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Question # 01: *How do you define an earthquake? What is your perspective of the necessary measures that should be taken in Pakistan to reduce the destructions caused be Earthquakes?*

Ans: Earthquake: *Earthquake, any sudden shaking of the ground caused by the passage of seismic waves through Earth's rocks. Seismic waves are produced when some form of energy stored in Earth's crust is suddenly released, usually when masses of rock straining against one another suddenly fracture and "slip." Earthquakes occur most often along geologic faults, narrow zones where rock masses move in relation to one another. The major fault lines of the world are located at the fringes of the huge tectonic plates that make up Earth's crust.*

- ***The response to the earthquake in Pakistan:***
  The earthquake that hit northern Pakistan on 8 October 2005 caused widespread destruction, killing over 73,000 people, severely injuring many more and leaving millions without shelter. The affected areas of Azad Jammu and Kashmir (AJ&K) and North-West Frontier Province (NWFP) suffered extensive structural and economic damage, with vulnerable groups in this mountainous region bearing the brunt of the disaster. The devastation was spread over 30,000 square kilometers of treacherous Himalayan terrain. Most educational institutions were destroyed, killing over 18,000 students. The majority of health care units and hospitals collapsed, the communications infrastructure was unusable and all essential utilities were disrupted; in all, the affected area was strewn with 200 million tons of debris. This was without question the worst natural calamity in Pakistan history; recovering from it is going to cost billion of dollars.

- ***The role of the Federal Relief Commission in reduction of destruction causes by earthquake in Pakistan:***
  No disaster management organization existed to handle a relief operation on such a large scale, and the existing infrastructure was either very poor or totally destroyed. Realizing the gravity of the disaster, the government immediately formed the Federal Relief Commission (FRC), with a mandate to manage the entire spectrum of the relief effort:

- ***The Federal Relief Commissioner*** *was mandated to co-ordinate and monitor the relief efforts. He was to report directly to the prime minister. All agencies concerned with the relief and rehabilitation efforts, including cabinet, health, interior, foreign affairs; communication and information divisions would function through FRC and form a part of the team. For this purpose their reps were attached with FRC. Reps from the concerned agencies of the armed forces were also to be a part of the team.*

- *Within days, the FRC had taken charge of the situation. The scale of the disaster, the harsh weather conditions and the collapse of civil order in the affected areas called for a response mechanism which could provide quick decision-making, coupled with the efficient execution of directives on ground. The Commission conceived and implemented an elaborate National Action Plan to ensure a coherent response, spelling out domains, policies and end-states for all the stakeholders and key players.*

- *Within the FRC itself, there were two distinct wings, the military and the civilian. The military wing was responsible for undertaking the rescue and relief operation, while the civilian wing, comprising ministerial representative and coordinators, looked after inter-department and inter-agency issues. The*

response was based on a four-fold strategy, comprising search, rescue and relief, consequence management, recovery and rehabilitation and reconstruction.

- ***The world's most successful relief operation:***

It has been claimed that the earthquake response was the most successful relief operation in recent history. It holds several important lessons for us in terms of best practice for the future:

- *There must be a full-time disaster management agency, with contingency plans for a quick and effective response. Ad hoc arrangements will not work in all circumstances.*
- *All stakeholders, including NGOs, international organizations and donors, must be taken into the government's confidence.*
- *We must cut through red tape wherever it adds delay.*
- *Speedy decision-making needs no emphasis. Provincial and district leaders should play stronger coordinating and executing roles.*
- *Adequate funding for the UN is necessary to enable a swift international response.*
- *Take the media on board by providing access, continuous interaction and sharing of data with them.*
- *Appropriate mechanisms should be established to track aid flows from source to end-user; the publication of this information is crucial for transparency.*
- *Given the inaccessibility of earthquake-affected areas and that fact that road links will always be difficult, helipads and landing strips are needed in quake-prone areas, along with enhanced radar communication for aircraft.*
- *The development of new strategies for disaster preparedness needs to be considered.*
- *Knowledge of disaster response needs to be increased within society and among the general public.*
- *All local and international NGOs and UN organizations must be registered, and this information must be kept up to date.*
- *People-centred solutions must be found. We must all constantly remind ourselves that the path of recovery is not for us to determine, but for the people who suffered.*

Question # 02:

a) Briefly describe the history of seismology.
b) What is seismoscope? Give a brief explanation of its working principle.

Part (a) : Briefly describe the history of seismology.

Ans: ***Natural Causes of Earthquakes:***

- ***Thales of Miletos (ca. 585 BC)***
  Earthquakes are caused by Water
- ***Anaximenes of Miletos (ca. 550 BC)***
  Earth Broke Down under its own weight, due aging
- ***Aristotle (ca. 340 BC)***
  Earthquakes are caused by Air in Motion (dry and smoky), trapped inside the earth
- ***Chang Heng (ca. 136 AD)***
  Invented the first instrument to respond to earthquakes, called Seismoscope
  1) *Providing the direction of the ground motion pulse*
  2) *Earthquake direction is behind the dragon dropped ball*
- ***Galileo Galilei (1638)***
  Considered Resistance of Solids (rock shear strength) to rupture
- ***Athanasius Kircher (1660)***

Stated One-Dimensional Linear Stress-Strain Relationship, laying the foundation for Theory of Elasticity for seismic waves

- ***Athanasius Kircher (1664)***
  Earthquakes are caused by the Movement of Fire within a system of channels inside the Earth
- ***Martin Lister and Nicolas Lemery (1703)***
  Earthquakes are caused by the Chemical Explosions within the earth
- ***Robert Mallet (1857)***
  Laid the foundation of Instrumental Seismology Carried out Seismological Experiments using explosive and mercury container
- ***Emil Wiechert's (1897)***
  Earth's interior consists of a mantle of silicates, surrounding a core of iron
- ***Richard Dixon Oldham (1906)***
  Identified the separate arrival on Seismograms
  a) *P-Waves*
  b) *S-Waves*
  c) *Surface Waves*

The Earth has a Central Core

- ***Harry Fielding Reid (1910)***
  Elastic Rebound Theory, proposed
- ***Harold Jeffreys (1926)***
  Found that below the crust, the Core of the Earth is liquid
- ***Inge Lehmann (1937)***
  Within the earth's liquid outer core there is a Solid Inner Core

➢ ***Milestones in the Development of Seismology***
Robert Mallet (1810 – 1881) Irish Civil Engineer, writes after field investigations of the earthquake near Naples, ITALY on 16 Dec. 1857

➢ ***The Father of Seismology:***
The First Principle of Observational Seismology

Determined the source Depth of earthquake

- *h = 10.40 km for Naples earthquake*

Pioneered the application of Physical and Engineering Principles to the explanation of the geologic nature of earthquakes

Defined still valid notions in Seismology:

- *Earthquake focus,*
- *Epicenter,*
- *Hypocenter*

First modern earthquake catalogue with information about location, time, and damages of earthquakes In 1851, first used dynamite explosion in England to measure speed of Elastic Waves – Explosion Seismology Concluded that,

- *Earthquake waves are similar to sound waves.*
- *Travel with different velocity through different materials depending on the material physical properties.*

First seismicity map Published in 1860.

Question # 02:

Part (b): What is seismoscope? Give a brief explanation of its working principle.

Ans: ***Seismoscope:*** *An instrument that documents the occurrence of ground motion (but does not record it over time).*

- ***Working principle of seismoscope:***
  An early seismic instrument called the seismoscope made no time record of ground oscillations but simply indicated that shaking had occurred. A Chinese scholar, Zhang Heng, invented such an instrument as early as 132 CE. It was cylindrical in shape with eight dragon heads arranged around its upper circumference, each with a ball in its mouth. Around the lower circumference were eight frogs, each directly under a dragon head. When an earthquake occurred, balls were released from a dragon's mouth, probably by an internal pendulum that moved back and forth according to the direction of vibration, and were caught by a frog's mouth, which produced noise.

Question # 03: Explain the various Disaster Risks of Pakistan

Ans: Disaster Risks of Pakistan: *Disaster risk which is causes from hazards, various hazards are given below.*

Pakistan is facing serious threat and great challenges from large-scale natural as well as anthropogenic disasters, such as, seismic events, landslides, droughts, floods, fog, torrential rains, tropical cyclones, dust storms, fires, locusts, oil-spills, depletion of Glaciers etc. Space technology can be used for monitoring and assessing natural disasters very effectively. Timely precautionary measures can thus be taken during the pre-disaster, disaster and post disaster stages, thereby minimizing loss of life and property.

1) ***October 2005 Earthquake in Pakistan:***
   Some of the common impacts of earthquakes include structural damage to buildings, fires, damage to bridges and highways, initiation of slope failures, liquefaction, and tsunami.

A powerful earthquake of 7.6 magnituted rattled northern Pakistan, India, and Afghanistan on 8 October 2005. Centered in northern Pakistan, the quake flattened nearby cities, causing thousands of deaths and leaving millions homeless. Below are some satellite images showing destruction caused by the earthquake.

2) ***Floods disaster risks :***

Loss of lives and property: Immediate impacts of flooding include loss of human life, damage to property, destruction of crops, loss of livestock, non-functioning of infrastructure facilities and deterioration of health condition owing to waterborne diseases. Flash floods, with little or no warning time, cause more deaths than slow-rising riverine floods.

The floods in Pakistan began in late July 2010, resulting from heavy monsoon rains in the Khyber Pakhtunkhwa, Sindh, Punjab and, Balochistan regions of Pakistan, which affected the Indus River basin. Approximately one-fifth of Pakistan's total land area was affected by floods.

3) ***Depletion of Glaciers:***
   Nature has bestowed Pakistan with more than a hundred glaciers, situated in the North of Pakistan. Satellite images of Batura Glacier pertaining to different years were analyzed. It was observed that the ice covered and ice free areas of Batura Glacier in the year 1992 were 98 and 25 sq km respectively, whereas in the year 2000, the ice covered area reduced to 81 sq km.

4) ***Fog:***
Occurrence of wide spread dense fog has become regular phenomena in winter every year. Its intensity is increasing, rendering poor visibility & health problems. Northeastern India & the neighboring sections of Pakistani Punjab can be seen covered with fog. It will cause a health problem.

5) ***Dust Storm in Pakistan:***
The impacts of sand and dust storms were described in terms of crop damage, soil productivity losses, economic losses, mass migration, health impacts, and impacts on climate. Dust storm also a negative impact on atmosphere.

On June 9, 2005, in Pakistan a severe windstorm sent trees, billboards, and power lines crashing to the ground in the province of Punjab in western India. As residents of this populous region recovered from the severe wind and rain

6) ***Snow Melt-off :***
Heat wave & snow melt caused flood in Swat & Kabul Rivers in June 2005. Worst affected areas were Noshehra, Charsada & Peshawar in KPK.

7) ***Oil Spill at Karachi Coast:***
On 14 August 2003 an oil tanker carrying 67,000 tons of crude oil, faced an accident and released about 30,000 tons of crude oil near the Karachi coast. The images given below are show the gradual dispersion of the oil spill.

Question # 04: *How does environmental vulnerability add up to the disaster risk of a community?*

Ans: ***Environmental vulnerability:*** *It is the measure of the health and welfare of the natural environment within the area that either contributes or reduce the propensity of population exposed to potential hazard.*

Poor environmental practices can turn minor events into major disasters. It may include

- *Deforestation,*
- *Improper land-use planning,*
- *Improper management of hazardous materials, etc.*

Environmental vulnerability add up to the disaster risk of a community:

The characteristics determined by physical, social, economic and environmental factors or processes which increase the susceptibility of an individual, a community, assets or systems to the impacts of hazards.

Vulnerability is the human dimension of disasters and is the result of the range of economic, social, cultural, institutional, political and psychological factors that shape people's lives and the environment that they live in.

Vulnerability can be a challenging concept to understand because it tends to mean different things to different people and because it is often described using a variety of terms including 'predisposition', 'fragility', 'weakness', 'deficiency' or 'lack of capacity'.

Some definitions of vulnerability have included exposure in addition to susceptibility to harm. However, it is now understood that exposure is separate to the 'susceptibility' element of vulnerability since it is possible to be exposed, whilst at the same time not susceptible to natural hazards.

Vulnerability relates to an Environmental factors:

e.g. poor environmental management, overconsumption of natural resources, decline of risk regulating ecosystem services, climate change, etc.

THE END