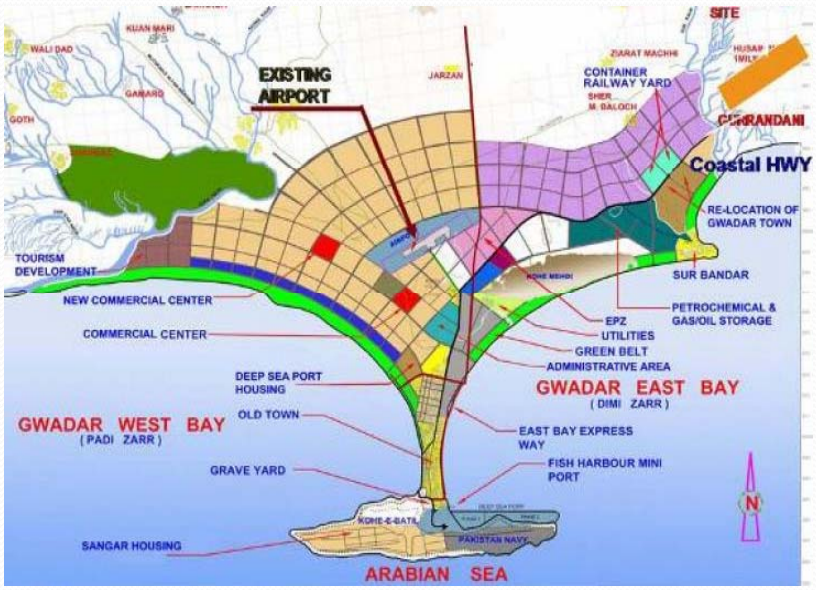
Seismic Intensity Meters Network (about 4000 cities)

Flow of issuance of Information about Tsunami & Earthquake in Japan



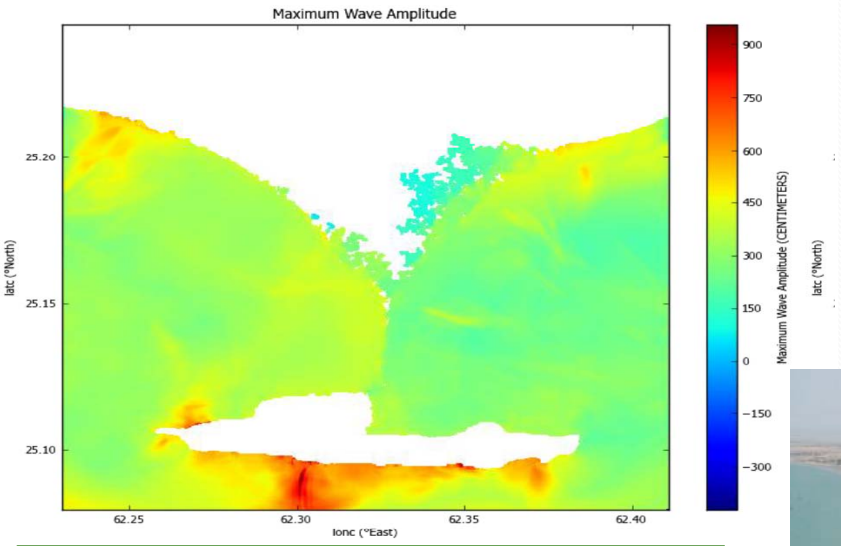
- If seismic intensity of earthquake is 3 or greater, JMA issues a Seismic Intensity Information Report within 1.5 minutes and then follow up information about hypocenter & magnitude of earthquake.
- If tsunami is expected , JMA issues Warning/Advisory within 3 minutes and then follow up announcements about the estimated height and arrival time of tsunami.

Theme of the Gwadar City Development & Detailed Master plan



- Vast area of the Balochistan province and available natural resources stipulated the development of Gwadar area.
- Gwadar is selected for development to work as a strategic future economic hub in the region. Located at coastline of Pakistan a new deep sea port has been developed.

Tsunami Inundation Modeling for Gwadar



Tsunami inundation modeling for Gwadar for Mw 8.5

Current landuse situation in Gwadar

Lessons from History for Future Development

From past decade earthquake events following aspects are identified for future disaster mitigation and better disaster management in planned Gwadar city.

- Lack of knowledge about hazard, vulnerability and risks
- Non existence of landuse and land control regime
- Lack of enforcement of building control

Problems for Future Sustainable Development

- **Core Issue-I**
  - Inadequate user orientation of EWS
  - Local knowledge about tsunami was non-existent
  - No large scale disaster awareness campaigns for the communities
- **Core Issue-II**
  - Inadequate landuse planning
  - Poor enforcement mechanism for landuse and building construction
- **Core Issue-III**
  - In lifeline infrastructure no hazard resistant methodologies are part of the governing laws
  - No emphasis on designation, knowledge of evacuation routes and centers

Possible Solutions and Remedies

- **Lifeline Facilities & Evacuation Centers**
  - At least some designated roads or highways, pipelines for water & power supply system must be build keeping in view future disasters.
  - Road possibly used for evacuation will be inundated by tsunami so a vertical evacuation scheme must be implemented in the hammer head side of the city which already has higher elevation.

Possible Solutions and Remedies

- **Mass Awareness using Media and School Education**
  - Promotion of disaster education in school system
  - All media channels broadcasts information on DRR and DRM for one hour daily
  - Special training for enforcement and regulation officers
  - Regular drills for any sort of emergency
- **Landuse Scheme**
  - Improvement and enforcement of landuse and land control plan
  - Reallocated safer location for old town
  - Strict ban on any kind of development and construction

Japan as World Leader in Disaster Management

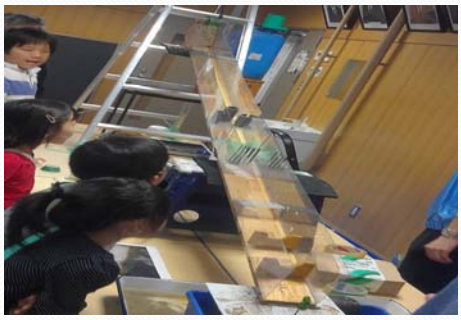
- Continuous efforts in reducing the post disaster effects throughout globe and particularly in Asia.
- Comprehensive research on causes of natural hazards and countermeasures against these hazards.
- Application of latest technology in DM
- DM knowledge sharing
- Comparative study of Japan with other countries
- Culture of preparedness against disasters through regular community based disaster risk management and drills.

Japan as World Leader in Disaster Management

Pictorial view of Drill in Miki City, Hyogo Prefecture September 2015

Japan as World Leader in Disaster Management



Community Based Disaster Management Activities in Kyoto University & Kobe Shoin Women's College, Hyogo Prefecture November 2015

Lesson Learned from Japan

- Appropriate policy, legal & institutional arrangements for DM in Japan
- Implementation of strategies
- Empowerment of DM institutions
- Over all environment for research in DRR and DRM
- Opportunity to learn and share experience of Japan in DM in VR member countries
- Japan built flawless earthquake-proof structures, highly efficient tsunami EWS and scientifically developed tsunami evacuation plan
- Well trained and fully equipped permanent staff for handling disasters
- Expert group of evacuators and relief managers
- Strong coordination among DM stakeholders
- Huge allocation of budget on DM activities

Conclusions & Recommendations

- Excellent environment in Japan to learn disaster management practices. The picture of structural measures against the natural hazards especially against earthquake and tsunami is tremendous effort done by Japan.
- Pakistan adopting proactive approach to DRM after 2005 earthquake.
- PMD plays role in pre & post disaster management by using Specialized Early Warning Centers, providing guidelines for hazards, risks and vulnerability assessment , seismic hazard analysis of various cities, tsunami modeling , created flood hazard maps.
- Mandatory for urban planning to take into account hazards in the master plan of the cities.

Conclusions & Recommendations

- Gwadar is in development phase, keeping in view the future disasters in the area disaster mitigation and management plans can be incorporated easily in current situation (as population is low) by using proper planning, enforcement of building control , launching awareness campaigns against disasters particularly against earthquakes and tsunamis , creating lifeline facilities & evacuation centers.
- Policies and scenarios at all levels must be developed for all types of disasters in Pakistan
- Both pre & post disaster policies must be implemented as a starting point for future sustainable and safe cities in Pakistan
- Pakistan can enhance its capacities by sharing rich experience of Japan knowledge and technology for risk assessment and early warning systems