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Training Manual for Disaster Managers

FLOOD MANAGEMENT THROUGH FLOOD FORECASTING AND EARLY WARNING SYSTEM

United Nations
Educational, Scientific and
Cultural Organization

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By

Project Team

Centre for Disaster Preparedness and Management (CDPM)

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UNITED NATIONS EDUCATIONAL SCIENTIFIC AND CULTURAL ORGANIZATION (UNESCO)

In 1945, United Nations Educational Scientific and Cultural Organization was created in order to respond to the firm belief of nations, forged by two world wars in less than a generation, that political and economic agreements are not enough to build a lasting peace. Peace must be established on the basis of humanity's moral and intellectual solidarity. UNESCO is known as the "intellectual" agency of the United Nations. At a time when the world is looking for new ways to build peace and sustainable development, people must rely on the power of intelligence to innovate, expand their horizons and sustain the hope of a new humanism. UNESCO exists to bring this creative intelligence to life; for it is in the minds of men and women that the defences of peace and the conditions for sustainable development must be built.

Since its establishment in Karachi - Pakistan in 1958 as the "Regional Centre for Reading Materials in South Asia" and after renaming as Regional Centre for Book Development in Asia covering 21 Member States in Asia by 1972, the UNESCO office was moved to Islamabad as the Regional Office for Book Development in Asia and the Pacific in 1989. By now UNESCO Islamabad office is functioning as the country office and is striving for building networks and to strengthen ties between nations and societies through Education; Natural Science; Culture and Communication and Information Sectors.

UNESCO Science Sector is working closely with Government of Pakistan to implement different initiatives including strategic Strengthening of Flood Warning and Management Capacity of Pakistan which included capacity building of national authorities particularly Pakistan Metrological Department (PMD), SUPARCO, and NDMA in reliable flood forecasting and information dissemination. UNESCO also promotes engineering qualification standardization in Pakistan. The organization also works in introducing the latest water management techniques in the arid areas and DRR awareness raising in Baluchistan, supporting the MAB Programme activities in the country and promoting the popularization of science.

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Japan International Cooperation Agency

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

Japan started its economic cooperation for Pakistan in 1954 and has built good bilateral relations for many years. In April 2009, Japan held the Pakistan Donors Conference and the Meeting of the Friends of Democratic Pakistan in Tokyo, which was attended by donors and countries having good relation with Pakistan, to show solid support by the international society for Pakistan's efforts in various challenges including economic reforms and counterterrorism. Japan's assistance to Pakistan is of great significance in helping this country develop as a "moderate and modern Muslim state" which has abundant workforce and potential as an economic market as well as importance for peace and stability of the international community.

The uppermost goal is the basic policy of assistance for building of a stable and sustainable society through economic growth. In order to demonstrate its full potential, it is indispensable for Pakistan to build a stable and sustainable society through achieving private sector-led economic growth while maintaining stable economic condition. In order to achieve the goal given above, Japan has set the following three priority areas including the improvement of economic infrastructure.

- Improvement of economic infrastructure
- Ensuring human security and improvement of social infrastructure
- Balanced and stable regional development including the border region

In addition, assistance will be carried out to contribute to improving the poor conditions of water and sanitation especially in the urban areas; improving health services in the communities including programmes for eradication of polio; and strengthening capabilities of disaster management to respond to frequent natural disasters. It is necessary for Japan to consider the security situation in Pakistan as well as measures Pakistan takes for disarmament and non-proliferation.

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Centre for Disaster Preparedness and Management (CDPM),
University of Peshawar

CENTRE FOR DISASTER PREPAREDNESS AND MANAGEMENT (CDPM), UNIVERSITY OF PESHAWAR - PAKISTAN

The Centre for Disaster Preparedness and Management (CDPM) was established with a clear cut vision to contribute towards national integration and consolidation and help overcome the sense of forlornness and alienation in vulnerable communities. Right from its inception the CDPM is continuously &efficiently playing its due role in research, training and education in the field of Disaster Management. It's worth mentioning that CDPM, which was inaugurated on April 04, 2009, is the first of its kind in the public sector of Pakistan. The CDPM is mandated for disaster education, research and policy advice to government. With the grace of ALLAH the almighty the pioneering CDPM is readily moving ahead in the right direction in its field. The CDPM has initiated the country's first ever standalone academic programmes regarding disaster management in the shape of a postgraduate diploma, BS (4 Years), M. Sc., M.S., M.Phil. and Ph.D. which is overwhelmed by the academicians and professionals working in the field of disaster management. Besides, CDPM is also providing support to the stakeholder's organization such as NDMA and PDMAs in the capacity building, research and policy formulation. Based on the performance of the CDPM since its establishment, it is envisaged that it would, in-sha-Allah, serve as a lynchpin and coordinate the services of relevant disciplines and guidance of the sensitive and responsive stakeholders.

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PREAMBLE

Pakistan is a country exposed to a wide variety of natural and human induced disasters. This susceptibility is attributed to the diverse nature of topography, wide variations in climatic conditions and communities with assorted cultures. The diversity in both topography and culture, though on one hand add strengths to the country resources, while on the other it serves to be a predominant determining factor in escalating vulnerability to a list of geophysical, hydro-meteorological and climatic disasters. Out of these, Pakistan had been a frequent victim of flash and riverine floods throughout its history. Almost each year, several small to large-scale flood events hit the vulnerable communities in different parts of the country. In the recent past, the frequency and intensities of flood events have been increased. The experts on climate change attribute this increasing recurrence to changing climate scenario. Since independence, Pakistan has been hit by sixteen major floods, which indicate that one mega flood disaster occurred after four-to-five years. However, the Floods - 2010 is considered as a century worst disaster.

In Pakistan, the devastating disaster in the form Floods - 2010 is partly attributed to the low coverage of flood forecasting system and subsequently inefficient flood early warning to the hazard hit community. In response, the United Nations Educational, Scientific and Cultural Organization (UNESCO) with financial assistance from the Government of Japan, is implementing a project to reinforce flood warning and management capacity of the Government of Pakistan. The Government of Pakistan has also developed National Disaster Management Plan (NDMP: 2012-2022) with the technical support of Japan International Cooperation Agency (JICA).

This manual has been developed to enhance the capacity of employees of the National Disaster Management Authority (NDMA), National Institute of Disaster Management (NIDM), Provincial Disaster Management Authorities (PDMAs), State Disaster Management Authorities (SDMA), Gilgit-Baltistan Disaster Management Authorities (GBDMA), FATA Disaster Management Authority (FDMA), Provincial Irrigation and Drainage Authorities (PIDAs), Pakistan Meteorological Department (PMD), Water and Power Development Authority (WAPDA), National Highway Authority (NHA), Provincial Highway Authorities (PHAs), Pakistan Army, Police Departments and other relevant line departments in Flood Management with emphasis on Flood Forecasting and Early Warning System.

The manual is a pioneering effort and a standard state-of-the-art resource for training on Capacity Building of all the stakeholders working in “Flood Risk Management” in Pakistan. The emphasis of the manual is on the Flood Risk Management through enhancing mechanism of Flood Forecasting and Early Warning System in the country. This manual will help in reduce the gaps in understanding flood forecasting and Early warning systems (EWS), and equip the participants with knowledge and skills as well as encourage them to build and develop their capabilities. The training manual will provide

learning opportunities, to understand vulnerabilities of the poor strata of the society to floods. In this way the manual will help reduce vulnerability and will lead to an effective Emergency Response System.

The manual is focused to understand the basic concepts of disaster management and status of disasters in Pakistan. This manual intends to explore flood phenomenon and its effects on the lives and livelihoods of people in Pakistan. The manual also enable the participants to encompass the flood risk assessment for effective forecasting and early warning system in Pakistan. Furthermore, it shares the knowledge of appropriate actions for flood management both in pre and post flood emergency situations.

1. About the Manual

This Training Manual for Disaster Managers specifically focuses on the "Flood Management through Flood Forecasting and Early Warning System". This resourceful manual has been explicitly designed to increase the understanding of target managers dealing with the flood phenomena, management of flood disasters through efficient flood forecasting and early warning system. It would ultimately lead to an overall improvement in performance of enhancing resilience potentials and reducing vulnerabilities to the impacts of riverine floods, flash floods, pluvial floods and/or coastal floods. The manual also addresses the possible impacts of flood extreme events upon the community in general and vulnerable groups in particular. This training manual also highlights all the structural and on-structural flood risk reduction strategies. In addition, the role of flood forecasting and early warning system is particularly linked with the flood risk management.

This training manual enables the disaster managers to understand what they themselves and their community might go through in case if flood disaster strikes, which would enable them to cope with the situation in a better and efficient way. Furthermore, the manual also gives an insight regarding how to respond if a flood disaster strikes the communities. The manual itself comprised of several sub-modules, which can be used for conducting trainings for the disaster managers of NIDM, NDMA, PDMAs and FDMAs etc. Designing this manual is an attempt to mainstream the knowledge of Disaster Risk Management (DRM) into all the stakeholders dealing with the flood management.

This resource manual is designed for the disaster managers, who would use the manual and incorporate the lessons learned in their managerial practices. The manual does not aim to last for a specified time period rather it aims at incorporating the lessons in the behaviours of the target audience to improve overall societal performance for reducing vulnerability and enhancing capacity in the long run.

2. Basic Concepts

This section of the manual gives an insight to the basic concepts and important terminologies that are frequently used in the context of Disaster Risk Reduction (DRR). It also discusses the types of hazards & disasters, vulnerability, capacity, prevention, mitigation, disaster management cycle, impact of disasters, disaster risk reduction strategies and disaster management.

2.1 Hazard

A hazard is a natural or human-induced phenomenon, which may cause physical damages, economic losses, or threaten human lives if it occurs in an area of human settlement, agriculture or industrial activity etc.

- Hazard is an event or occurrence that provokes disaster.

"Hazard is a phenomenon that has the potential to cause injury to life, livelihoods and habitats."

2.2 Natural Hazards

Natural Hazards are natural phenomena which pose threat to people, structures or economic assets and may trigger disaster. Earthquakes, cyclones, heavy storms, tsunamis, floods, wild fires, volcanic eruptions, landslides and droughts are typical natural hazards.

"Natural Hazard is a danger brought about by a degree of exposure to an environmental agent for which the community is usually not prepared."

2.3 Human-Induced Hazards

The conditions that may have disastrous consequences for a society and associated with industries or energy generation facilities or any other such as explosions, leakage of toxic waste, urban fire, accidents, pollution, dam failures, war, conflicts and terrorism are included in category of Human-Induced hazards.

2.4 Hazardous Waste

Any waste which is flammable, corrosive, reactive or toxic and which may pose substantial or potential hazard to human health and safety or to the environment when improperly managed.

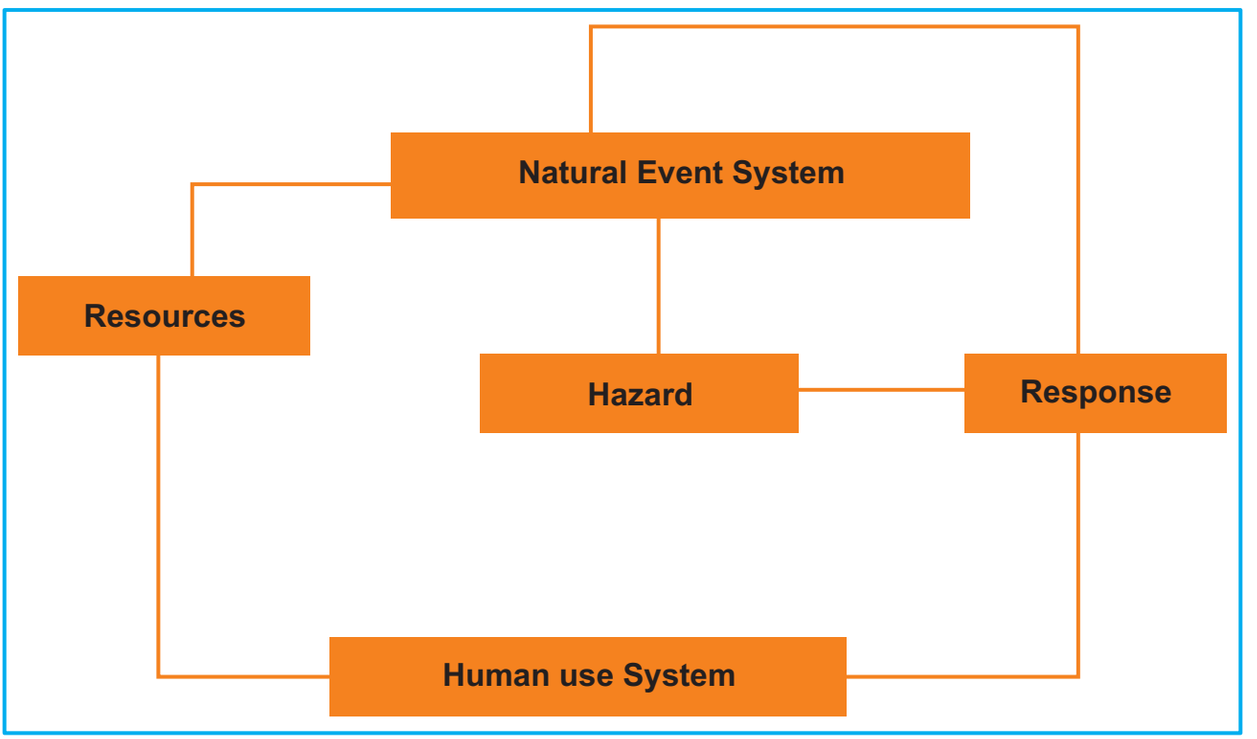
2.5 Human-Nature Interaction

There are three alternative/parallel terms used to deal with the extreme events such as natural and or Human-induced or Human-nature interaction. It is therefore very important to draw a distinction between the process (causal factors) and the responses (result) of extreme events. It is clear from these definitions, that an extreme natural event only becomes a hazard when people or property are involved. It means that although

Natural Hazard is a condition of environment, it has strong relationship with human being. **Therefore,** no Natural Hazard exists unless and until it is perceived and in turn provoke a human response. This provocation and perception varies according to its triggering factors, where cultural variation is one of the most important factor.

From this discussion, one can deduce that physical environment is a **Neutral stuff**, however, it is human culture which determines whether elements are considered to be resources or hazards. Hence, it is people who transform the environment into **Resources** and**/or Hazards** by using natural features for economic, social and aesthetic purposes. The interaction of nature and man creates both useful resources and hazardous threats for human being. Responding to these hazards, society may seek to modify the natural event system and for the human use system of location, livelihood and social organizations. Hence, a considerable cultural variation exists in the conception of natural hazards. Similarly change occurs both in time and space.

Human-Nature Interaction



Activity

"Ask the participants to list at least 5 natural and human-induced disasters from their areas"

2.6 Classification of Hazards

Natural Hazards can be classified variously using criteria such as on the basis of magnitude, velocity, duration, death toll, and financial cost etc. The most widely used and workable classification is based on the mode of operation of hazards. According to this classification, natural hazards can be divided into two major categories of **terrestrial and Extra-Terrestrial hazards**:

Terrestrial are those **hazards** which occur within the earth.

Extra-Terrestrial hazards are those which originate outside the limit of the earth, perhaps in space, but cause harm to human beings; For instance falling of meteorites.

Terrestrial hazards can be sub-divided into three categories:

i) **Exogenic:** Exogenic are those hazards which operate on the earth. Exogenic hazards can further be categorised into:

   a. Atmospheric Hazards

   b. Hydrospheric Hazards

   c. Lithospheric Hazards

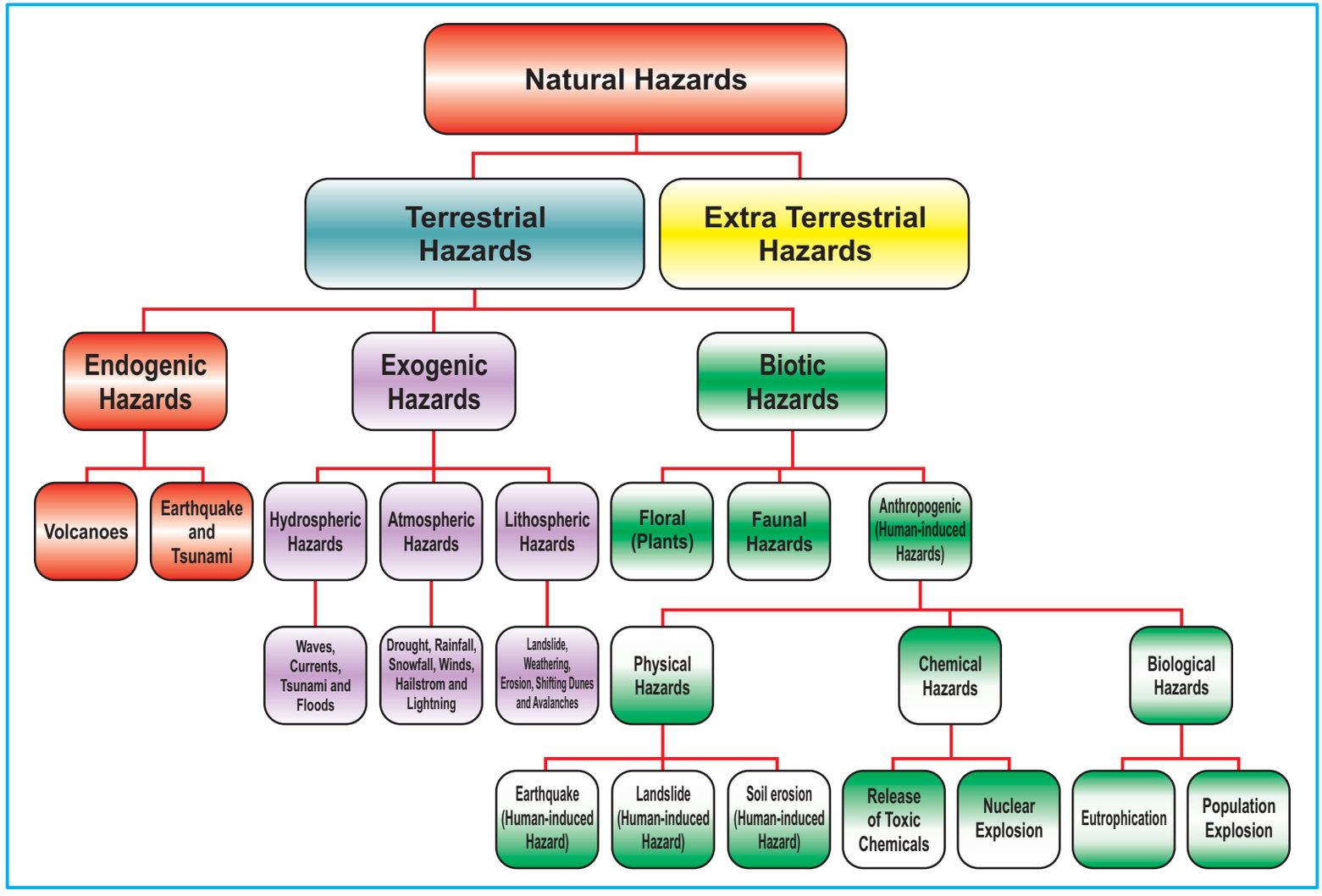
ii) **Endogenic:** Endogenic are those hazards which originate inside the earth. For instance volcanic eruption and earthquake etc.

iii) **Biotic:** Biotic hazards are those which are caused by living organisms like plants, animals and mankind.






"Meteorite falling of is typical example of Extra-Terristrial Hazrads"



Source: Adopted from Khan, 2016

2.7 Disasters

The term 'disaster' is defined variously by different scholars. For example:

- Sudden or great misfortune and /or calamity.
- A sudden calamitous event producing great material damage, loss and distress.
- An event natural or Human-Induced, sudden or progressive, which impact with such severity that the affected community has to respond by taking exceptional, measures.
- A Condition or situation of significant destruction, disruption and/or distress to a community.
- A catastrophic situation in which the day to day patterns of life are suddenly disrupted and as a result, people need Emergency Response such as evacuation, protection, food, clothing, shelter, medical and social care and other necessities of life.

Disaster causes great losses and damage that the affected communities do not have the capacity to cope with.

2.8 Extreme Events in Nature and Disaster

The occurrence of extreme natural events like earthquake, landslide etc. is not disaster in itself, and it becomes disaster only when it harmfully interacts with human population, their activities and properties.

Therefore, a disaster should be defined on the basis of its human consequences rather than on the phenomenon that has caused it. Cataclysms of nature that took place before man's appearance on the earth and that still occur in uninhabited area of the world are not disaster. For instance, a very strong tropical cyclone becomes extreme event only when it occurs and dies in the midst of an ocean, but it becomes disaster

when it strikes the inhabited coastal areas and inflicts serious damages to human property and lives. Hence, two elements are important for disaster situation:

i. **Extreme physical/natural event**

ii. **Vulnerable population**

From the definitions, it is obvious that **Hazards** are the processes whereas the **Disaster** is the results or responses to hazards.

ENERGIZER

Hazard Race

This is a great game to get participants moving around, and thinking about linkages between different types of hazards. Choose four types of hazards that might affect somewhere in your area. Assign each hazard a place in the room.

Have all participants stand in the center of the room, and have one leader call out words relating to a hazard (for example, jolts for earthquakes). Participants need to think about what hazard the word applies to, and run to that area of the room. When a word applies to more than one type of hazard (i.e. Generic words like preparedness), they can stay in the middle of the room. If a word applies to two types of hazards, they can stand in between the areas of those two hazards.

2.9 Classification of Disasters

It is a common saying among the various people dealing with disaster, that no two disasters are alike. It is because of the fact that disasters can take many forms and they are the result of variety of processes. Therefore, it is very difficult to classify disasters in such a classification which covers all the factors and processes. One way of classifying disasters into:

a. Cataclysmic / Rapid on-set disasters

Cataclysmic are those disasters which are sudden impact. They cause tremendous amount of suffering and chaos but very soon things begin to improve.

Cataclysmic disasters are more disruptive than destructive. They destroy buildings and entire human settlement and can cause wide spread losses. Their extent of disruption depends on the factors: season, location and total area affected. These disasters are mostly the result of natural hazards like earthquake, volcanoes and floods etc.

b. Continuing / Long term disasters

They are slow and steady disasters. In these disasters, the situation after the events remain constant or more deteriorated and worsen after the time passes. Unlike cataclysmic disasters, the damage area in continuing disaster is extremely large. They disturb transportation, infrastructure, distribution network, etc. It can sometimes bring these facilities to a complete halt and ultimately destroy the system. Drought is one the continuing natural disasters. War and famine are the other.

Activity

"Individual story narration: Have the participants ever come across a disaster in their lives?"

Activity

"Ask the participants in groups of 5 if they can list down at least 5 disasters that have struck Pakistan"

"A set of prevailing or consequent conditions which adversely affect the community's ability to prevent, mitigate, prepare for or respond to hazard event"

2.10 Vulnerability

- **Vulnerability** is the susceptibility to harm those at risk.
- The extent to which an individual, community, sub-group, structure, service, or geographic area is likely to be damaged or disrupted by the impact of a particular hazard.
- Conditions of vulnerability are a combination of factors that include poor living conditions, lack of power, exposure to risk, and the lack of capacity to cope with shocks and adverse situations.
- Vulnerability depends on the characteristics of a person or group in terms of capacity to anticipate, cope with, resist and/or recover from the impact of hazard.

WHO IS VULNERABLE?

ELDERLY PEOPLE:

They are physically weak and in poor health. They may be nervous and also feel strongly that they do not want to leave their homes no matter what.

CHILDREN:

They do not have the physical skills or coordination of older people. Curiosity can lead them to danger. They may be too young to know how to set priorities.

WOMEN:

They may place their children and family (and even their belongings and property) above themselves. They may be physically less strong than men and may lack access to information.

MARGINALIZED GROUPS:

They may be people with disabilities, street children, people forced to be beggar, migrant workers, displaced people and people of ethnic minorities. They may lack information and education and have limited access to social services.

Activity

"Ask the participants to enlist at least 5 different vulnerabilities from their village/ community"

2.11 Types of Vulnerability

Vulnerability can be classified as:

Physical Vulnerability is the hazard-prone locations of settlement, insecure and risky sources of livelihood, lack of access to basic production resources (such as land, farm inputs, and capital), lack of knowledge and information, lack of access to basic services.

Social Vulnerability is reflected in the lack of institutional support structures and leadership, weak family and kinship relations, divisions and conflicts within communities, and the absence of decision-making powers.

Attitudinal Vulnerability is seen in dependency, resistance towards change, and other negative beliefs. People who have low confidence in their ability to affect change or who feel defeated by events are harder hit by disasters than those who have sense of their ability to bring the changes they desire.

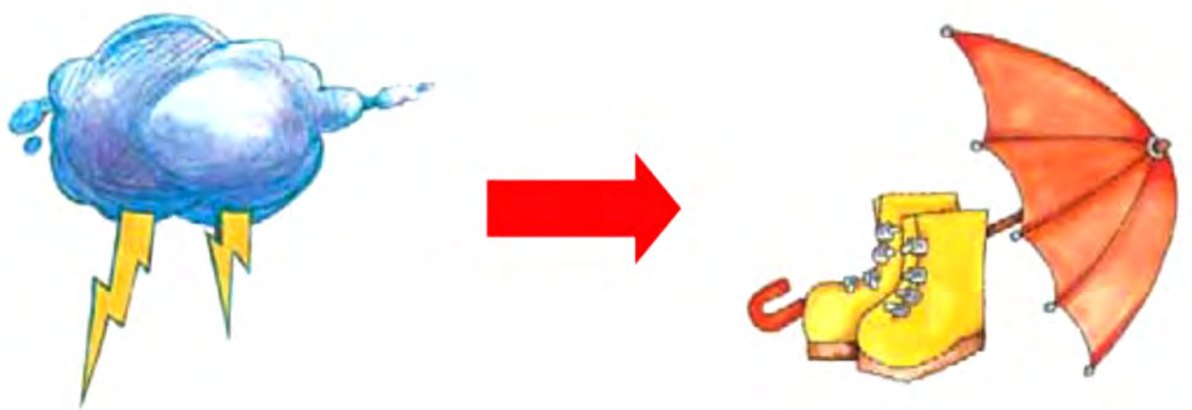
Economic Vulnerability pertains to how people make their living and from where they get their livelihood. Determining which type of livelihood is easily affected by disasters (e.g. fishing, tricycle driving, etc.) is a key issue to be considered in determining the magnitude of economic vulnerability.

2.12 Capacity

"Capacity is strengths and resources which are present in individuals, households and communities which, enables them to prevent, mitigate, prepare for, cope with or quickly recover from a disaster"

Activity

Ask the participants to explain the following image.



"Capacity is an ability to cope with a situation"

Capacity is

- Specific to hazards
- Differ among countries & organizations
- Change over time
- Sustained through ownership and local initiatives

Capacity Dimensions

- Awareness
- Laws and Regulations
- Organizational Mechanisms
- Plans
- Expertise and technology
- Disaster Risk Reduction (DRR) Activities

"Even the weakest in the community have some Capacity, such as skills, resources and strengths etc. to help themselves and perhaps others."

2.13 Disaster Risk

Risk is the likelihood of meeting danger or suffering harm and loss.

The term 'risk' is defined in different ways. For example:

- Risk is nothing more than the consequences of hazard.
- The possibility of suffering harm from a hazard.
- Risk is the probability of an event occurring, or the likelihood of a hazard happening.
- Risk refers to the probability that death, injury, illness, property damage, and other undesirable consequences will stem from a hazard.

Characteristics of Risk

a. **Distribution:** The distribution of risk is universal and concerned with many countries including developed and underdeveloped.

b. **Identification:** Risk is difficult to identify and sometimes identification is too late that it occurs after some adverse consequences have been felt.

c. **Measurement**: Risk can never be measured exactly.

d. **Evaluation:** The evaluation of risk varies in social term. Therefore, a risk considered serious in one locality may not be so important in another.

2.14 Disaster Management

Disaster Management is to anticipate future situations and requirements, thus ensuring the application of effective and coordinated counter-disaster measures. It is an applied science which seeks, by the systematic observation and analysis of disasters to improve measures relating to prevention, mitigation, preparedness, emergency response and recovery etc.

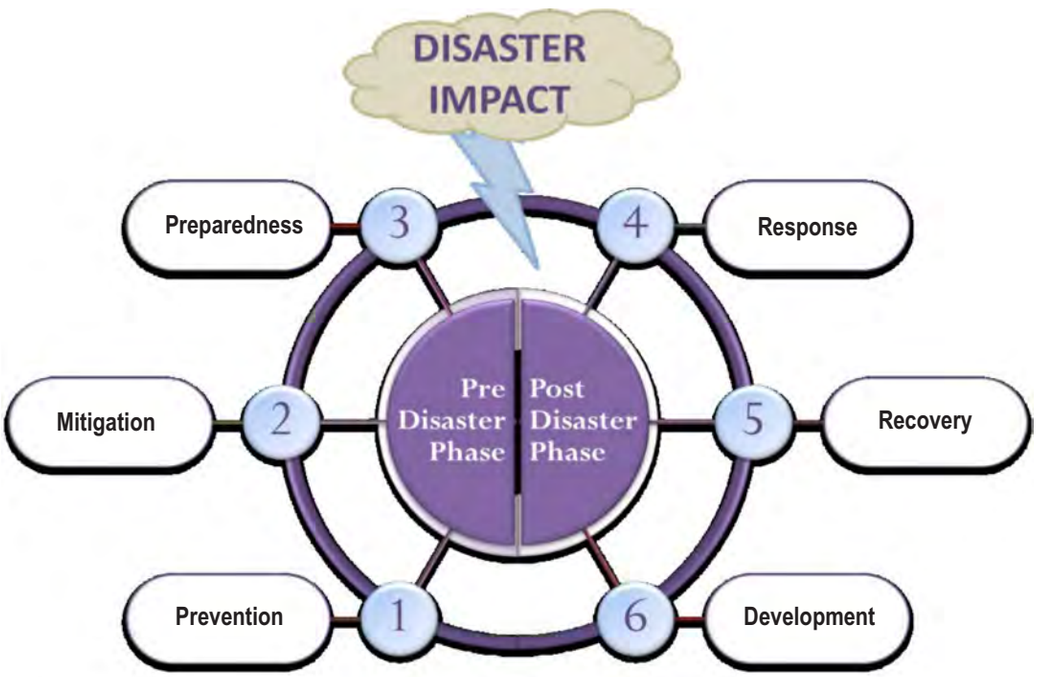
Disaster management usually refers to the management of natural and human induced catastrophes such as fire, flooding, or earthquakes etc. It includes the development of disaster recovery plans, for minimizing the risk of disasters and for handling them when they do occur, as well as the implementation of such plans including crisis management, contingency management, and risk management etc.

Activity

Find out whether the participants have heard these terminologies before, if yes, in what context and from whom.

2.15 Disaster Management Cycle

Management is a cyclic process, which can be graphically illustrated as the following:



2.16 Prevention

Actions with in this segment are designed to impede the occurrence of a disaster event and/or prevent such occurrence having harmful effects on communities or key installations. It includes the following, for example:

- The construction of a dam or level to control flood waters so that the latter cannot adversely affect people, buildings and other installations, livestock, means of production and subsistence etc.
- Controlled burning-off in a fire prone area before the high fire-risk period. This action can remove potential fuel and actually prevent a fire from starting, or if it does start, prevent it from reaching threatening proportions.
- Some form of legislation can also be regarded as prevention, for instance land use regulations while ensure that communities are not allowed to develop on vulnerable sites such as disaster-prone areas of flood plains.
- It is worth noting that some countries tend to use the term prevention/mitigation as a combined heading for action within these two segments.

2.17 Mitigation

Actions with in this segment usually take the form of specific programs intended to reduce the effects of disaster on a nation or community.

- For instance, some countries regard the development and application of building codes as being in the category of mitigation, whereas other countries may regard such building codes in the category of prevention.
- The term mitigation more generally implies that whilst it may be possible to prevent some disaster effects other effects will persist but can be modified or reduced provided appropriate actions are taken.
- It indicates that under some circumstances the term prevention/mitigation may be more suitable for some countries than utilizing prevention and mitigation as two separate concept and activities.

The following are actions that can be included under the heading of mitigation:

- ✓ Enforcement of building codes
- ✓ Land use regulations
- ✓ Safety regulations relating to high-rise buildings
- ✓ Control of hazardous substances
- ✓ Safety codes governing land, sea and air transport systems
- ✓ Agriculture programs aimed at reducing the effects of hazards on crops
- ✓ System to protect key installations, such as power supplies and its communications
- ✓ Development in infrastructure, such as routing of new highways away from disaster-prone area

Mitigation	Prevention
Measures taken prior to the impact of a disaster to minimize its effects (sometimes referred to as structural and non-structural mitigation measures).	Measures taken to avert a disaster from occurrence, if possible (to impede a hazard so that it does not have any harmful effects).

2.18 Preparedness

Preparedness is usually regarded as comprising measures which enable governments, organizations, communities and individuals to responds rapidly and effectively to disaster situations. Some examples of preparedness measures include the following:

- The formulation and maintenance of valid up-to-date counter disaster plans which can be brought into effect whenever required.
- Special provisions for emergency actions, such as the evacuation of population or their temporary movement to safe heavens.
- The provision of warning system.
- Emergency communications.
- Public education and awareness.
- Training programs including exercises and tests etc.

One aspect of preparedness which is not always given adequate priority is individual and family preparedness. In many circumstances where government resources and emergency services are limited such individual and family preparedness may be vital for survival.

Some experts may divide preparedness segment into sub-segment such as the following:

i. Warning:

The time or period when a hazard has been identified but has not yet threatened a particular area, for instance notification that a cyclone exists but is long distance away.

ii. **Threat:**

The time or period when a hazard has been identified and assessed as threatening a particular area for example a cyclone is tracking towards that area.

iii. Precautions:

Action taken after receipt of warning to offset effect of disaster impact. Such action might include, for example closing offices, and schools etc.; bringing emergency power generators to readiness; Cutting crops to avoid total loss from high winds and heavy rain etc.

ENERGIZER

Add an Action

Ask participants to form a circle. Each participant, in turn, has to say their name and then do an action that has something to do with DRR (wave hands to be wind, run on the spot for evacuation). They need to say each person's name, and the action of everyone who came before them, then say their own. If they forget, the game has to start again, until all participants are able to go around in the circle saying names and doing the actions.

2.19 Disaster Impact

This segment is self-explanatory, being the point in the disaster cycle at which a disaster event occurs, for instance when a cyclone strikes a country or a particular area. However, its inclusion serves as a reminder that in disaster management cycle, impact can vary between different types of disasters. For instance: An earthquake may give no warning and its impact time can be very short, yet the results can be very serve indeed. On the other hand a cyclone may provide a long warning period and its impact time may be protracted or prolonged, during which it has very destructive and damaging effects.

2.20 Response

Response measure are usually those which are taken immediately prior to and following disaster impact. It may include early warning system (EWS), Evacuation, rapid need and preliminary damages assessment (RNA & PDA), search and rescue, Triage, Medical First Aid, Firefighting, Hospitals, Security, Relief, Camp management, Traumatic and social counseling etc. The response segment is shown in the cycle as immediately after disaster impact which in fact is the time when most response measures are applied. Such measures are mainly directed towards saving lives and properties, and dealing with the immediate disruptions, damages and other effects caused by disaster.

Relief

Relief includes all those measures which are required in search and rescue of survivors, as well as to meet the basic needs for water, shelter, food and health care. Relief can also be defined as the provision of material aid and emergency medical care necessary to save and preserve human lives on humanitarian basis. Relief supplies and services are provided free of charge in the period immediately following a sudden disaster. Relief may need to be provided for extended period in the cases where population displacement and migration take place.

Recovery

Recovery is the process undertaken by a disaster affected community to fully restore itself to pre-disaster level of functioning. Recovery can also be defined as a process through which community and the nation are assisted in returning to their proper level of functioning following a disaster. The recovery processes can be taking 5-10 years, or even more.

Restoration & Rehabilitation:

Actions taken in the aftermath of a disaster to:

- Assist victims to repair their dwellings;
- Re-establish essential services;
- Revive key economic and social activities.
- Provision of temporary housing.
- Measures to assist the physical and physiological rehabilitation of persons who have suffered from effects of disaster.

Reconstruction:

It includes all those permanent measures to repair or replace damaged dwellings and infrastructure and to set the economy back on the track. For example the permanent reconstruction or replacement of severely damaged physical structures, the full restoration of all services and local infrastructure, and the revitalization of the economy, including industries and agriculture etc. The reconstruction must be fully integrated into

ongoing long-term development plans taking into account the future disaster risks and possibilities to reduce those risks through incorporation of appropriate mitigation measures. Damaged structures and services may not necessarily be restored in their previous form or locations. Reconstruction may also include the replacement of any temporary arrangements established as a part of emergency response or rehabilitation. Long term measures of reconstruction, including replacement of building and infrastructure which have been destroyed by the disaster as well as Post-disaster review are also included as part of the recovery process. It is very important to note that recovery should take place as soon as practicable after the disaster event.

2.21 Development

The development segment provides the linkage between disaster-related activities and national development. Its inclusion in the disaster management cycle is intended to ensure that the results of disaster are effectively reflected in future policies in the interest of national progress. Some example in this regards are the following:

a) Introducing improved and modernized building system and programs.

b) Utilizing international disaster assistance to optimum effects and lesson learned.

c) Applying disaster experiences in future research and development programmes.

d) Using any other means appropriate to a particular situation.

It is worth mentioning that disaster and development linkage should be utilized to ensure that national development does not create further disaster problems, nor exacerbate the existing ones. This is what is called sustainable development. In this connection, it is important to bear in mind that two major factors are likely to trigger action in some or all of these segments. These factors may also affect the balance between activities and the priorities allotted to individual activities.

Following are these important factors:

i. Post Disaster Review:

Post Disaster review should be carried out as early as practicable in the recovery period. Such review will often reveal deficiencies in plans and will also indicate weakness in other stages For instance, if certain activities such as preparedness measures and response arrangements need strengthening.

ii. **Monitoring:**

An effective day-to-day disaster management under an active National Disaster Council and National Disaster Management office should monitor all aspects of activity and initiate necessary action accordingly.

Activity

Amongst the three phases of Disasters, what the participants think is more important and feasible in their areas and why?

ENERGIZER

Know the Phases

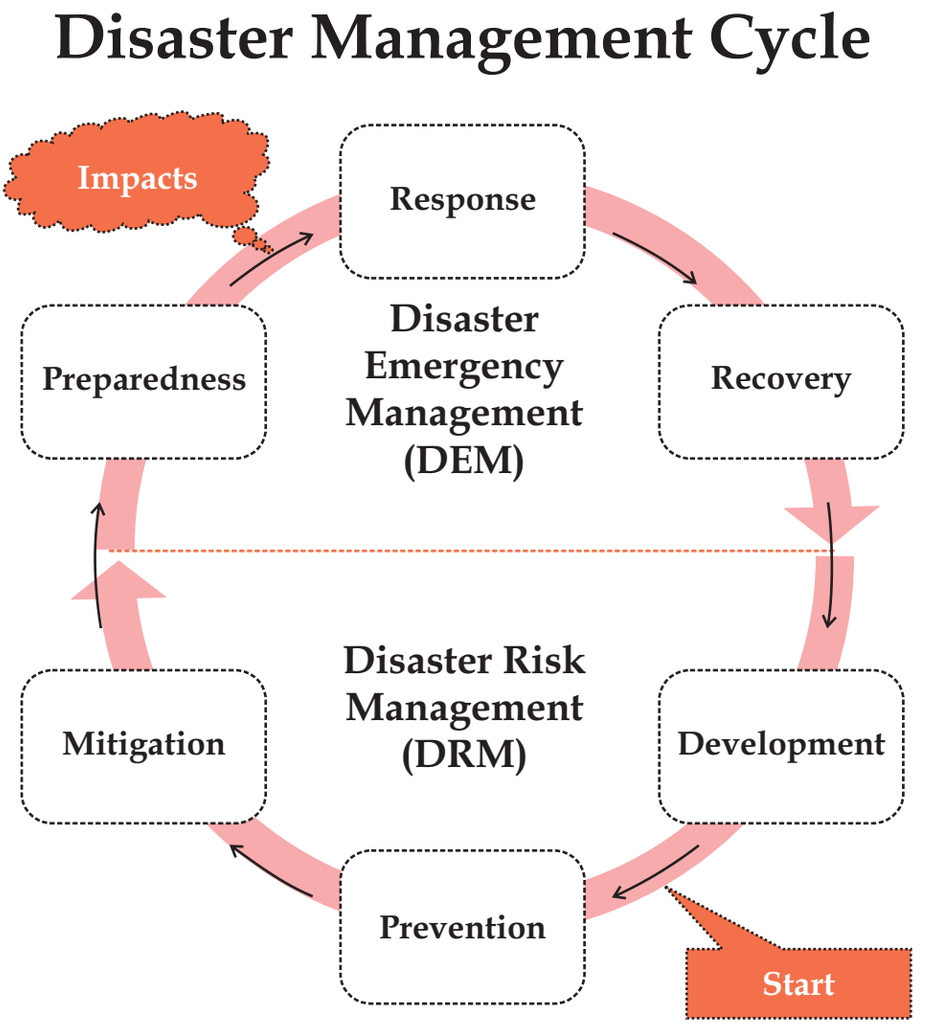
Divide the class in two groups. Group 1 has to list out as many measures in pre-disaster phases as they can in a given time. Group 2 has to do the same in post-disaster phases. Both groups have to ask from each other to what phase the listed measures belong. Group with higher number of correct answers and higher number of listed measures wins the game.

2.22 Disaster Risk Management

Disaster Risk Management is a broad range of activities designed to:

i. Prevent the loss of lives
ii. Minimize human suffering
iii. Inform the public and authorities about risk
iv. Minimize property damage and economic loss
v. Speed up the recovery process

Disaster Risk Management is a systematic application of management policies, procedures and practices and to identify, analyze, assess, treat, monitor and evaluate disaster risks. This involves decision-making based on the examination of those risks, which includes hazard, vulnerability and capacity of people and institutions. Disaster Risk Management is about looking beyond hazards alone to considering prevailing conditions of vulnerability. It is the social, cultural, economic, and political setting in a country/ region and or community that makes people vulnerable to unfortunate events. The main components of Disaster Risk Management are Prevention, Mitigation and Development.



2.23 Emergency Management

Disaster is bound by a specific period in which lives and essential properties are immediately at risk. Whereas an emergency can encompass a more general period in which, there is a clear and marked deterioration in the coping abilities of a group or community.

Characteristics of Emergency:

i. Disruptive to Individuals and Communities
ii. Not Part of Day-to- Day Experience
iii. Unpredictable in Occurrence and Effects
iv. Requires a Response
v. Local Resources may be "**inadequate**" to effectively cope with the situation.

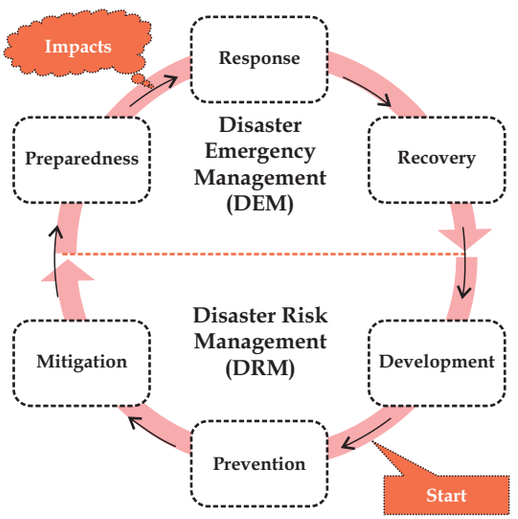
Objectives of Emergency Response:

i. To reduce the number of casualties
ii. To reduce impacts and damages to property.
iii. To ensure the restoration of basic needs of the victims and avoid further miseries.

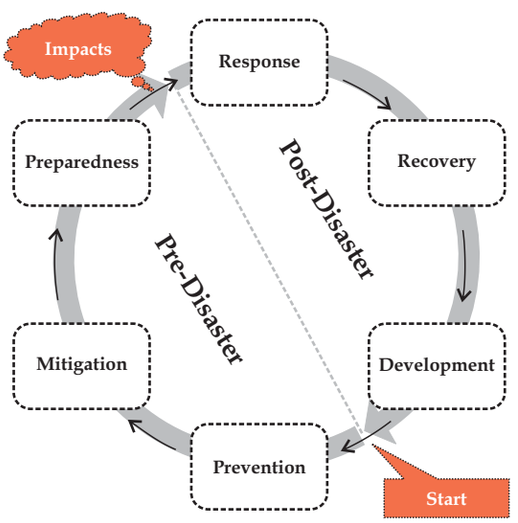
Ask the participants (Individually) to differentiate between two diagrams

Activity

Disaster Management Cycle



Disaster Management Cycle



2.24 Hydro-Meteorological Hazards

Hydro-Meteorological hazards are the one which are caused by extreme metrological and climate events such as floods, droughts, hurricanes, tornadoes, thunder storms etc. it can also be defined as process or phenomenon of atmospheric, hydrological or oceanographic nature that may cause loss of life, injuries or other health impacts, property damages, loss of life, livelihoods, services, social and economic disruption, or environmental damage.

Some Types of Hydro-meteorological Hazards

i. Wind chill, Strong winds/Gales, Winter storm, Storm surges/storm, Tropical Cyclones, Typhoons, Hurricanes, Tornadoes
ii. Sand Storms, Dust Storms
iii. Thunderstorms, Lightning, Thunder Squalls,
iv. Riverine, Flash, and Coastal Floods
v. Snow Avalanches
vi. Frost/Glazed Frost, Freezing Rain/Sleet, Waterspouts, Heavy Rainfall, Freezing Drizzle, Heavy Snowfalls, Blizzards, High Humidity, Fog/Dense Fog, Freeze, Blowing Snow, Hail, Snow Squalls
vii. Cold Wave/Intense Cold, Heat Waves/Excessive Heat
viii. Tidal Waves, Tsunamis/Seismic Sea Waves
ix. Drought

3. Historical development of DM at the UN Level

UN International Strategy for Disaster Reduction

Given the increasing concern about the impacts of disasters The UN General Assembly adopted the International Strategy for Disaster Reduction in December 1999 and established United Nation International Strategy for Disaster Reduction (UNISDR). Its mandate was expanded in 2001 to serve as the focal point in the United Nations system to ensure coordination and synergies among disaster risk reduction activities of the United Nations system and regional organizations and activities in socio-economic and humanitarian fields (UN General Assembly resolution 56/195) this strategy was built upon the experience of international decade for natural disaster reduction 1990-99. The decade was launched by general assembly in 1989.The International Strategy for Disaster Reduction builds upon the experience of the International Decade for Natural Disaster Reduction (1990-1999), which was launched by the General Assembly in 1989. The International Strategy embodies the principles articulated in a number of major documents adopted during the Decade.

UNISDR supports the implementation, follow-up and review of the Sendai Framework for Disaster Risk Reduction 2015-2030, which was adopted by the Third UN World Conference on Disaster Risk Reduction on 18 March 2015 in Sendai, Japan. The Sendai Framework is a 15-year voluntary, non-binding agreement that maps

out a broad people-centred approach for disaster risk reduction, succeeding the Hyogo Framework for Action that was in force from 2005 to 2015.UNISDR was created as an inter-agency secretariat of ISDR together with the Inter-Agency Task Force on Disaster Reduction. The UNISDR mandate was then expanded to serve as a focal point within the United Nations System for the coordination of disaster reduction and to ensure synergies among the disaster reduction activities of the UN system and regional organizations and activities in socio-economic and humanitarian fields. Further mandates are to promote public awareness and commitment, to expand networks and partnerships, and to improve knowledge of disaster causes and options for risk reduction, building on the Yokohama Strategy and Plan of Action and as follow-up to the International Decade for Natural Disaster Reduction.

UNISDR is led by the United Nations Special Representative of the Secretary-General for Disaster Risk Reduction (SRSG/ASG), UNISDR has over 100 staff located in its headquarters in Geneva, Switzerland, and five regional offices and other field sub offices.

Global Platform for Disaster Risk Reduction (GPDRR)

UNISDR leads the preparation and follow-up of the Global Platform for Disaster Risk Reduction established in 2006 (UN General Assembly resolution 61/198). The Global Platform has become the main global forum for disaster risk reduction and for the provision of strategic and coherent guidance for the implementation of the Sendai Framework and to share experience among stakeholders. Other areas of work for UNISDR includes issuing the Global Assessment Report on Disaster Risk Reduction every two years, supporting countries in monitoring risk trends and the implementation of the Sendai Framework, and leading global campaigns on disaster risk reduction for safer schools, safer hospitals and safer cities.

The UN organizations have prioritized DRR within their 2014-2017 strategic work plans of Food and Agricultural Organization (FAO); United Nations Development Programme (UNDP); United Nations Environment Programme (UNEP); United Nations Fund for Population Activities (UNFPA); UNHABITAT; United Nations International Children's Emergency Fund (UNICEF); United Nations Office for Project Services (UNOPS); World Food Programme (WFP); World Meteorological Organization (WMO); World Health Organization, (WHO); United Nations Educational, Scientific and Cultural Organization (UNESCO); United Nations Volunteers (UNV) and World Bank etc.

Some Other UN agencies and organizations committed to Disaster Risks:

i. International Atomic Energy Agency (IAEA)
ii. International Labour Organization (ILO)
iii. International Organization for Migration (IOM)
iv. International Telecommunication Union (ITU)
v. UN Office for the Coordination of Humanitarian Affairs (OCHA)
vi. Office of the United Nations High Commissioner for Human Rights (OHCHR)
vii. UN Centre for Regional Development (UNCRD)
viii. UN Convention to Combat Desertification (UNCCD)

ix. UN Development Operations Coordination Office (UNDOCO)

x. UN Development Programme - Bureau for Crisis Prevention and Recovery (UNDP/BCPR)

xi. UN Economic Commission for Europe (UNECE)

xii. The UN Framework Convention on Climate Change Secretariat (UNFCCC)

xiii. UN High Commissioner for Refugees (UNHCR)

xiv. UN Institute for Training and Research (UNITAR)

xv. Office of the High Representative for the Least Developed Countries, Landlocked Developing Countries and Small Island Developing States (UN-OHRLLS)

xvi. UN Office for Outer Space Affairs (UNOOSA)

xvii. UN University (UNU)

xviii. UN Entity for Gender Equality and the Empowerment of Women (UNWOMEN)

xix. The UN Development Group (UNDG)

xx. The Inter-Agency Standing Committee (IASC)

International Strategy for Disaster Reduction (ISDR)

2002 - The Johannesburg Plan of Action

The World Summit on Sustainable Development (WSSD) in Johannesburg, South Africa, noted that "an integrated, multi-hazard, inclusive approach to address vulnerability, risk assessment and disaster management, including prevention, mitigation, preparedness, response and recovery, is an essential element of a safer world in the twenty- first century."4 The Johannesburg Plan of Implementation provided UNISDR and the Inter-Agency Task Force with a concrete set of objectives for integrating and mainstreaming risk reduction into development policies and processes.

2005 - Second World Conference on Disaster Reduction and the Hyogo Framework for Action 2005-2015

The World Conference on Disaster Reduction was held in Kobe, Japan and adopted the "Hyogo Framework for Action 2005-2015: Building the Resilience of Nations and Communities to Disasters", which is currently serving as the guiding document in strengthening and building international cooperation to ensure that disaster risk reduction is used as a foundation for sound national and international development agendas.

The HFA outlines 5 priority areas for action and offers guiding principles for achieving disaster resilience. Mandate of the HFA is to reduce disaster risk and losses by 2015 by building the coping capacities of the nations and at risk communities to disasters. Priority areas of Hyogo Framework for Action are the following:

1. Ensure that disaster risk reduction is a national and a local priority with a strong institutional basis for implementation.
2. Identify, assess and monitor disaster risks and enhance early warning.
3. Use knowledge, innovation and education to build a culture of safety and resilience at all levels.

4. Reduce the underlying risk factors.
5. Strengthen disaster preparedness for effective response at all levels.

2007 - First session of the Global Platform on Disaster Risk Reduction

The UN General Assembly established a biennial Global Platform on disaster risk reduction to support the implementation of the Hyogo Framework for Action, allowing government representatives, NGOs, scientists, practitioners, private sector, IFIs and UN organizations to share experiences, identify remaining gaps, and formulate strategic guidance and advice for the implementation of the HFA. Six Regional Platforms and over 80 National Platforms have also been established as multi-stakeholder forums.5 Regional Platforms also assess progress but focus on the details of the regional plans of implementation and National Platforms act as the national coordinating body for disaster risk reduction.

2011 - Programme of Action for the Least Developed Countries for the Decade 2011-2020

The Istanbul Programme of Action (IPoA) charts out the international community's vision and strategy for the sustainable development of LDCs for the next decade with a strong focus on developing their productive capacities. The Programme recognized that the scale and impact of natural disasters has increased over recent decades, threatening hard-won development gains of LDCs. It encourages LCDs to take action in implementing and integrating disaster risk reduction in their national and long-term planning and policies.

2012 - United Nations Conference on Sustainable Development - Rio+20

The outcome Document - The Future We Want – of the United Nations Conference on Sustainable Development – Rio 20+ held in Rio de Janeiro, Brazil on 20–22 June 2012 contains a section (Chapter V-A) on disaster risk reduction that sets a firm foundation for discussions on a post-2015 framework to continue guiding nations after the Hyogo Framework expires in 2015.

2015 - Third United Nations World Conference on Disaster Risk Reduction and the Sendai Framework for Disaster Risk Reduction 2015-2030

The Third United Nations World Conference on Disaster Risk Reduction was held in Sendai, Japan from 14 to 18 March 2015, drawing 6,500 delegates to the conference itself and 50,000 people to the associated Public Forum. The Conference adopted the Sendai Framework for Disaster Risk Reduction 2015-2030 (Sendai Framework) as the first major agreement of the Post-2015 Development Agenda, with seven global targets and four priorities for action.

The Sendai Framework for Disaster Risk Reduction 2015-2030 is the successor instrument to the Hyogo Framework for Action (HFA) 2005-2015: Building the Resilience of Nations and Communities to Disasters. The HFA was conceived to give further impetus to the global work under the International Framework for Action for the International Decade for Natural Disaster Reduction of 1989, and the Yokohama Strategy for a Safer World: Guidelines for Natural Disaster Prevention, Preparedness and Mitigation and its Plan of Action, adopted in 1994 and the International Strategy for Disaster Reduction of 1999.

The Sendai Framework for Disaster Risk Reduction 2015-2030 outlines 7 targets and four priority areas for action to avoid new disaster challenges and mitigate the risk of existing disasters. These four priority areas are the following:

- Priority 1: Understanding disaster risk
- Priority 2: Strengthening disaster risk governance to manage disaster risk
- Priority 3: Investing in disaster risk reduction for resilience
- Priority 4: Enhancing disaster preparedness for effective response and to "Build Back Better" in recovery, rehabilitation and reconstruction.

4. Floods in Pakistan (Factors controlling water system in Pakistan)

Globally, flood is a recurrently occurring damaging phenomenon. In terms of flood related damages, approximately 90% is reported from the developing countries, where poverty is a major risk factor and holding low resilience. Pakistan has no exception to it, where flood is a frequently occurring adverse event. Pakistan is one of the flood prone countries in the world because of its physical and climatic characteristics. The Indus plain is occupied by more than 120 million populations, where agriculture is the major source of livelihood. Majority of them are poor section of the society and tenant cultivators. During the span of 67 years (1947-2013), on the average after each four-year, a severe flood hit the country. The increasing population, degradation of ecological environment and the changing climate scenario have further multiplied the risk of flood disasters.

4.1 Hydro-morphology of Pakistan

Hydro-morphology is the physical characteristics of the shape, boundaries and contents of water body. The topography of Pakistan is a profound blend of landscapes varying from plains to deserts, forests, hills, plateaus and high mountains ranging from the coastal areas of the Arabian Sea in the south to the mountains of the Karakoram ranges in the north. Likewise, the climate of Pakistan is also predominately arid and semi-arid in nature.

In such a unique diversity Allah the Almighty has gifted Pakistan with numerous glaciers, abundant water resources, with rivers flowing down the Karakorum Himalayas rough. It is this unique drainage system, which supports the life line in the country and help in generation of hydro-electricity. Managing the Indus River Basin in the light of scenario changing climate, water supply is rapidly decreasing for agricultural and urban needs particularly in big cities Karachi, Lahore and Faisalabad etc., where population growth has exceeded the physical institutional capacity of the public water system.

It's very unfortunate that Allocation of water among the provinces used to be made on ad hoc grounds up to until recently, when there was mutual consensus in the form of inter-provincial water accord. Unfortunately, due to drought of the late 1990s continued to the 21st century resultantly the accord remained unworkable. This has made imperative to work out inefficient and equitable management strategy about Indus Basin.

Every year due to floods a lot of water drains into the sea. Furthermore its inundation causes huge and irreparable losses to human lives, property and assets of both in public and private sectors. To work out a

sound and water conservation strategy is the need of the time, as demand for water continues to rise because of increasing use of water in agriculture and industry for the purpose of economic development and likewise population growing rapidly; whereas there is limited supply of water is very limited. Hence in such a scenario Water management is the biggest challenge of 21st century confronted by the country. The critical issue in water sector is to resolve the scarcity of water through augmentation and conservation.

4.2 Physiography of Pakistan

The physical pattern of Pakistan can broadly be classified into mountains, plateaus and plains. The physiography of Pakistan is a is a unique blend of landscapes varying from vast Indus plains to hills and plateaus ranging from the coastal areas of the Arabian Sea in the south to the highest mountains of the Karakoram, Himalayas and Hindu Kush in the north and north-west. Pakistan geologically overlaps both with the Indian and the Eurasian tectonic plates, where Sindh and Punjab provinces lie on the north-western corner of the Indian plate and hence prone to violent earthquakes where the two tectonic plates collide. The physical framework of Pakistan has been built by two major geomorphic processes that have produced two distinct physiographic entities:

i. The North Western Highlands produced by the mountain building movement extended from the Makran Coast in the south to the Pamir Plateau in the extreme north.

ii. The Indus Plains resulting from the deposition of sediments by the Indus River and its tributaries.

The following are main physiographic regions of Pakistan:

i. The North and Western Highlands

The north-western part of the country is occupied by the Hindu Kush Mountains, whereas Karakoram Range lies to the east of the Hindu Kush and north of the Himalayas. The highest peak in Karakoram Range is K2 with an elevation of 8,611m, whereas in the Himalaya Range, the highest peak is Nanga Parbat with an elevation of 8,126m. In the Hindu Kush range, Tirich Mir is the highest peak with 7,690m. Pamir Mountain is the junction of the Tian Shan, Karakoram, Kunlun, and Hindu Kush ranges. In Sulaiman Mountain Ranges, Takht-e-Sulaiman with 3,487m is the highest point. In Safed Koh range, Mount Sikaram with the height of 4,761m and in Salt Ranges (abundant with salt) has the highest peak of Sakaser with 1,522m. Toba Kakar Range and Kirthar Ranges are located in Balochistan and Sindh provinces respectively.

ii. **Potwar Plateau**

The Potwar Plateau extended in the north of salt range. Small hills of bare rocks rises steeply above the surface. The Soan River dominates the area. Makran range, Semi-desert coastal strip in the south of Balochistan along the coast of the Arabian Sea and the Gulf of Oman. The 1,000 Km coastline, about 750 km falls in Pakistan.

iii. **Baluchistan Plateau**

Most of the Balochistan is located on this plateau. The population density is very low due to the mountainous terrain and scarcity of water. The southern region is known as Makran, whereas the Sulaiman Mountains dominate the north-eastern corner.

iv. Indus Plains

These are flood plains of the Indus. The total length of the Indus River is 3,180 kilometers (1,976 miles). The river has a total drainage area of about 1,165,000 square kilometers. The river's estimated annual flow stands at around 207 Cubic Kilometers. The Indus River basin is a large, fertile alluvial plain formed by silt from the Indus. This area has been inhabited by Indus valley civilizations for at least 5,000 years. The upper Indus Basin includes Punjab province, whereas the lower Indus Basin begins at the Panjnad River (the confluence of the eastern tributaries of the Indus) and extends south to the Indus delta.

v. Deserts of Pakistan

Pakistan has also variety of desert vision the important are flowing Kharan Desert, Kharan District, Balochistan, Pakistan. Nara Desert, Wildlife Sanctuary is located in Mirpurkhas District, Sindh, Pakistan. Thar Desert, also known as the western section of Great Indian Desert. In Pakistan, Thar Desert covers eastern Sind province and the south-eastern portion of Pakistan's Punjab province. The Cholistan Desert is in Punjab Province and covers an area of 16,000 km².

4.3 Climate of Pakistan

Climate is condition of the atmosphere at a particular location over a long period of time. Climate encompasses the average condition of temperature, humidity, atmospheric pressure, winds, rainfall, atmospheric particle count and numerous other meteorological elements in a given region over long period of time.

Pakistan is located on a great landmass north of the tropic of Cancer between latitudes 24° and 37° North. It has continental type of climate characterized by extreme variations in temperature, both seasonally as well as on daily basis. Very high altitudes modify the climate in the cold, snow-covered northern mountains, whereas temperatures in the Baluchistan Plateau remains high during summer. Evenings are cool; the diurnal variation in temperature may be as much as 20° to 30° F (11° to 17° C). Winters are cold, with minimum mean temperatures of about 40° F (4° C) in January.

Climate Controlling Factors of Pakistan:

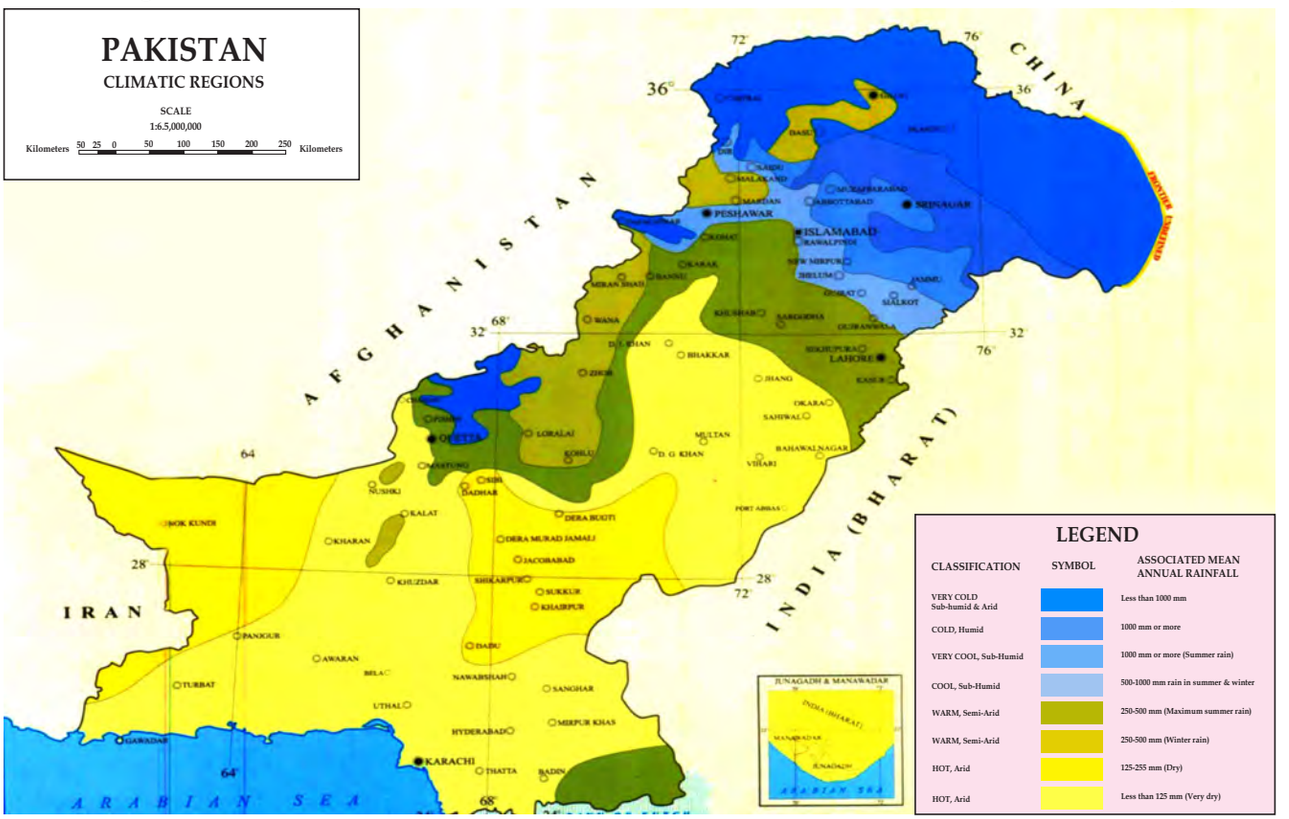
i. Location of Pakistan in the sub-Tropical location of Pakistan that tends to keep the temperature high, particularly in summer.

ii. The oceanic influence of the Arabian Sea that keeps down the temperature contrast between summer and winter at the coast.

iii. Higher altitudes in the west and north that keep the temperature down throughout the year.

iv. The Monsoon winds causing from Indian Ocean that bring rainfall in summer.

The Western Depression originating from the Mediterranean region and entering Pakistan from the west that brings rainfall in winter. These cyclones make a long land journey and are thus losses of most of the moisture by the time they reach Pakistan. A temperature inversion layer at a low elevation of about 1,500 m in the south during the summer that does not allow the moisture-laden air to rise and condensation to take place.



Climatic Regions of Pakistan:

- **Arid**
  - i. Warm Summer Mild Winter
  - ii. Hot Summer Mild Winter
  - iii. Warm Summer Cool Winter
- **Semi-Arid**
  - i. Hot Summer Mild Winter
  - ii. Warm Summer Cool Winter
- **Humid**
  - i. Hot Summer Mild Winter
  - ii. Warm Summer Cool Winter
  - iii. Highlands

4.4 Water Resources of Pakistan

In Pakistan, there are various sources of water resources including surface water, groundwater and water in the form of glaciers and snow. Pakistan receives ample amount of precipitation in the form of rainfall and snow fall during two well-marked seasons of summer monsoon and western depression in winter. The glacier area of Pakistan is about 13,680 sq. km and accounts for most of the rivers turnoff in summer.

Indus is the major river system of Pakistan with a number of tributaries. The five main rivers which join Indus from eastern side are Jhelum, Chenab, Ravi, Beas and Sutlej; beside three minor rivers are the Haro, Soan and Siran. There are number of Right Hand Rivers which join the River Indus from the west side, in which biggest river is Kabul and others are Gomal, Kurram, Tochi, Kohat and Tank zam. Beside Indus, small coastal rivers and inland streams are in Baluchistan. These are down and lakes America and torrent which are discussed below

Important Dames of Pakistan

Mangla Dam:

Mangla dam is on river Jhelum.

Warsak Dam

Warsak Dam is on river Kabul situated 30 km north-west of Peshawar near Warsak**.**

Terbala Dam

Tarbella Dam is in indus and in the world's largest earth-filled dam on river Indus in district Haripur.

Important Lakes of Pakistan

Lake Saif-Ul-Maluk

In Kaghan Valley Lake Saful Muluk is one of the most romantic lakes on planet Earth.

Rawal Lake

The Rawal Lake is located in Islamabad area and falls in the foothills of Murree and Margallah hills

Lake Khanpur

Lake Khanpur is located on Haripur-Taxila road. It is beautiful scenic spot.

Lake Simli

Lake Simli is reachable via Bhara Kahu and it is fed by springs and snow melt from Murree hills.

Lake Kallar Kahar

Lake KallarKahar is located in Salt range and on motorway. This Salt Lake is beautiful picnic spot with boating facilities.

Lake Rama

Lake Rama is located in astore valley of Gilgit-Baltistan. The lush green alpine forest multiplies its beauty.

Lake Satpara

Lake Satpara is a fresh water lake near Skardu.

Lake Bagshar

In Mirpur District, Lake Bagshar is a beautiful tourists resort with a clear crystal water.

Lake Haliji

Lake Haliji is located near Karachi and sanctuary of the largest number of bird.

Lake Kachura

Lake Kachura is in Skardu region and a famous for deep blue waters.

Lake Mahodand

Lake Mahodand is in upper Swat and beautiful tourist attraction site

Lake Naltar

Lake Naltar is located near village in Gilgit.

Lake Shandur

Lake Shandur is in Shandur Pass along the east bank of Laspur River, passing through the Harchin village.

Lake Hanna

Lake Hanna is located in the north east of Quetta in Hanna-Orak Valley

4.5 Drainage System in Pakistan

Indus River is the longest and the largest river system in Pakistan. Indus and its tributaries provide more than two-thirds of water for irrigation and households in Pakistan. Two or Three major drainage systems in Pakistan:

i. Indus Drainage Basin
ii. Inland Basin
iii. Coastal Drainage Basin

i. <u>Indus Drainage Basin:</u>

The Indus and its main tributaries (listed from mouth to the source) are: Indus River, Panjnad River, Chenab River, Ravi River, Poonch River, Kunhar River, Neelum River (Kishanganga), Sutlej River, Gomal River, Kundar River, Zhob River, Kurrum River (Karam), Tochi River (Gambila), Soan River, Haro River, Kabul River, Swat River, River Jindi, Panjkora River, Bara River, Lutkho River, Siran River, Tangir River, Astore River, Gilgit River, Hunza River, Naltar River, Hispar River, Shimshal River, Chapursan River, Misgar River, Khunjerab River, Ishkuman River, Yasin River, Shigar River, Braldu River, Shyok River, Saltoro River, Hushe River, Dras River and Shingo River.

The total drainage basin area of the Indus River is more than 1,165,000 km^2. Estimated annual flow of the Indus River stands at around 243 km^3. The Indus River is twenty-first largest rivers in the world in terms of annual flow. Beginning in a mountain spring and fed with glaciers and rivers in the Himalayas, the river supports ecosystems of temperate forests, plains and arid countryside.

ii. Inland Basin:

Hamun-i-Mashkel: Mashkel River and Rakshan River (Baluchistan)

Sistan Basin (Afghanistan): Lora River or Dori River (Baluchistan)

Indus Plains: Nari River, Mula River, Bolan River, Beji River, Anambar River, Loralai River, Loe Manda River (Baluchistan)

iii. Coastal Drainage Basin:

The source area of these seasonal rivers are Baluchistan Plateau, Kirthar Ranges and Makarn Ranges flowing into the Arabian Sea. Some of these rivers flow only during the rainy season and some are converted to dry torrents. The rivers of coastal Drainage Basin are: Dasht River, Kech River, Basol River, Hingol River, Nal River, Porali River, Hub River, Orangi Nala, Malir River, Lyari River and Gujjar Nala.

4.6 Indus Water Treaty 1960

The Indus Waters Treaty is a water-distribution treaty between India and Pakistan which was brokered by the World Bank. The treaty was signed by President of Pakistan General Ayub Khan and Prime Minister of India Jawaharlal Nehru in Karachi on September 19, 1960. The treaty has twelve articles and eight annexures. According to this agreement, control over the three "eastern" rivers of the Indus system i.e. the Beas, the Ravi and the Sutlej was given to India, while control over the three "western" rivers i.e. the Indus, the Chenab and the Jhelum to Pakistan. Since the ratification of the treaty in 1960, India and Pakistan have not engaged in any water wars. Most disagreements and disputes have been settled via legal procedures, provided for within the framework of the treaty. The treaty is considered to be one of the most successful water sharing endeavors in the world today, even though analysts are of the view that there is need to update certain technical specifications and expand the scope of the document to include climate change.

The treaty, under Article 5.1, envisages the sharing of waters of the rivers Ravi, Beas, Sutlej, Jhelum and Chenab which join the Indus River on its left bank (eastern side) in Pakistan. According to this treaty, Ravi, Beas and Sutlej, which constitute the eastern rivers, are allocated for exclusive use by India before they enter Pakistan. However, a transition period of 10 years was permitted in which India was bound to supply water to Pakistan from these rivers until Pakistan was able to build the canal system for utilization of waters of Jhelum, Chenab and the Indus itself, allocated to it under the treaty. Similarly, Pakistan has exclusive use of the western rivers Jhelum, Chenab and Indus. Pakistan also received one-time financial compensation for the loss of water from the eastern rivers. Since March 31, 1970, after the 10-year moratorium, India has secured full rights for use of the waters of the three rivers allocated to it. The treaty resulted in partitioning of the rivers rather than sharing of their waters.

Both the countries agreed to exchange data and co-operate in matters related to the treaty. For this purpose, treaty creates the Permanent Indus Commission, with a commissioner appointed by each country. It would follow the set procedure for adjudicating any future disputes arising over the allocation of waters. The Commission has survived three wars and provides an ongoing mechanism for consultation and conflict resolution through inspection, exchange of data and visits. The Commission is required to meet regularly to

discuss potential disputes as well as cooperative arrangements for the development of the basin. Either party must notify the other of plans to construct any engineering works which would affect the other party and to provide data about such works. In cases of any disagreement, a neutral expert has to be called in for mediation and arbitration. While neither side has initiated projects that could cause the kind of conflict that the Commission was created to resolve, the annual inspections and exchange of data continue, unperturbed by tensions on the subcontinent.

4.7 Elements at Risk to Floods

In Pakistan, due to frequently occurring flooding events numerous elements are at risk. It includes people, Buildings, Crops and farmland, Livelihoods, Infrastructure, Services, Environment, Organizations, Culture and heritage, Equipment, Reputations etc.

4.8 History of Floods in Pakistan

After Independence in 1947, major flood disasters occurred in Pakistan are briefly discussed below. In 1955 flood inundated 2,420 villages, where 400 people and 70,000 cattle lost their lives. The estimate of crop damages were 101,911 hectares. The total estimated damages caused by the flood of 1955 were RS. 83 Million.

In 1973,flood inundated approximately 3.6 million hectares of crops. It destroyed about 10,000 villages and 1,600 persons have lost their lives. Besides this, during 1973 to 1978 five serious floods have caused enormous destruction to lives and properties. These floods have victimized approximately 12.7 million persons. The Total cost of damages were about $ 15 million.

In the history of floods, the Karachi flood of 1977was unique in nature, which was caused by torrential rainfall. Actually in Karachi region rainfall extremely erratic. Here years may pass without any appreciable precipitation, and then several times the annual mean rainfall may be occurring a single month. On, July 1st 1977, a total of 299 mm of rainfall occurred in a single day. This heavy down pour caused flash floods in Lyari & Malir Rivers. Low lying areas of Karachi city were also flooded to a depth of 1.5 meters. Railways tracks near Mauripur were washed out; telephone lines, power supplies and drinking water mains were totally cutoff and the whole city was insolated for several days from its sources. This flood has killed 280 people, rendered about 18,000 homeless and destroyed 5000 dwellings units. Most of them who washed away in the bed of the Malir River were squatter settlers. Pakistan`s National Oil Refinery lost 60,000 drums of petrochemicals, scattered over 16 km of estuary as a result of the flood of July is, 1977.

Another notable event was the flood of 1992. In 1992, torrential rainfall occurred consequently Azad Jammu &Kashmir, Northern parts of Punjab including Potwar were severely affected, where a total of 1,500 people died as result of 1992 floods and about 8.5 million people were victims of flood. This flood also affected the province is said very badly. As a whole more than twelve thousand villages suffered extensive damages, more than 1.2 million houses were destroyed, and over 24 million hectares of agricultural land was devastated. The losses to crops and infrastructure were estimated at the tone of US $ 80 million. A lot of forest damages also occurred in this flood. It has been observed that the unprecedented violence of the monsoon rains of 1992 was the worst since Pakistan came into being.

In 2003, Sindh province was badly affected when above normal monsoon rainfall caused flood in the province. This flood urban flooding led to Karachi where two days of rainfall of 284.5 millimetres created havoc in the city, while Thatta district was the worst hit area where 404 mm rainfall has caused flash floods in the district. More than 480 people died and some 4,476 villages in the province were affected.

In 2007, Khyber-Pakhtunkhwa, Sindh and coastal Baluchistan were badly affected due to monsoon rainfall. Sindh and coastal Baluchistan were affected by Cyclone Yemyinin June and then torrential rains in July and August, while Khyber-Pakhtunkhwa was affected by melting glaciers as well as heavy rainfall in July and August. At least 130 people died and 2,000 were displaced in Khyber-Pakhtunkhwa in July and 22 people died in August, while 815 people died in Baluchistan and Sindh due to flash floods.

In 2010, almost all of Pakistan was affected when massive flooding caused by record breaking of rainfall hit the country. It severally affected Khyber-Pakhtunkhwa, Punjab and Sindh provinces. The number of individuals affected by the flooding exceeded the combined total of individuals affected by the 2004 Indian Ocean tsunami, the 2005 Kashmir earthquake as well as 2010 Haiti earthquake. Almost 2,000 people died and 20 million people were affected by the flood-2010.

In September 2011, about 361 people were killed due to flood. Some 5.3 million people were affected and 1.2 million houses were damaged around apart from this the flood in undated around 1.7 million acres arable land as a result of monsoon rains.

In September 2012, more than 100 people died, and thousands of houses were destroyed, with huge amount of arable land affected when intense rainfall battered Khyber Pakhtunkhwa, Southern Punjab and Upper Sindh. In August 2013, more than 80 people died as a result of flood. Likewise in September 2014, due to massive rain in occupied Jammu and Kashmir as well as in Azad Jammu & Kashmir and in Punjab created flood situation in River Chenab and River Jhelum.

5. Disaster Management System in Pakistan

5.1 History of Disaster Management

Before looking into the history of disaster management one should know about the hazard profile of Pakistan. Pakistan is vulnerable to wide range of disasters. The prevailing hazards in Pakistan are floods (Riverine, Flash Floods, Urban Floods, GOLFs, Coastal Floods), Earthquake, Drought, Avalanches, Cyclones, Tsunami, Sediments, Climatic Variations, Heat and Cold Waves etc. These disasters some time create secondary disasters.

It has been already discussed that diking during1980-2010, the country was hit by series of hydro-meteorological and geo-physical events. In the past three decades, a total of 138 disasters have been reported, where 87,053 people have lost their lives making an average of 2,808 per year. In the same events 58,098,719 people were affected making average of 1,874,152 affected persons per year with a total estimated economic loss of US$ 18,402,814. The frequency and recurrences of flooding events are 1.87 per year, earthquake 0.65 per year, cyclone 0.58 per year and epidemic 0.29 per year. This indicates that flood is the most recurrently occurring disaster.

Top 7 Natural Disasters from 1990-2010

Disaster	People Killed	Total Effected Population
Flood 2010	1,985	18,102,327
Flood 1992	1,334	6,655,450
Earthquake 2005	73,338	5,128,309
Drought 1999-2001	-	2,200,000
Cyclone 2007	609	1,650,000
Flood 1996	451	1,300,000
Flood 1995	600	1,255,000

5.2 Disaster Management Legislations

In Pakistan, mainstreaming DRR has become a policy requirement at local, regional and national level planning. In the context of DRR panning, disaster risk cannot be eliminated; nevertheless, its impact can be reduced through effective risk reduction techniques. That's why; it requires effective institutional set-up, national strategy and legislative coverage. In Pakistan, the national DRR efforts are in full-swing and trying to systematically encapsulate DRR practices in development programmes, planning and policies. In this regards, the Government of Pakistan has recently established climate change division, climate change policy, National DRR Policy and framework to address DRR initially under the umbrella of Hyogo Framework for Action (HFA) and now in-line with the Sendai framework.

National Calamities Prevention and relief Act 1958

In Pakistan, till 2006 the National Calamity Act of 1958 was the only legal document to regulate the relief, rehabilitation and reconstruction. This indicate that there no proactive strategy rather only reactive disaster related legal document functioned across the country for a long time. Under this regulation, there was an emergency relief cell within the cabinet division, which clarify that a legal coverage was there for relief compensation in either disaster phase or post-disaster period. There was no other task of relief commissioner rather to wait for a disaster to hit the country and start compensation. Under the National Calamity Act 1958, in the province a relief commissioner was overall in charge to supervise and coordinate the relief compensation and rehabilitation efforts. The data sources for the relief compensation was the Board of Revenue in each province and the same was held responsible to collect information related to disaster damages and to maintain the record of compensation.

National Disaster Management Ordinance

The 2005 earthquake was a stimulating factor together with the HFA (2005) as a signatory, the Pakistan Government become serious to institutionalise DRR. In the country, there was poor state of capacity building, institutional set-up at all levels right from national to community. During 2005 earthquake, several problems emerged and encountered the situation. Keeping in view this alarming state, the then president of Pakistan promulgated the National Disaster Management Ordinance (NDMO; now Act) in 2006. Under this ordinance, National Disaster Management System was introduced and National Disaster Management Commission (NDMC) was established at provincial and federal level. The NDMC has established NDMA and assigned the task to prepare guidelines, policy and national DRR plan.

National Disaster Management Act

In Pakistan, National Disaster Management Ordinance was promulgated in 2006 and the same was subsequently approved by the parliament in December 2010 and became the Act called as National Disaster Management Act (DMA) 2010. This Act provides a foundation for the establishment of full fledge system of national disaster management. Under DMA, three levels of disaster risk management have been established i.e. national provincial and at district level. The National Disaster Management Act provides the comprehensive guidelines and legislative set-up for entire disaster risk management system in Pakistan. National Disaster Management Act has highlighted the function and power of national disaster management commission and establishment of NDMA. The National Disaster Management Act focuses on the function and power of provincial disaster management commission and development of PDMA. Nevertheless, National Disaster Management Act discusses the third tier of district disaster management authority. It also discusses the establishment of national institute of disaster management, function of local authorities, establishment of national disaster response force and penalties. In Pakistan, the National Disaster Management Authority (NDMA) was established in 2007. Under the NDMO, the NDMA was made a focal point and held responsible for coordinating, implementing and monitoring body for DRR in the country. Under the Ordinance (now Act), the National Disaster Risk Management Framework (NDRMF) was prepared by in March 2007, which serves an overall guideline for disaster risk management at national, provincial and district level. Parallel to this, the NDMA, in collaboration with international and national partners has been strengthening the disaster risk management system in the country. In March 2010, the NDMA formulated the National Disaster Response Plan (NDRP) for identifying specific roles and responsibilities of the key stakeholders in emergency response including Standard Operation Procedures (SOPs). Various authorities have their areas of jurisdiction.

Pakistan National Disaster Risk Management Framework

In Pakistan, there was a paradigm shift in disaster management system from active approach to proactive one. Beside the provincial/regional authorities, the NDMA was set-up as a focal body and held responsible to effectively promote the DRR agenda, develop close liaison and implement the same in coordination with the regional and local disaster management authorities. In this regard, in 2007 the National Disaster Risk Management Framework was developed to identify and guide all the stakeholders. The vision of framework is to achieve sustainable socio-economic and environmental development through minimizing vulnerabilities and risk specifically marginalized groups, emergency response and early recovery. The framework has identified nine priority areas including Institutional and legal arrangements for Disaster Risk Management; hazard and

vulnerability assessment; training, awareness and education; planning for disaster risk management; community and local level programming; Multi-hazard early warning system; Mainstreaming disaster risk reduction into development; Emergency response system, and Capacity development for post disaster recovery.

The role of National Disaster Management Authority is to:

- Coordinate complete spectrum of DRM at national level
- Act as Secretariat of the National Disaster Management Commission
- Map all hazards in the country and conduct risk analyses on a regular basis

- Develop guidelines and standards for national and provincial stakeholders
- Ensure establishment of DM Authorities at provincial, district levels
- Provide technical assistance to federal ministries
- Organize training and awareness raising activities
- Collect, analyze, process, and disseminate inter-sectoral information
- Ensure appropriate regulations are framed to develop disaster response volunteer teams
- Create requisite environment for participation of media in DRM activities,
- Serve as the lead agency for NGOs and international cooperation
- Establish a National Disaster Management Fund,

Whereas the regional authorities such as PDMA, FDMA & SDMA are to:

- Coordinate complete spectrum of disasters in the province/region,
- Formulate provincial/regional disaster risk management plan
- Continuously monitor hazards, risks and vulnerable conditions
- Develop guidelines and standards for provincial/regional and local stakeholders
- Ensure preparation of disaster risk management plans by all districts;
- Coordinate implementation of provincial DRM
- Promote education, awareness and training on DRR and response
- Provide necessary technical assistance and advice to local authorities for carrying out their functions effectively;
- Coordinate emergency response in the event of a disaster
- Develop specific capabilities to manage threats that exist in the province/region,

At district level, the role of District Disaster Management Authorities are to:

- Formulate district DRM plan
- Review development plans of government departments and provide guidance on mainstreaming DRR measures in these plans,
- Monitor hazards, risks and vulnerable conditions within the district,

- Prepare guidelines and standards for local stakeholders on DRR
- Conduct education, training and public awareness programmes
- Encourage involvement of community groups in DRR
- Undertake appropriate preparedness measures at district level
- In the event of a disaster, organize emergency
- Keep linkages with the Provincial Disaster Management

The role of community Organizations are:

- Capacity building of existing CBOs
- Establishment of new community based groups/organizations
- Local early warning system, evacuation, first aid, search and rescue, firefighting etc. would be done in close coordination with CBOs
- Financial management for CBOs

National Disaster Management Plan (2012-2022)

The country faces wide range of hazards, which requires country ability to effectively handle these challenges through comprehensive national approach of disaster risk management. During 2008-2009, on the request of Government of Pakistan, JICA has studied the entire legal and administrative set-up of DRM in Pakistan and a project document on formulation of a National Disaster Management Plan (NDMP) for Pakistan (GoP 2012b). In 2012, with technical assistance of JICA, national disaster management plan was prepared. The government of Pakistan approved the project which span on long ten years (2012-2022) with an estimated cost of 1.040 Billion US Dollars. The plan was aimed at enhancing the capacity to prepare and respond to disasters by proactive approach for dealing through disaster risk management in line with the National Disaster Management Act.

NDMP is a comprehensive plan, consisting of the “Main Plan” document along with three supporting volumes besides the Executive Summary, which identifies macro level hazards and risk assessment, development of the multi hazard early warning system to reduce the vulnerability to disasters by enhancing and strengthening the early warning capacity, identification of the roles and responsibilities of key stakeholders, including federal, provincial and district governments, community organizations, NGOs, businesses, and individuals who are involved in the disaster management. The Community Based Disaster Risk Management (CBDRM) approach, in view of its universal reorganization and importance in DRM planning, has been given due place in the Plan. Based on pilot activities tested in different hazard contexts and social settings, best practices and guidelines have been documented in the Plan to serve as model for future CBDRM activities in Pakistan. The Plan also

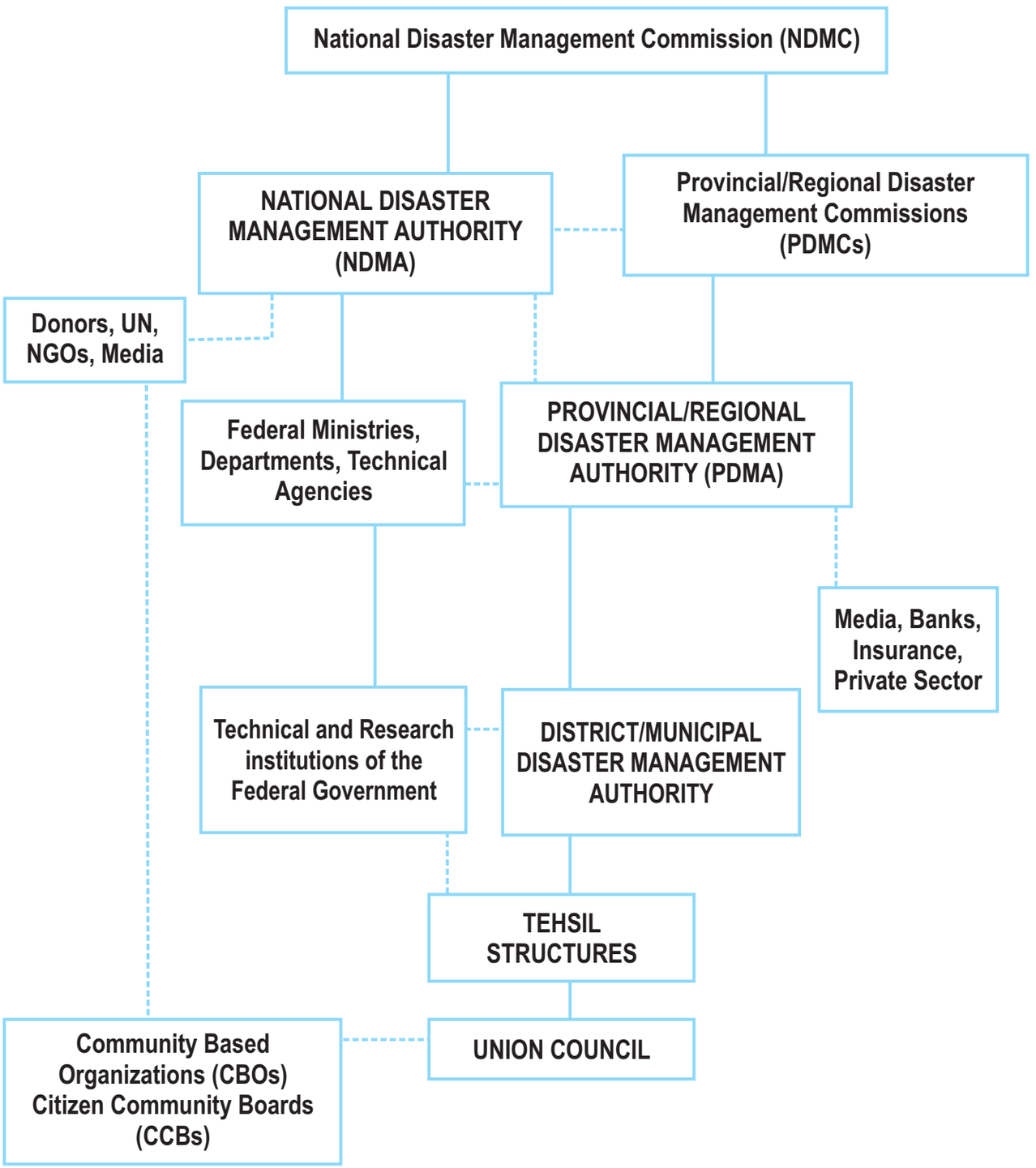
provides strategic direction for systematic human resource development in the field of disaster management and the operational plan for the National Institute of Disaster Management (NIDM).

Disaster Management is the coordination and integration of all activities necessary to build, sustain and improve the capability to prepare for, protect against, respond to and recover from threatening or actual natural or human-induced disasters. Key Actors are Federal, provincial and local governments, civil society, private sector and international community. The National Disaster Management Framework (NDMF) provides this mechanism that serves as a regulatory guideline for effective and efficient disaster management. The framework defines measurable, flexible and adaptable coordinating structures, and aligns key roles and responsibilities of disaster management stakeholders across the nation;

Priorities for Disaster Risk Management

- ✓ Institutions and Legal Arrangements (DM authorities established)
- ✓ National Hazard and Vulnerability Assessment
- ✓ Training, Education and Awareness
- ✓ Promoting Disaster Risk Management Planning
- ✓ Community and Local Level Risk Reduction Programming
- ✓ Multi-hazard Early Warning System
- ✓ Mainstreaming Disaster Risk Reduction into Development
- ✓ Emergency Response System
- ✓ Capacity Development for Post Disaster Recovery

Structure for Disaster Risk Management



6. Flood Management in Pakistan

6.1 Types of Floods in Pakistan

i. Riverine Floods

Riverine flooding occurs when water upsurges over the banks of river or stream. This is the most common and can occur in any size of channel from small ranging streams these are caused by prolong rainfall and meting now to big rivers. The damage from a river flood can be widespread as it overflow the levees, often causing dams and dikes to break and inundate nearby built up or agriculture areas.

ii. Coastal Floods (Fluvial and Tsunami)

Coastal Floods is a type of waves triggered by the earthquake or undersea volcanic eruption. Out in the bottom of the ocean tsunami waves do not dramatically increase in height. But as the waves travel towards the land, they build up to higher and higher heights as the depth of the ocean decreases, due to the constructive waves (constructive waves are those waves which travels along the same direction). The speed of tsunami waves depends on depth of the ocean.

Tsunami waves may travel as fast as jet planes over deep waters, only slowing down when reaching shallow waters, or due to the destructive waves. While tsunamis are often referred to as tidal waves, this name is discouraged by oceanographers because tides have little to do with these giant waves.

iii. Flash Floods

Flash flood is categorized by an intense, high velocity torrent of water that occurs in an existing river channel with very less lead time as a result of heavy downburst. Flash floods are very catastrophic not only because it carries sediment load. Flash flood occurs in torrents that are normally dry.

iv. Urban floods

Urban floods can be categorized with flash flood. Urban flooding is natural phenomenon occurs when an extremely heavy downpour of rain saturates the urban drainage system and the excess water cannot be absorbed. It has become a serious problem of cities of both Developed and Under- developed region. The population influx and aerial growth of cities and intensive urban development have intensified this problem. Cities are generally flooded when excessive precipitation takes place beyond the capacity of surface drainage. Urban sprawl and urban encroachment intensify this problem in form of reducing rainwater infiltration and increasing surface runoff. Lack of planning about rainwater and sewerage discharge and population growth aggravate this problem.

6.2 Causes of Floods in Pakistan

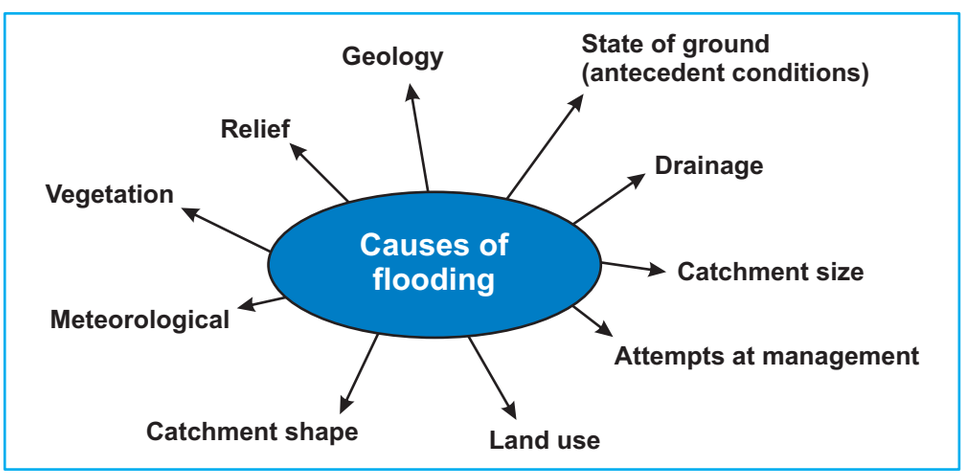
Floods are not always caused by the precipitation. They can be generated by other phenomena as well. For example in coastal areas flood mostly occurs due to the storm surge followed by cyclones. Other factors which may contribute to flooding include:

i. volume, spatial distribution, intensity and duration of rainfall over a catchment;

ii. the capacity of the watercourse or stream network to convey runoff;

iii. catchment and weather conditions prior to a rainfall event;

iv. tidal influences



Metrological cause of flood refers to the climatic variations. This type of cause is concerned with the weather i.e. Heavy downpour of the water from the clouds and cyclones in the coastal areas etc.

6.3 Floods Intensifying factors in Pakistan

Apart from causes there are flood intensifying factors, some of which are the following:

- Deforestation
- Overgrazing
- Unplanned Urbanization
- Encroachment
- Lack of effective flood management policies
- Lack of awareness
- Topography

6.4 Impacts of Floods

Floods have very devastating consequences and have severe effects on the economy, environment and human lives. Flood have both negative as well as positive impacts on human life, depending upon the location and extent of flood and the vulnerability and value of the natural and constructed environment it effects. As immediate impacts of flood include casualties, collapse of buildings, destruction of crops, loss of livestock, and deterioration of health conditions owing to waterborne diseases. As communication links and infrastructure such as power plants, roads and bridges are damaged and disrupted, some economic activities may come to a standstill, people are forced to leave their homes and normal life is disrupted.

i. Death and injuries
ii. Physical drainage
iii. Agriculture
iv. Infrastructure

Direct & Indirect Losses

Direct loss due to floods are all those damages which are directly associated with inundation e.g. crop destruction, direct casualties, death toll, damage to building and infrastructure, loss of livestock etc.

Direct loses: **Loss of contact with flood water**	**Indirect loses:** **No contact – loss as a consequence of flood water**
e.g. Buildings and contents, vehicles, livestock, crops, infrastructure	e.g. Disruption to transport, loss of value added in commerce and business interruption, legal costs associated with lawsuits
e.g. Lives and injuries, loss of memorabilia, damage to cultural or heritage sites, ecological damage	e.g. Stress and anxiety, disruption to living , loss of community, loss of cultural and environmental sites, ecosystem resource loss

Indirect losses are secondary losses which are not on the spot but resultant of the direct losses. Less agriculture yield, inflation, migration, waterborne diseases, insomnia etc. are secondary or indirect losses.

Economic losses

Economic loss is a term of art which refers to financial loss and damage suffered by a person such as can be seen only on a balance sheet rather than as physical injury to the person or destruction of property. During floods communication infrastructure, farms, houses and automobiles are destroyed. People become homeless. Additionally, the government deploys firemen, police and other emergency apparatuses to help the affected households. All these come at a heavy cost to people and the government. It usually takes years for affected communities to be re-built and business to come back to normalcy. Floods destroy decades of developmental progress in a week or even in days. Resultantly, most of the developmental projects halted and the economy being diverted to the relief and recovery of the affectees.

Natural Disasters in Pakistan for the period 1900 to 2011 Numbers of Total Affected People
Source: SAARC, 2014)

Disaster	Date	Total No of Affectees
Flood	28 July 2010	20,202,327
Storm	26 June 2007	1,650,000
Flood	9 February 2005	7,000,450
Earthquake	8 October 2005	5,128,000
Drought	November 1999	2,200,000
Flood	8 September 1992	6,655,450
Flood	15 July 1992	6,184,418
Flood	July 1978	2,246,000
Flood	2 August 1976	5,566,000
Flood	August 1973	4,800,000

List of massive flood events in Pakistan with at least 100 fatalities, 1950-2013

Year	Region affected	Fatalities	No of villages affected	Year	Region affected	Fatalities	No of villages affected
1950	Punjab	2,900	10,000	1996	Punjab	111	-
1954	Punjab, Sindh	300	-	1997	Punjab	140	-
1956	Punjab, Sindh	270	11,609	1998	Baluchistan	1,000	-
1959	Punjab	100	-	1999	Sindh	231*	-
1964	Sindh	450*	-	2001	Islamabad	210	50
1965	Karachi	10,000*	-	2003	Sindh	230	-
1973	Punjab, Sindh	474	9,719	2005	Baluchistan	520	1,931
1976	Punjab, Sindh, KP	338	18,390	2006	KP, Punjab	233	2,477
1977	Karachi	848	-	2007	Baluchistan, Sindh	242*	6,500
1978	Punjab, Sindh	393	9,199	2007	Sindh, KP	358	-
1988	Sindh, Punjab	196	1,000	2010	Punjab, Sindh, Baluchistan, KP, AJK	1,985	78 Districts
1992	AJK, Sindh and Punjab	1,444	13,208	2011	Sindh	509	23 Districts
1993	Sindh	609*	-	2012	Punjab	480	-
1994	Punjab, Sind, KP	316	-	2013	Punjab, Sindh	446	-
1995	Punjab, Sindh, Baluchistan, KP, AJK	1,051	6,852				

Source: Rahman 2010; EM-DAT 2014; Paulikas and Rahman 2014. *indicate cyclone induced floods

Damages of floods-2010 in Pakistan

PAKISTAN: FLOOD DISASTERS, 2001-2013

Year	Number of Deaths	Number of Persons Affected	Est. loss in USS (millions)
2001	210	400179	1900
2002	36	3010	2500
2003	266	1266243	2500
2004	5	5	9500
2005	636	7527043	-
2006	400	8125	103
2007	526	2706	327.118
2008	83	290764	0
2009	102	75080	30
2010	1985	20359496	-
2011	509	5400755	-
2012	518	5050564	0.03
2013	446	3002129	246

Source: EM-Dat: the OFDA/CRED International Disaster Database 2014; FFC 2013

6.5 Flood Prevention and Mitigation Measures

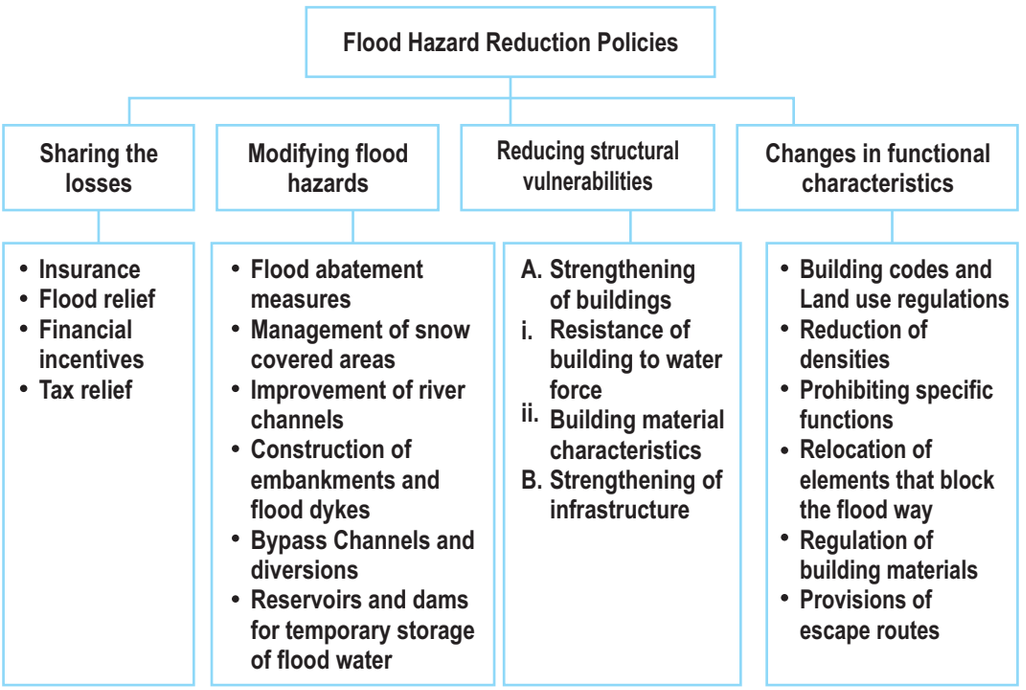
Investing in pre-disaster phase is far better than post disaster phase. Reactive approach will cost 10 times more as compared to proactive approach. In fact effective response is only possible when preventive, mitigation and preparedness measures are taken efficiently. Flood prevention and mitigation measures can be categorize into structural and non-structural measures;

Structural Measures

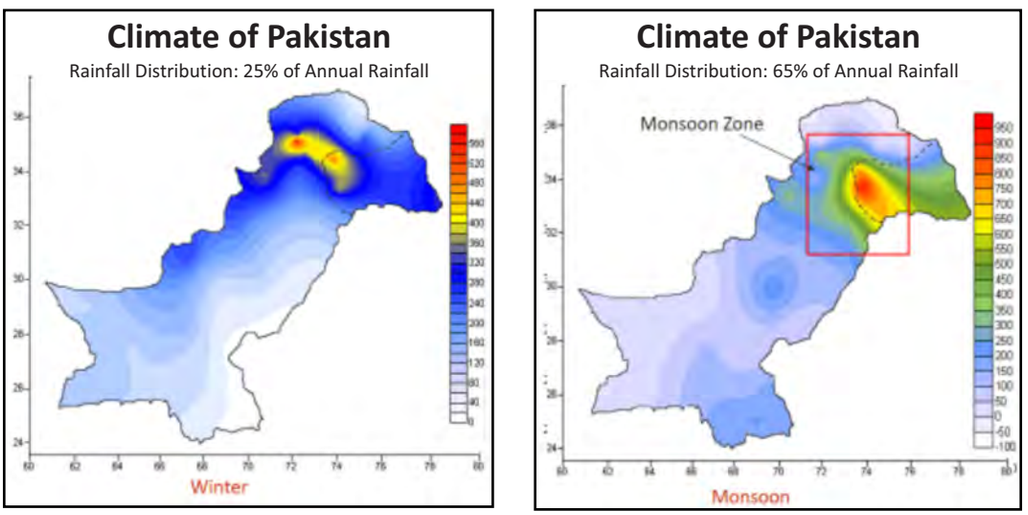
Structural measures refer to the physical interventions taken in order to prevent or lower the consequences of flooding on human lives, property, infrastructure and livelihoods. Structural measures are further categorized into engineered structured measures and non-engineered structural measures. Engineered structural measures are soil bio-engineering, embankments, dikes, retention walls, dams, check dams, relief channels watershed management etc. while non-engineered structural measures are sand bagging or other indigenously/domestically taken measures.

Non-Structural Measures

Non Structural Measures refer to a set of mitigation and/or adaptation measures that do not make use of traditional structural flood protection measures. They reduce damage without influencing the current of the flood event. Non-structural measures are non-physical measures taken to enhance the coping capacity of the communities at risk. These are the policies, trainings, education, awareness, simulation exercises, incorporating disaster risk management subjects in the curricula, ban on illegal litigation along river side, land use planning etc.



Source: Adopted from Khan, 2016



Pakistan: Distribution of Rainfall during winter and summer

7. Flood Forecasting and Early Warning System

Flooding became a regular annual based phenomenon in various regions of the world, occurring with different magnitudes and frequencies to which people have adapted for decades. These floods are generally probable in many parts of the world, since they enrich the soil and provide both water and livelihoods. In contrast, flooding resulting from extreme hydro-meteorological events and occurring in unexpected magnitudes and frequencies can cause loss of lives, property, livelihoods, infrastructure and environment.

Floods have the greatest potential for damage of all natural disasters worldwide and affect the greatest number of people. Globally, there is evidence that the number of people affected by flooding is on the rise at an alarming rate, with associated economic damage. These floods affect life and livelihoods in human settlements in all areas such as flood plains, coastal zones, river deltas and alpine region as well. Flooding is also increasing in urban areas causing severe problems for poor and vulnerable people. Most the damages occurs due to poor early warning system and fault in the forecasting.

Providing flood forecasting is a part of flood management planning and development strategies. These strategies address occupied flood plain areas where non-structural measures can be effective for example temporary defences such as flood gates or movable barriers or domestic protection such as sandbagging as well as local evacuation to flood shelters.

Flood management requires engaging water management agencies and local or municipal authorities along with transport and communications operations and emergency services. Flood forecasting has to provide information to these users so they can prepare and respond. In extreme cases flood forecasting is part of a wider disaster management capacity devolving from the highest level of government. The precise role of flood forecasting will vary according to the circumstances dictated by both the hydro-meteorological environment and the built-up environment.

PMD: Pakistan Meteorological Department

Flood Forecasting System at PMD

10-cm Doppler Radars

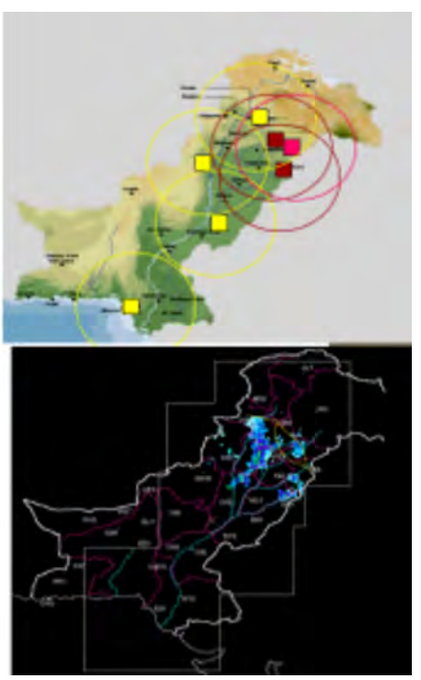
Lahore (1)
Mangla (2)

QPM Radar

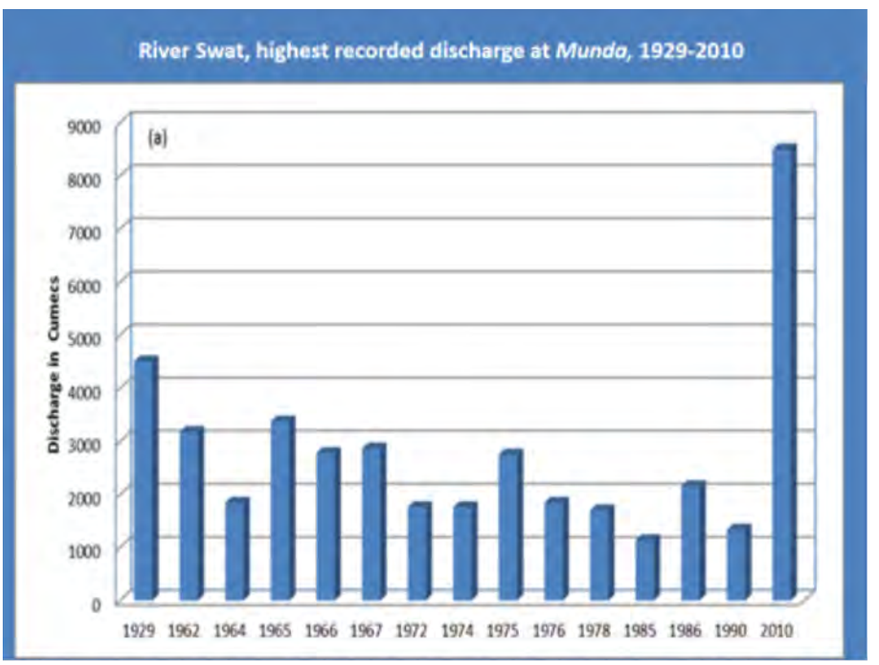
Sialkot (1)

5-cm Wx. Surveillance Radars

Islamabad (1)
D.I.Khan (3)
Rahim Yar Khan (4)
Karachi (4)



Cyclone 2A making landfall near Karachi at peak intensity as Category-3 Hurricane in May 1999



PMD: Pakistan Meteorological Department

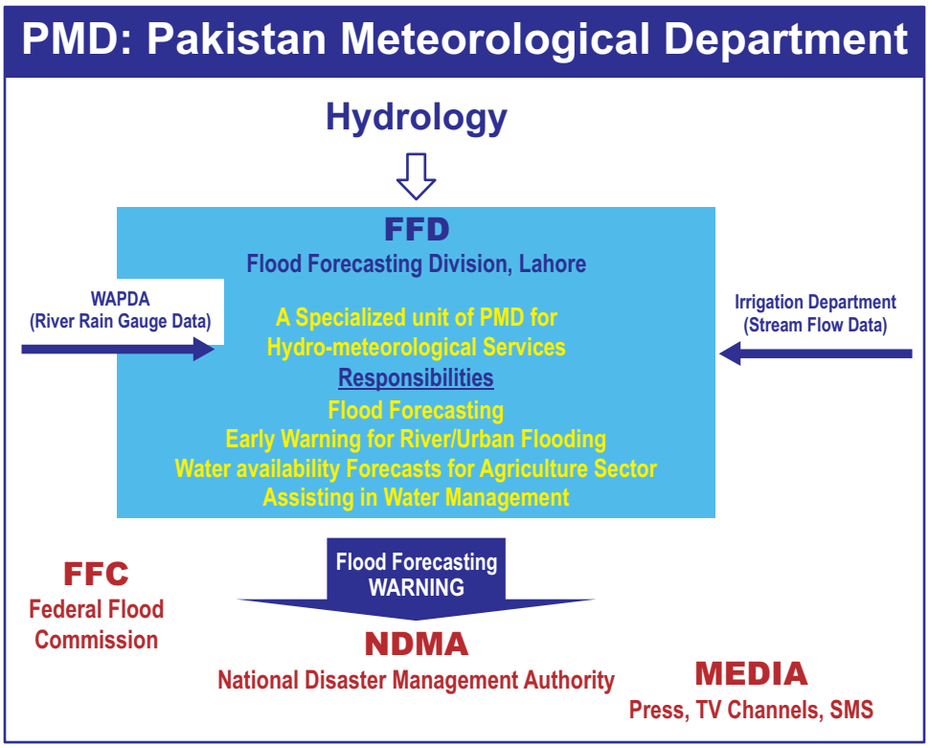
Specialized Early Warning Centers of PMD

- National Weather Forecasting Centre Islamabad (NWFC)
- Marine Meteorology & Tropical Cyclone Early Warning Centre Karachi (TCWC)
- National Drought Monitoring Centre Islamabad (NDMC)
- National Seismic Monitoring & Tsunami Early Warning Centre Karachi (NTWC)
- Flood Forecasting Division Lahore (FFD)
- Flash Flood Forecasting & Warning Centre For Lai Nullah Basin Islamabad

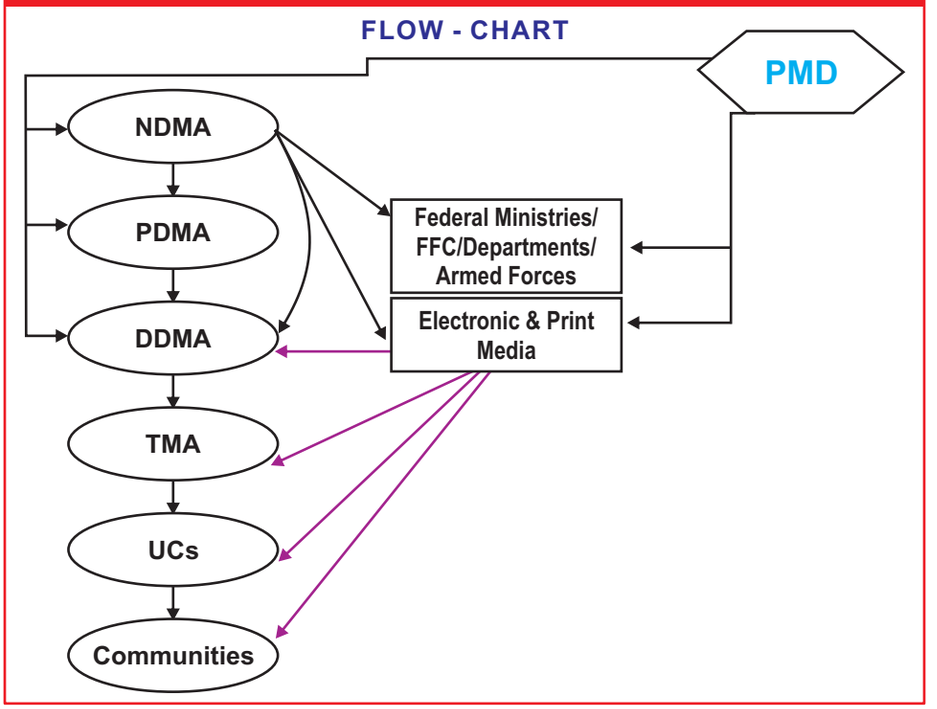
Flood Forecasting Tools

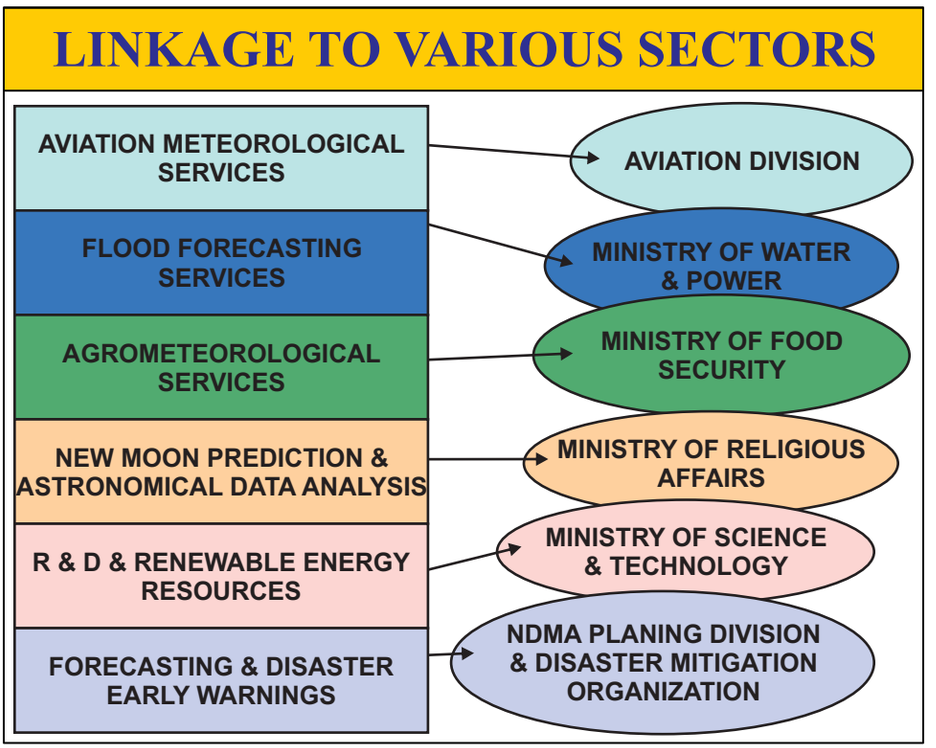
- Real Time Hydro Meteorological Data (from Wapda & Irrigation Department)
- Real Time and Prognostic Weather Charts (PMD NWP Center & Global Products)
- Numerical Weather Prediction Models (PMD NWP Center & Global Products)
- Hydrological Models/Statistical Model
- Satellite data (Hydro estimator, JAXA)
- Weather Radar Network

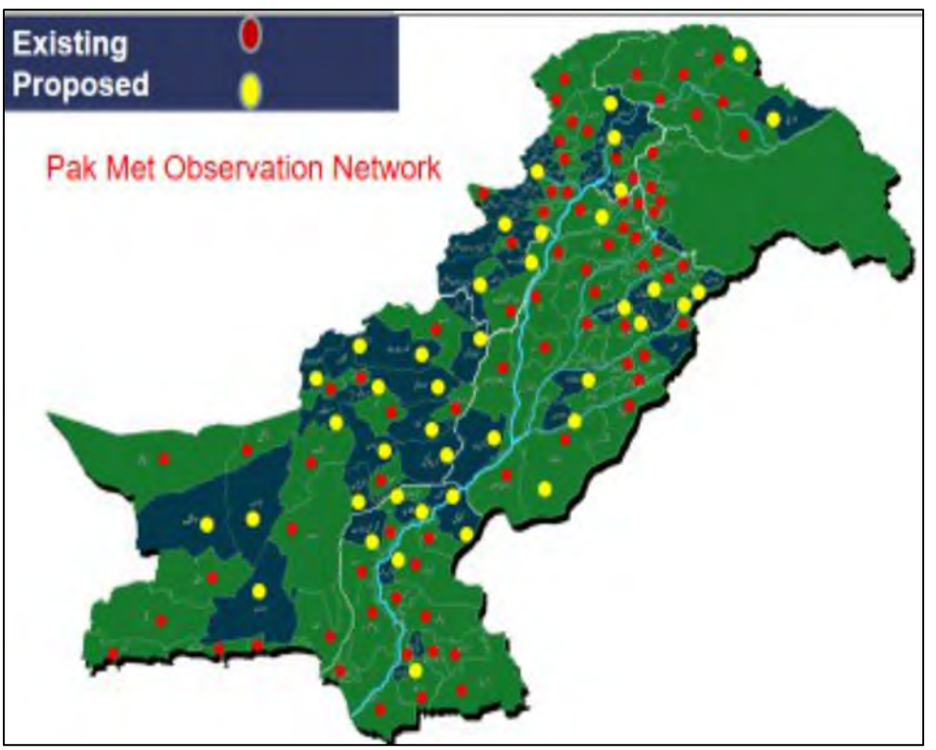
PMD: Pakistan Meteorological Department



Early Warning Information Dissemination - Institutional Cooperation




LINKAGE TO VARIOUS SECTORS
AVIATION METEOROLOGICAL SERVICES
FLOOD FORECASTING SERVICES
AGROMETEOROLOGICAL SERVICES
NEW MOON PREDICTION & ASTRONOMICAL DATA ANALYSIS
R & D & RENEWABLE ENERGY RESOURCES
FORECASTING & DISASTER EARLY WARNINGS
AVIATION DIVISION
MINISTRY OF WATER & POWER
MINISTRY OF FOOD SECURITY
MINISTRY OF RELIGIOUS AFFAIRS
MINISTRY OF SCIENCE & TECHNOLOGY
NDMA PLANING DIVISION & DISASTER MITIGATION ORGANIZATION


Existing
Proposed
Pak Met Observation Network

7.1 Early Warning System (EWS)

Natural Hazards and Early Warning System (EWS)

The term "early warning" is used in many fields to mean provision of information on an emerging dangerous circumstance where information an enable action in advance to reduce the risks involved. Early warning systems exist for natural geophysical and biological hazards, complex socio-political emergencies, industrial hazards, personal health risks and many other related risks.

In the present setting we are concerned with geophysical. Hazards like storms, floods, droughts, landslides, volcanic eruptions, tsunamis etc. and related hazards that have a geophysical. Component, such as wild-land fire, locust plagues and famines. In the current UN-ISDR terminology, early warning is defined as 'the provision of timely and effective information, through identified institutions, that allows individuals exposed to a hazard to take action to avoid or reduce their risk and prepare for effective response.

Types of flood warning information

There are two types of flood warnings. Formal flood warning systems operated to warn other agencies and the public of flooding. Although there is unofficial or 'self-warning', or community based flood warning have so far gained least attention. Official flood warning systems often have several levels or types of warning e.g. in England these are 'flood watch', 'flood warning', 'severe flood warning' and 'all clear'.

Whatever the warning source, flood warnings may be

(1) Timely,
(2) Untimely and
(3) A so called 'false warning'

Effective flood forecasting and early warning system

The effective flood forecasting and early warning system is:

- To aggregate, in a centralized system, various types of data related to flood and flash flood events.
- The availability of data on past floods and flash floods
- To assist and enhance the warning and emergency preparedness procedures

7.2 Flood Early Warning System in Pakistan

Early warning systems is defined that it need to actively involve the communities at risk, facilitate public education and awareness of risks, effectively disseminate alerts, and warnings and ensure there is constant state of preparedness

In Pakistan, monsoon Season normally starts in July-September. However, the Flood Warning Centres of all flood management related agencies start functioning from 15th June every year for collecting weather & flood flows data and keep continue up to15th October. During this period effective interaction and communication between various floods related provincial as well as federal agencies is maintained in order to counter any eventuality due to monsoon rain-induced floods in the most vulnerable regions of Pakistan.

7.3 Responsible Organizations in Flood forecasting and early warning

Flood hazard management is a multifunctional process. Number of organizations are play significant role in flood hazard assessment. The federal Government organizations, as well as provincial organizations play key role. The organization which play role in flood management are the Provincial Irrigation Departments (PIDs), WAPDA, Provincial Relief Organizations, Pak Army, Emergency Relief Cell (ERC) of the Cabinet Division, Federal Flood Commission (FFC), NHA, Pakistan Railways, Flood Forecasting Division (FFD), PMD, National Disaster Management Authority (NDMA), Provincial Disaster Management Authorities (PDMAs) Provincial and DDMAs District Administration on district level.

7.4 Flood Hazard Monitoring

Channel/River Characteristics

Channel characteristics refer to the width, depth, sediment load capacity, length of the channels. Nature of the soil and encroachment effect channel characteristics. Which further leads enhance the damageability of the flood hazard? In flood management assessing the river characteristics is of basic concern.

Drainage Pattern

Drainage pattern is dendritic or network characteristics that define the bifurcation ratio of the water-shed. The higher the bifurcation ratio the lower will be the probability of occurrence of flood, the lower the bifurcation the more will be chances of flooding. Channels that joins one main river are known as tributary

while the channel that comes out of the main channel are called distributor. These tributaries and distributaries make the drainage pattern. In flood management drainage pattern must be evaluated in order to understand the behaviour of overflow.

Drainage Pattern of Rivers in Pakistan

Flooding occurs mostly due to heavy rainfall when water channels do not have the capacity to convey excess water. However, floods are not always caused by heavy rainfall. They can result from other phenomena. Particularly in coastal areas where outpouring can be caused by a storm surge associated with a tropical cyclone, a tsunami or a high tide coincide with higher than normal river levels. Dam bursting triggered for example by an earthquake, will result in flooding of the downstream area, even in dry weather conditions. Other factors which may contribute to flooding include; volume, spatial distribution, intensity and duration of rainfall over a catchment. The capacity of the watercourse, or stream network to convey runoff, Catchment, encroachment and weather conditions prior to a rainfall event, Ground cover, Topography and tidal influences. Intensifying factors are all those factors which directly or indirectly increases the level, intensity and duration of overflow. This might be natural as well as human-induced. Natural intensifying factors are; topography, geology, slope, sediment load etc. Human induced flood intensifying factors are encroachment into the flood plain, illegal litigation on flood plain, no land use planning, sediment load, nature and material used in buildings etc. Surface runoff is water from precipitation, snowmelt, or other sources that flows over the land surface. Runoff that occurs on surfaces before reaching a channel, is also called overland flow. When runoff flows along the ground, it can pick up soil contaminants. Urbanization increases surface runoff by creating more impervious surfaces, such as pavement and buildings do not allow percolation of the water down through the soil, to the aquifer. It is instead forced directly into streams where erosion and siltation can

be major problems even when flooding is not. Increased runoff re1duces groundwater recharge thus lowering the water table and making droughts worse especially for farmers and others who depend on water wells. Human settlement from the beginning are attracted by the water bodies. There are mainly four reason:

(1) The soil near water is very fertile and can be used for growing crops

(2) The bodies of water themselves are sources of drinking and irrigation water; and

(3) Water courses support transportation and facilitate commences and trade.

(4) Land values are very low near water bodies specifically in under developed and developing countries.

Due to these four human tends to reside on flood plains. Which narrows down were channels which even in time of low participation overflow from the banks can be observed.

7.5 Components of Early Warning System

i. Flood hazard assessment and monitoring

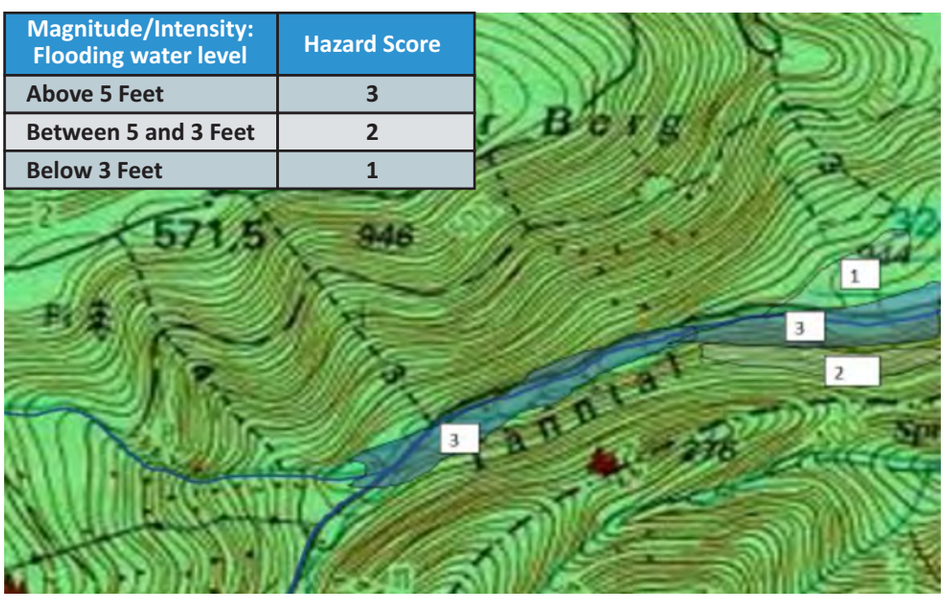
The first step is to aggregate various types of data such as Historical Hazard Database, Hazard Statistics, Climate Forecasting and forward looking hazard trend analysis Exposed assets & vulnerability Risk analysis tools related to flood and flash flood events, so that the system is able to provide any piece of available information related to a documented event.

The second step, inherently linked to the availability of data on past floods and flash floods, is to raise the awareness of forecasters on the likelihood that similar events are likely to occur in a certain region with a documented history of such events. Various statistics can be subsequently performed on the available sets of information covering the stored events.

Hazard Score Calculation: (Magnitude + Frequency)/2

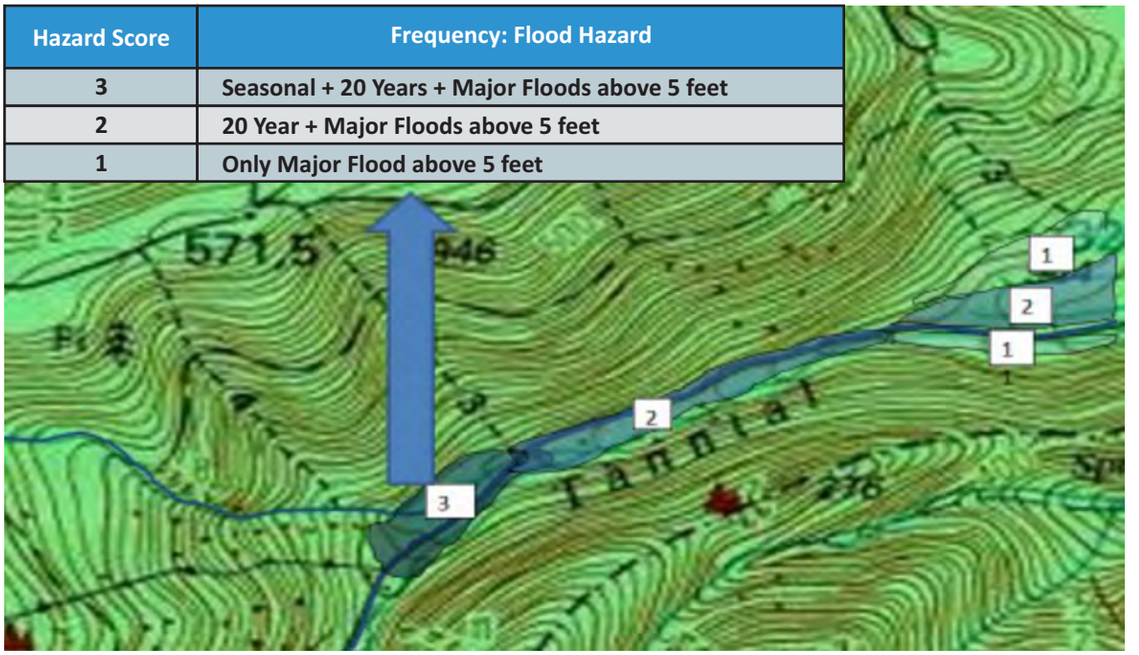
IF only flood is existing in the area

Magnitude/Intensity: Flooding water level	Hazard Score
Above 5 Feet	3
Between 5 and 3 Feet	2
Below 3 Feet	1



Flood Hazard Scoring for Seasonal, 20 years & Major Flood

Hazard Score	Frequency: Flood Hazard
3	Seasonal + 20 Years + Major Floods above 5 feet
2	20 Year + Major Floods above 5 feet
1	Only Major Flood above 5 feet



Hazard Score Calculation: (Magnitude + Frequency) / 2

Calculation of hazard scores from magnitude and frequency for different hazards. These scores are **examples**, they have to be determined

Flood Hazard	Frequency	Magnitude	Flood Hazard Score
Major Flood over 5 feet	1	3	2
Major Flood between 5 and 3 feet	1	2	1.5
Major Flood under 3 feet	1	1	1
20 Years Flood	2	2	2
Hazardous Seasonal Flood	3	1	2

ii. Flood risk assessment, reduction and forecasting

- Provision of flood condition reports, forecasts and warnings to enable effective coordination of flood response planning.
- Operation of dams and the provision of data and forecasts for the operation of flood ways and diversions.
- Flash flood watches, warnings and flood advisories due to heavy rainfall are issued when significant impacts are anticipated.

iii. Communication and Dissemination

- Provide flood warnings for river flood events due to melting snow or heavy rainfall,
- Produce monthly water supply forecasts from February to August.
- Develop reservoir operation procedures for flood and water supply management.
- Access to more accurate precipitation and snowfall estimation and forecasts. Up-to-date soil moisture products for use in forecasting.
- Improved modeling tools; modeling of more watersheds.
- Tools and approaches for ensemble forecasting in flood prone areas.
- Support tools to more effectively communicate results of forecasts, risk, and uncertainty.

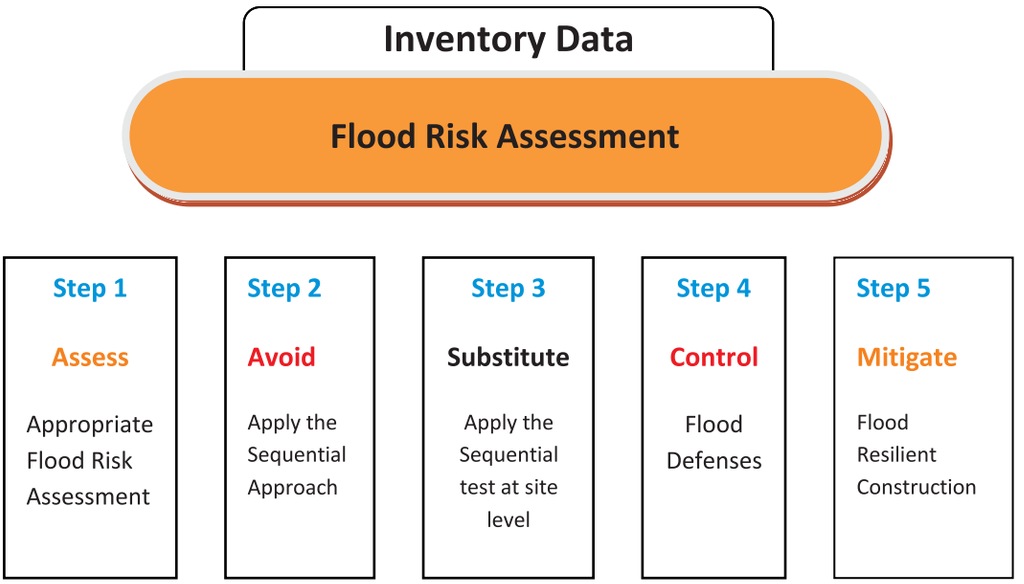
iv. Flood Response

- To assist and enhance the warning and emergency preparedness procedures
- Warning Construction and Communication.
- Response and proper dissemination of warning information.
- Preparedness (saving lives) early warning systems emergency planning and response.
- Prevention (Reduction of economic losses) Medium to long term sectoral planning (e.g. zoning, infrastructure, agriculture).
- Early warning is one of the major components of disaster risk reduction which saves lives and reduces both material and economic losses from disaster
- Community-based early warning systems (CBEWS) are essential approach to prepare and empowering the communities to face natural hazards

7.6 Flood Risk Assessment

Inventory of Elements at Risk

Inventory of element at risk is a complete list of the things that are in place in order to avoid mismanagement during disaster. It includes people, livelihoods, agriculture, livestock, buildings, infrastructure and environment etc.



Capacity and Vulnerability Assessment

Vulnerability and capacity assessment is to assess and record the actual impact of disaster on elements at risk. Different hazards effects elements in different ways. Capacities are sometimes hazard specific for example in case of flood hazard medical specialist is capacity as flood can cause waterborne diseases, skin problems and diarrhea etc. while in case of earthquake due to collapse of buildings possible damages apart from infrastructure is bone, spinal and head injuries, in that case orthopedic surgeon will be an asset.

Vulnerability and capacity assessment is to assess vulnerability from four main dimensions i.e. physical, social, attitudinal and economic. In capacity assessment it is crucial to assess the level of capacities it might be Individual, Household, Institutional, National, Regional and International Capacities. Vulnerability and Capacity Assessment (VCA) could be done with potential stakeholders by participatory rural appraisal tools, like, transact walk, focus group discussion, Venn diagram, timeline etc.

Exposure to Floods

Location of the elements describes the value/extent of exposure to hazard. A building maybe exposed to flood hazard but not vulnerable. Sensitivity and fragility makes the exposed infrastructure vulnerable.

Picture showing a house which is at the same time exposed to flood event but not vulnerable

Risk assessment process involves the following steps;

- Establishment of priorities
- Assessing the level of risk i.e. acceptable risk, residual risk, and high risk.
- Elaboration of risk scenarios and measures
- Social & economic cost/effective analysis

7.7 Tools for Flood Risk Assessment

Geo-spatial Dynamic Exposure of Flood

While assessing the flood risk one should look topography, population, population growth, settlements progression and exposure, livelihood activities and financial constraints of the area very keenly. The geo-spatial dynamic exposure like topography, population, population growth, increased demand of fuel, settlements progression and exposure, vulnerabilities, livelihood activities and financial constraints defines the level of exposure, vulnerability and risk.

Deterministic vs Probabilistic Flood Risk Assessment

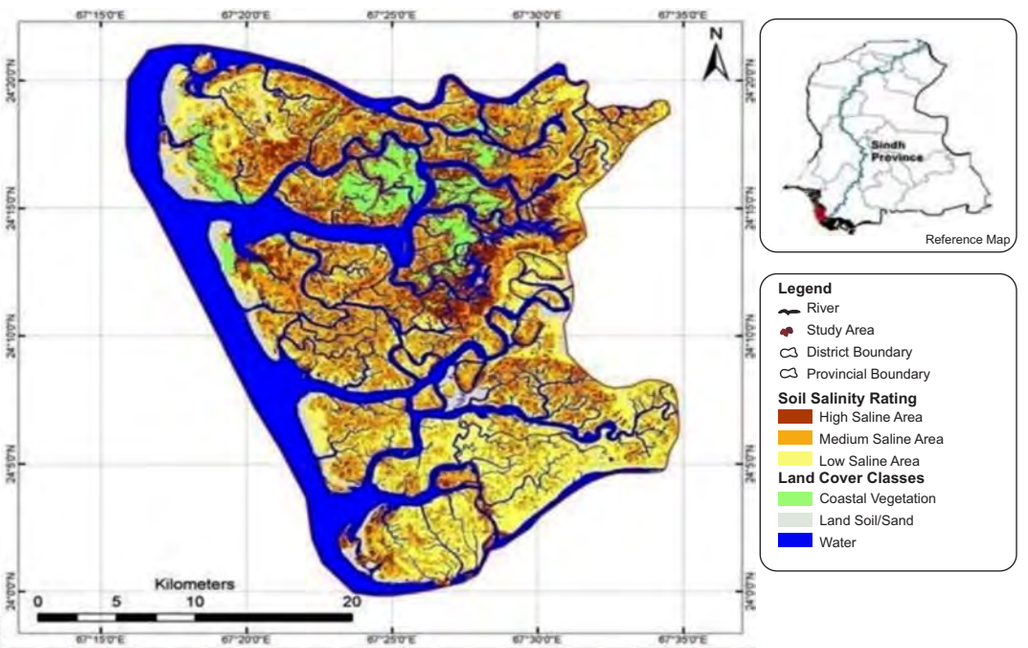
Deterministic flood risk assessment confines to the evaluation and assessment of flood, whereas probabilistic flood risk assessment considers all possible scenarios, their likelihood, associated impacts and secondary hazards that might be triggered by flood i.e. landslide and waterborne diseases. Generally deterministic risk assessment used to assess and evaluate a given hazard situation while probabilistic assessment used to obtain more précised assessment and evaluation of hazard frequency and damages. Probabilistic approach can be used to generate a deterministic scenario, like acceptable flood risk, residual flood risk and high flood risk.

Quantification of Flood Risk

Quantification of flood risk refers to find or calculate the quantity or amount of flood risk. Flood risk assessments are mainly comprises of two parts i.e. Hazard and Vulnerability Assessment. The hazard assessment investigates the level and scale of typically large flood events, while the vulnerability part assesses the impact of the flooding on specific commodity.

Role of GIS and Remote Sensing in Flood Risk Assessment

Geo-spatial dynamic exposure with fragile environment is the most triggering and intensifying factors. The geo-spatial component of the approach involves extraction of several layers of information such as detailed topography or terrain, man-made features i.e. buildings, roads, bridges, dams, railway line. For such type of assessment widely used tools are Remote Sensing and Geographic Information System which has significantly improved the efficiency of forecasting, monitoring, evaluation and management of flood hazard. By utilization of these technologies a rapid, exact and zoning/digitization of the most threaten communities to flood could be done via satellite images.



7.8. Communication and Dissemination of Flood Early Warning

The activities that define flood hazard early warning system (EWS), from the collection of baseline data, to the decision to warn at risk threaten communities in order to migrate them from flood prone at risk areas to safer locations. If individuals and groups receive the warning message timely, understand its meaning, and take appropriate actions, damages there will be no damages.

Communication and dissemination of early warning system is a very systematic (EWS) process. EWS is hazard specific, the information should be very clear, understandable and in local language. So that each and every individual of the community should understand, and take the appropriate necessary actions. Coordination mechanism and roles and responsibilities among the line agencies should be very clear.

8. Stakeholders/Organizations for Flood

Stakeholders in flood communication and dissemination of early warning are all the individuals, households, organizations and line agencies which have direct or indirect stake/influence on the process. Stakeholder organizations are;

- National Disaster Management Authority (NDMA)
- Provincial Disaster Management Authority (PDMA)
- District Disaster Management Authority (DDMA)
- Provincial Emergency Response Cell (PEOC)
- Flood Forecasting Cell (FFC)
- Pakistan Metrological Department (PMD)
- Hospitals
- Irrigation Department
- WAPDA
- WSSP
- Police
- Community
- Public Health Engineering
- Rescue 1122
- PDA
- Executive District Officer Finance
- Planning & Development
- Communication & Works Department (C&W)
- Army

The flood early warning system should be based on

8.1 Flood Early Warning Initiation

Once flood has been detected and it has been understood that it has a reasonable probability of occurring and a decision has been made on its potential impact, information must be provided to PDMA by the concerned stakeholders, the media, the public, and other persons groups and organizations that will be affected by the event or have stake. The PEOC then on behalf of PDMA share information via text messages and electronic and print media, especially that contained lifesaving warning messages, will have a much better chance of being understood if it is conveyed in concise, easy-to-understand language, in a predictable (and hence familiar) format. If the information that the products contain is not understood then it is less likely that the proper actions will be taken by recipients.

8.2 Inter-Organizations Communication and Dissemination

Inter-organizations communication is in dire need in order to properly disseminate authentic early warning system. It is difficult for an individual organization to gather information, monitor, evaluate, making decision, utilize and disseminate these information. For that an integrated approach is adopted. Information from different sources are gathered to a central location i.e. PDMA then PDMA deliver this information to PEOC and PEOC share the information to the at risk communities via text messages, print and electronic media.

Warnings are primarily a PDMA's responsibility. PDMA have local DDMAs, as Disasters are local, and PDMA has the primary responsibility to look after the welfare of households. Thus PDMA has the primary legal responsibility and authority to warn communities at risk and help them to prepare for, respond to, and recover from disasters. However, it is beyond the capability or capacity of PDMA individually. In order to respond effectively to hazard an integrated, multi-channel, nationally standardized system is available to them for delivering warnings to their citizens. This is the responsibility of the provincial government to establish liaison with other key stakeholders although national government works in close coordination with the provinces in times of national emergencies. Most warnings originate from government organizations and it is often issued by federal agencies, but usually in close coordination with regional organizations.

In Pakistan, Flood Forecasting and Warning Division of PMD is responsible for forecasting and early warning. The Provincial Irrigation and Drainage Authority (PIDAs) forecast and monitor peak discharge or flood water and give updates to the PDMA. In case there is high risk of flooding PDMA issue warning to the general public to move to safer locations. Most disaster warnings are issued by government agencies because in the absence of clear standards of best practices, private organizations could incur significant liability.

9. Flood Response Mechanism

Line Agencies

It is not just difficult but impossible for a single department to carry out all the administrative responsibilities individually. In case of flood response mechanism PDMA is main stakeholder while District Disaster Management Authority, Provincial Emergency Operation Centre, Flood Forecasting Cell, Pakistan Metrological Department, Hospitals, Irrigation Department, WAPDA, WSSP, Police, Community, Public Health Engineering, Rescue 1122, PDA, Executive District Officer Finance, Planning & Development, Communication & Works Department, Army and other stakeholders are line agencies.

Community/General Public

Community and general public are the first respondents to all types of disasters as they are the first to suffer and first line of defence as well. Community's assets are at stake therefore they must be tangibly as well as intangibly equipped in order to lower the consequences of disasters.

Preparedness for Flood Emergency Response

Evacuation Management

Many minor emergencies can be managed without shifting the at risk communities to safer location. However some large scale emergencies like tsunami, floods, earthquake, chemical spell, volcanic eruption may not be managed without shifting the masses to safer locations. Need assessment study should be carried out before shifting the masses to safer locations. Emergency evacuation plans are developed to efficiently respond to the disaster. The order of evacuation is;

i. Detection of the risk
ii. Decision of evacuate by the decision makers
iii. Alarm, to let the community know to prepare for the evacuation
iv. Reaction, to take the necessary belongings along with them
v. Movement to an assembly area
vi. Transportation to the evacuation center

An emergency evacuation kit should be given per house

A registration point should be there in evacuation centre to register the evacuees Registries used after disaster being used to help reunite families that have become separated after a disaster this process is known as Restoring Family Links (RFL).

Emergency Relief Activities

Emergency relief activities offers emergency supply of food, water, non-food items, providing psychosocial support, search and rescue, triage, and other basic necessities.72 hours soon after disaster occurrence are

considered as golden hours. Effective response mitigates the losses to a greater extent within these golden hours. Relief activities are largely dependent on the preparedness level. The more comprehensive the disaster preparedness, the more will be sustained, timely and effective will be the emergency relief.

International Agenda and Early Warning Systems

- **First International Early Warning Conference** *(Postdam, 1998)*
- **Second World Summit on Sustainable Development** *(Johannesburg, 2002) - JPA*
- **Second International Early Warning Conference** *(Bonn, 2003) -* ***PPEW***
- **World Conference on Disaster Reduction** *(Kobe, January 2005) -* ***HFA***
- **G-8 Summit and UN General Assembly** *(2005, 2006)*
- **Third International Early Warning Conference** *(Bonn, March 2006)*
  - **Global Early Warning Survey *and* EWS checklist**
- **First Symposium on Multi-Hazard EWS for Integrated Disaster Management (WMO with ISDR, World Bank, UNDP, IFRC, UNESCO, OCHA)** (*Geneva, May 2006*)
- **First Session of Global Platform for Disaster Risk Reduction** (*5 - 7 June 2007*)
- **Second Experts' Symposium on EWS with Multi-Hazard Approach (WMO and MeteoFrance)** (*Toulouse, 5 - 7 May 2009*)
- **2009 Global Risk Assessment Report** (*Launched in Bahrain, May 17, 2009*)
- **Second Session of Global Platform for Disaster Risk Reduction** (*16-19 June 2009*)

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