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Semester# 6th

Exam: Final

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Question 1:

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?

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. (See the table of major earthquakes.)

My perspective of the necessary measures that should be taken in Pakistan to reduce the destructions caused be Earthquakes:

Introduction:

Pakistan is located in South Asia, sharing borders with India, Iran, Afghanistan, and China. The total land area covers 770,875 km2, which is divided into three major geographic regions: the Balochistan Plateau, Indus River plains, as well as the northern mountain ranges (the Himalayas, Karakorum, and the Hindu Kush). The climate varies largely depending on the topography, but most of the country is covered by dry deserts – 60 percent of the total land area is classified as arid, receiving less than 200 mm of rainfall annually (ADRC, 2016). Despite the arid to semi-arid conditions, Pakistan encompasses a wide range of ecosystems, which are categorized into 12 vegetative zones from snowfields and cold deserts to swamps and mangrove forests at the Indus River plains (Baig & Al-Subaiee, 2009).

In terms of hazards, Pakistan is among the most disaster-prone countries in South Asia, having suffered an estimated US$ 18 billion in damages and losses during the past decade (World Bank, 2017). For example, tectonic processes at the colliding boundaries of the Indian and the Eurasian tectonic plates, driving the Himalayan orogeny, are causing significant seismic instabilities in the region. Regular flooding also takes place at the Indus river basin where major floods occur during the July-September monsoon season as a result of the seasonal low depressions developing over the Arabian sea or the Bay of Bengal (NDMI, NDMA, UNDP, 2007). Heatwaves in the early summer may also cause flooding at various sites due to many rivers being snow-fed. Other hazards include droughts, landslides, storms and cyclones, glacial lake outburst floods (GLOFs), avalanches and technological accidents (NDMI, NDMA, UNDP, 2007). Pakistan has also been ranked highly in the Climate Vulnerability Index of 2019 - ranking 8th among the 10 most affected countries by extreme weather events between 1997 and 2016 (GermanWatch, 2019).

Despite the recurrent disasters, Pakistan has made significant progress in economic and human development by reducing absolute poverty and increasing shared prosperity over the past two decades. Between 1991 and 2011 the number of people with an income less than US$ 1.25 a day was more than halved (World Bank, 2014), and the country has a future potential for rapid growth similar to that of other South Asian nations.

Measures against earthquakes

Personal measures

- Seek shelter under stable tables or under door frames.
- If outside, stay away from buildings, bridges and electricity pylons and move to open areas.
- Avoid areas at risk from secondary processes, such as landslides, rockfall and soil liquefaction.
- After an earthquake, check gas, water and electricity pipes and lines for damage.
- Listen to the radio and follow the instructions issued by the authorities.

Technical/biological measures

- No measures can be taken to prevent earthquakes themselves, however limited measures exist that can counteract their secondary effects like landslides, rockfall and soil liquefaction.
- Earthquake-proof planning and design of buildings
- The micro zoning of the local geological substratum provides indicators of areas in which tremors will have a particularly strong or attenuated effect.

Organizational measures

- At present, earthquake prediction is insufficiently precise to provide the public with sufficient advance warning. For this reason, adequate preparedness and assistance in catastrophes is extremely important in areas affected by earthquakes. Measures of this nature enable numbers of human lives to be saved.

Tha only thing you can definitely predict about earth quake is:

- The further you are from the last one
- The nearer you are to the next
- Calculate the affected population they become homeless in the earthquake.
- Calculate the time difference between the past earthquake and in present earthquake.
- First of all clear the area from people where the earthquake are mostly occure.
- The building and dam's are constructed on construction think about the factor of safety.
- To update all the device by which record the disaster.
- To make a department for these disaster.
- Also make a doctor team for the emergency.
- Don't construct a multi-story building in those areas where the earthquake enhance are more.

Question 2:	
(a)	Briefly describe the history of seismology.
(b)	What is seismoscope? Give a brief explanation of its working principle.

(a) Briefly describe the history of seismology.

History of Seismology:

Early Thoughts on Earthquake Disasters:

The black cat fish below the earth cause earthquakes

Milestones in the Development of Seismology:

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

- Providing the direction of the ground motion pulse

- 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.

The 1755 Lisbon Earthquake, Portugal – M = 8.5 – 9.0 ?

Outcomes

- Scientific attempts to understand the Behaviour and Causation of earthquakes
- John Michell (1761)

Earthquakes originate within the Earth Waves of movement caused by “Shifting masses of rock miles below the surface”


Devestation caused by earthquake tsunami started after 40 minuts
Fire also following earth quake Model of building type that survived

- 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

- P-Waves

- S-Waves
- Surface Waves

The Earth has a Central Core

- Harry Fielding Reid (1910)

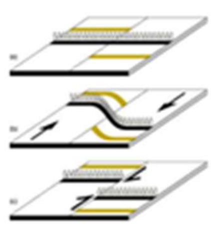
Elastic Rebound Theory, proposed

- 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



Mechanics of Elastic Rebound

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

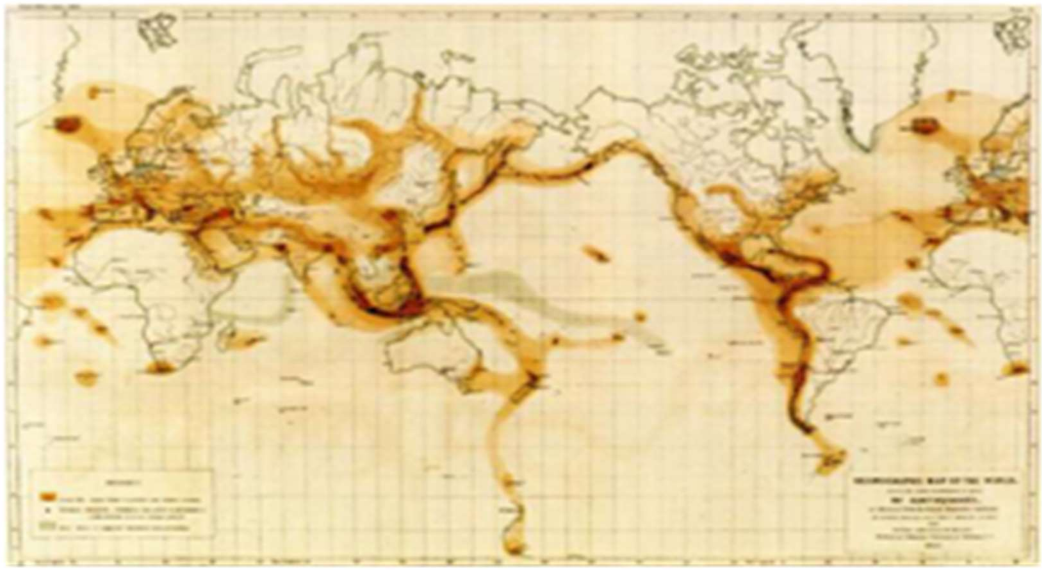
First modern earthquake catalogue with information about location, time, and damages of earthquakes

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

Published first seismicity map in 1860



First World Seismicity Map (1890) by Robert Mallet

Development

- Compiling data on the earthquake observations

- Discriminate areas with a lot of earthquakes from those with few earthquakes

- Look at the actual effects of earthquakes in terms of observed intensity distributions A powerful means of showing what has happened in the past
What might happen if an earthquake should occur, cann't be easily explained.

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

Seismoscope:

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

A seismoscope is an instrument that gives a qualitative measure of the oscillatory motion produced by an earthquake or other disturbance of the earth's surface. Unlike the seismograph, it lacks a device to calibrate the time. Several designs and variations exist, and many are easy to build with common materials. In this Demonstration, an oscillating cone filled with sand hangs by a string. The sand falls from a hole over a moving surface and draws the waveform that shows the general characteristics of the motion.

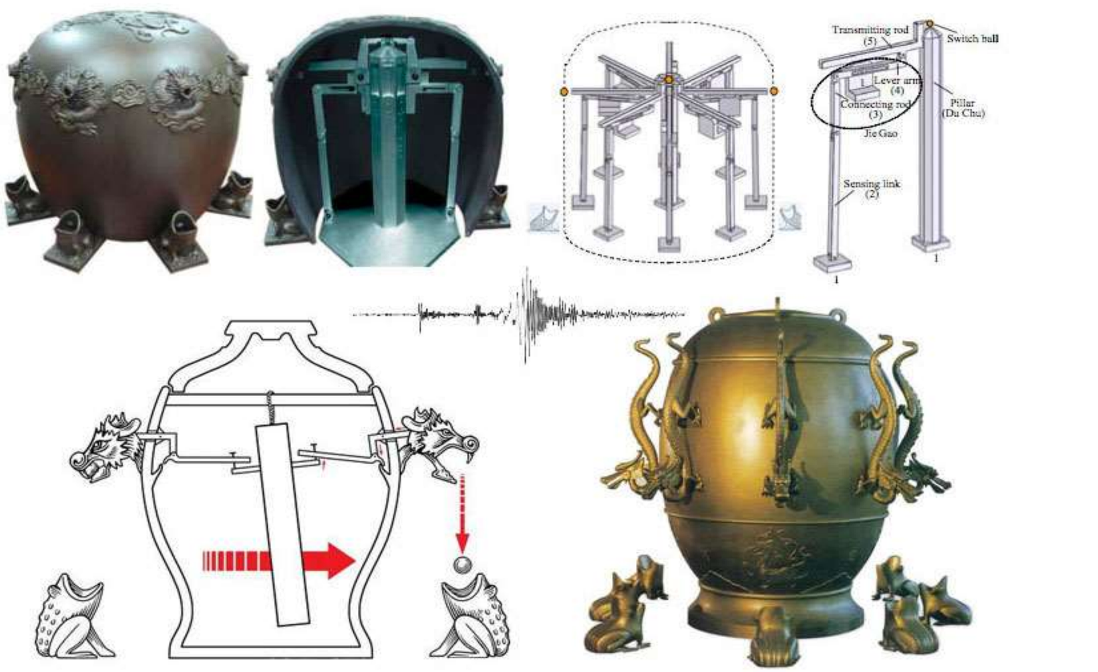
Zhang Heng, Wade-Giles romanization Chang Heng, (born 78 CE—died 139), Chinese mathematician, astronomer, and geographer. His seismoscope for registering earthquakes was apparently cylindrical in shape, with eight dragons' heads arranged around its upper circumference, each with a ball in its mouth. Below were eight frogs, each directly under a dragon's head. When an earthquake occurred, a ball dropped and was caught by a frog's mouth, generating a sound.

Zhang Heng believed that earthquakes were caused by wind and air;

"The chief cause of earthquake is air, an element naturally swift and shifting from place to place. As long as it is not stirred, but lurks in a vacant space, it reposes innocently, giving no trouble to objects around it. But any cause coming upon it from without rouses it, or compresses it, and drives it into a narrow space ... and when opportunity of escape is cut off, then 'With deep murmur of the Mountain it roars around the barriers', which after long battering it dislodges and tosses on high, growing more fierce the stronger the obstacle with which it has contended."

To indicate the direction of a distant earthquake, Zhang's device dropped a bronze ball from one of eight tubed projections shaped as dragon heads; the ball fell into the mouth of a corresponding metal object shaped as a toad, each representing direction in which the seismic wave was travelling. His device had eight mobile arms (eight directions) connected with cranks having catch mechanisms at the periphery. When tripped, a crank and right angle lever would raise a dragon head and release a ball supported by the lower jaw of the dragon head. The seismoscope device also included a vertical pin passing through a slot in the crank, a catch device, a pivot on a projection, a sling suspending the pendulum, an attachment for the sling, and a horizontal bar supporting the pendulum.

There are no clear historical documents and physical remains of Zhang Heng's seismoscope device. Several reconstruction designs have been attempted to replicate Heng's original seismoscope which today is still a famous but mysterious instrument. Many scholars tried to reconstruct Zhang Heng's seismoscope in the past 150 years. In the early stage, some exterior appearances of Zhang's seismoscope were proposed (Imamura 1942; Milne 1883; Wang 1963; Bolt 1978). Later, the interior mechanical structures with various operating functions were presented (Wang 1936; Feng et al. 2006 a, b; Sleeswyk and Sivin 1983; Imamura 1939; Wang 1963; Lee 1994; Imamura 1942; Yan and Hsiao 2007). It is believed that the design principle of Zhang's seismoscope and early modern seismograph are based on the principle of inertia.



Question 3:
Explain the various Disaster Risks of Pakistan.

Various Disaster Risks of Pakistan:

During the last 30 years, Pakistan has undergone extreme transformations with respect to population and economic conditions. As a hazard-prone country with more people living in high-risk areas than ever before it is increasingly important to pro-actively address natural and man-made hazards and the cumulative risks that they pose at multiple spatial and temporal scales. In this study an assessment has been undertaken of hazards that were selected on the basis of their frequency and severity. Hazard potential and vulnerability factors were first derived on the basis of expert opinion. A combination of these factors was then used to create an integrated total risk assessment map that addresses the socio-economic, environmental and physical dimensions of vulnerability for the districts of Pakistan. The total integrated vulnerability map reveals the damage potential and coping capacity of each district, providing support to decision makers and to end users such as local authorities, non-governmental organizations and disaster prevention officers, enabling them to (a) decide what is an acceptable level of risk, (b) determine the level of protection and (c) decide which predefined mitigation measure to apply.

INTRODUCTION:

Pakistan is situated within a hazard-prone region and is exposed to a variety of natural disasters such as floods, cyclones, earthquakes, landslides and droughts. Rapid population growth, uncontrolled development and unmanaged expansion of infrastructure are the most common factors that result in more people being vulnerable to natural hazards than ever before (Cardona et al. 2003). The burden of natural disasters in Pakistan can be underlined by the fact that they have been responsible for the deaths of 6037 people in the period from 1993 to 2002, with a further 8.9 million people also affected (World Disasters Report 2003). More than 80 000 people died and 3.5 million lost their homes in a single event: the earthquake of 8 October 2005. A consistent major problem for Pakistan's authorities is that natural hazards occur more or less regularly at all scales. Furthermore, disaster management in Pakistan, particularly with regard to natural hazards, focuses mainly on rescue and relief processes. There is a dearth of information and little understanding of the processes involved in hazard identification, risk assessment and management, and the relationship between people's livelihoods and disaster preparedness (WCDR 2005). Disaster management policy in Pakistan does not make adequate use of recent developments in scientific methodologies, methods and tools for cost-effective and sustainable interventions.

As our conceptual basis we started from the hypothesis that every hazard has a spatial dimension that determines when a hazard turns into a disaster, and hence may influence vulnerability to spatially relevant natural hazards (Cutter 1996 a,b).

The impacts that disasters have on humans are not solely dependent on their exposure to the hazard, but also on how capable they, and their surroundings are of anticipating, resisting, coping with, and recovering from, their effects (Wisner et al. 2004, Greiving 2006). We may consider particular environments to be hazard or disaster agents and the origins of risk and disaster to lie in the physical environment (Gilbert 1995). From this perspective disasters are regarded as a function of external agents and communities as the victims of extreme events (Hewitt 1983, Flint and Luloff 2005). Alternative perspectives also exist that place societal conditions at the centre of the disaster descriptions and interpretations, in which disasters are not necessarily the inevitable outcome of a hazard's impact but a result of intersections between hazards and everyday vulnerabilities (Hewitt 1998, Flint and Luloff 2005). Spatial planning may therefore become crucial to keeping a balance between the two viewpoints. Spatial planning may contribute effectively to disaster risk reduction but according to the United Nations Development Programme (UNDP), many countries still lack clear guidelines on how to deal with hazards and risk on a spatial planning level (UNDP 2004). The Kashmir earthquake 2005 increased awareness in the general public and public administration of the overall high level of risk in Pakistan, and the fact that it is steadily increasing. It is however not sufficient to restrict policies to the response phase of the disaster management cycle: hazard mitigation activities are also crucially important if lives are to be saved and damage reduced, and preparedness is an essential component of any sustainable planning practice. Evidence from scientific literature and best practice examples around the world makes it clear that Pakistan does not have in place appropriate spatial planning tools. Even if we accept that awareness of natural hazards and their associated risks has increased over recent years in Pakistan, the effectiveness of the majority of planning and management related activities will remain limited while they remain based on single hazard approaches.

One assessment of social vulnerability to environmental hazards that used county-scale indicators across the United States (Cutter et al. 2003) has provided guidance for this study of Pakistan, but in this case the available data are incomplete. Some simplifications are therefore necessary when designing a methodology for Pakistan, as there is insufficient hard data available for an understanding of social vulnerabilities at a local level, or of the interactions between biophysical and social vulnerabilities. Proxy indicators have instead been derived: some were derived directly from census data while others were developed from auxiliary data using GIS analyses. Studies of relevant literature (e.g. Cutter 1996a, b, Clark et al. 1998, Tralli et al. 2005, Greiving 2006, Fleischhauer 2006, Birkmann and Wisner 2006, Birkmann 2007) have revealed that integrated multi-hazard risk approaches are still rare in many parts of the world. This is despite improved scientific understanding and the ability to disseminate temporal geospatial information that can potentially be integrated with demographic and socioeconomic data. The means are available to develop comprehensive risk mitigation planning and improved disaster response. The scientific community recognizes the manifold interactions between the hydrosphere, atmosphere, biosphere and solid Earth as a complex system (Tralli et al. 2005), and that geospatial information in general, and GIS and remote sensing in particular, today provide a synoptic planning perspective for a multiplicity of spatial scales with variable temporal resolution. There is clear evidence that the use of recent technologies, internationally coordinated observation systems, and modelling, can help characterize, monitor and possibly forecast a wide range of devastating events and their effects. Remote sensing and geospatial information tools and techniques, including numerical modelling, have advanced considerably in recent years (Tralli et al. 2005, Joyce et al. 2009).

The nature of spatial planning requires a multi-risk approach that analyses all relevant hazards as well as the vulnerability of a particular area. In §3.2 of this article we integrate socio-economic, environmental and physical dimensions of vulnerability in order to estimate the damage potential and coping capacity. Our approach cannot, however, be regarded as all-inclusive due to the versatile nature of vulnerability, and also due to the limitations on data availability as explained in §3.1.1.

Vulnerability is a relatively new approach that links hazard distributions with risk research and refers to the susceptibility of individuals, communities or regions to natural or technological hazards (Cutter 1996a, b, Cutter et al. 2003, Kumpulainen 2006, Birkmann, 2007). Vulnerability is a condition, but at the same time it is also a process resulting from physical, social and environmental factors that increase the susceptibility of a community or area to the impact of a hazard (ADRC 2005). Vulnerability also encompasses the concepts of response and coping, since it is dependent on the potential of a community or area to withstand or react to a disaster. Westgate and O'Keefe (1976) suggested vulnerability has a social character and is not limited to potential physical damage or to demographic determinants. It is stated that disasters only occur when the losses exceed the capacity of the population to support or resist them.

Pakistan lies between 23° 35′ to 37° 05′ N latitude and 60° 50′ to 77° 50′ E longitude (figure 1). It touches the Hindukush Mountains in the north and extends from the Pamirs to the Arabian Sea. The country has a total area of 796 095 km2. It consists of such physical regions as: (a) the Himalayas, which cover its northern part, and K-2 in its north western part; (b) the Balochistan plateau; (c) The Potohar Plateau and salt range; and (d) The Indus plain, the most fertile and densely populated area of the country. It gets its sustenance from the Indus River and its tributaries. Most of Pakistan has a generally dry climate and receives less than 250 mm of rain per year, although northern and southern areas have noticeable climatic differences. The average annual temperature is around 27°C, but temperatures vary with elevation from −30°C to −10°C during the coldest months in mountainous and northern areas of Pakistan. The plains of the Indus valley are extremely hot in summer with cold and dry weather in winter. The coastal strip in the south has a moderate climate. Due to the rainfall and high diurnal range of temperature, humidity is comparatively low. Only the coastal strip has high humidity.

Disaster scenarios in Pakistan:

Pakistan is subject to a range of natural disasters including floods, cyclones, earthquakes, landslides and drought. In this subsection we summarize some basic facts concerning four of the major hazards, which are relevant to this hazard risk and vulnerability study.

1. *Earthquakes:* Pakistan lies within a seismic belt and therefore suffers from frequent small and medium magnitude earthquakes (GSP 2001). Earthquakes commonly occur along the Himalayas and Karakorum ranges and parts of Hindu Kush in the north of the country, in the Koh-e-Suleiman Range in the west with Chaman fault line along Quetta, Zob and Mekran fault line affects Gawadar district along the sea of the south-west coast.

2. *Cyclones:* According to the World Disaster Report 2003, the 960 km long coastal belt of Pakistan is occasionally battered by cyclones causing widespread loss to life and property, especially in the coastal districts of Gawadar, Badin and Thatta.

3. *Floods:* Pakistan is one of the five South Asian countries that have the highest annual average number of people physically affected by floods

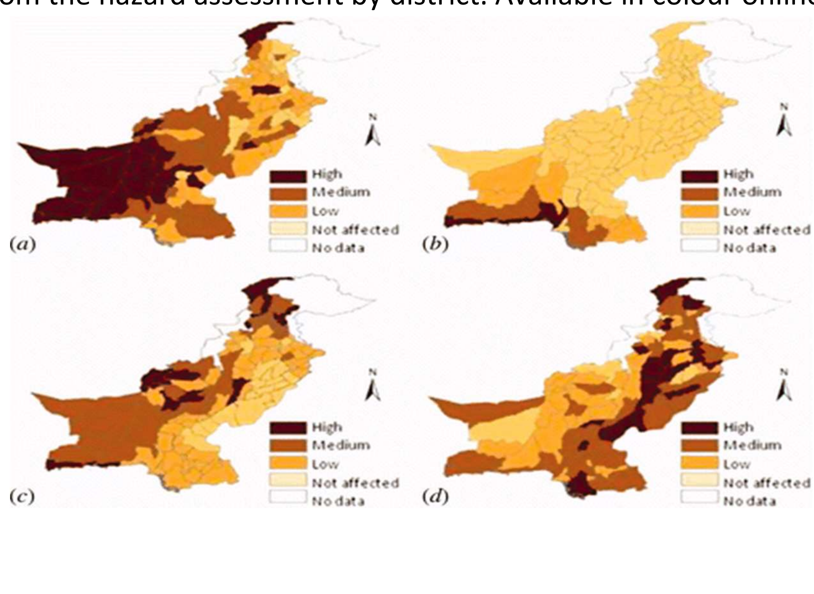
(UNDP 2001). The alluvial plains of the Indus river system formed as flood plains and remain vulnerable to recurrent flooding. Riverine floods occur during the summer monsoons. Flash floods and landslide hazards occur frequently in the northern mountains. Districts along the Indus plain are particularly affected by riverine floods, while hill torrents tend to affect the hilly districts located in the northern and western parts of Pakistan.

4. *Drought:* Pakistan is one of the countries that is expected to be hit hardest by the effects of global warming, and drought is one of the possible consequences of global warming resulting in a sharp fall in water table levels and drying up of wetlands (PMD 2002). Districts along the south-western and eastern parts of Pakistan have become severely affected by drought.

Earthquake hazards

- The distribution of seismic zones and historical records of earthquake events measured and analysed by the Geological Survey of Pakistan (GSP) were used to identify those districts most prone to earthquakes. (*c*) shows distributions for various categories of earthquake- affected districts, where a 'high' classification refers to those districts located in high seismicity zones (between 8.0 and 5.9 on the Richter magnitude scale) that are frequently affected by medium and low intensity earthquakes, 'medium' refers to districts situated in the medium seismicity zone (between 5.0 and 3.9 on the Richter magnitude scale) that are occasionally affected by low intensity earthquakes, 'low' refers to districts in low seismicity zones (between 3.0 and 1.0 on the Richter magnitude scale) that are rarely affected by earthquakes, and 'not affected' (less then 1.0 on the Richter magnitude scale) refers to those districts that are neither in a seismic zone nor affected by earthquakes.

  Major hazards in Pakistan (a) drought, (b) cyclone, (c) earthquake, (d) flood: results from the hazard assessment by district. Available in colour online.



Question 4: How does environmental vulnerability add up to the disaster risk of a community?

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

Natural resource depletion and resource degradation are key aspects of environmental vulnerability.

Example: Wetlands, such as the Caroni Swamp, are sensitive to increasing salinity from sea water, and pollution from storm water runoff containing agricultural chemicals, eroded soils, etc.

Environmental vulnerability and resilience are concepts that play a key role in environmental management and the quest for sustainable development. Originally developed by ecology and hazards assessment, environmental vulnerability and resilience are now of interest to many disciplines, governments, companies, and enterprises. Reduction of environmental vulnerability and improvement of resilience can be a challenge given the often complex and frequently indirect and/or cumulative impacts involved. Currently global warming and sea-level change draw most attention, but many other terrestrial and extraterrestrial environmental threats need to be considered as well.

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.

The world's population will approach nine billion people by 2050, altering the requirements of, and consequences for, our environment. Inevitably, this complicated relationship between our expanding global population and the environment will have implications for the climate, our planet, and for societies. Health effects from pressures on the environment include biodiversity loss, ocean acidification, land degradation, and water scarcity. Climate change can affect human health through the direct outcomes of hazards such as heatwaves, floods and storms, or through the indirect effects of disrupted ecosystems and altered patterns of infectious diseases. Our environmental impacts pose especially urgent threats to vulnerable populations who have contributed the least to their causes. In order to sustain the planet and the people living on it, we need to expand our knowledge of energy, sustainability, water and food security, humans as part of the global ecosystem, and the nexus with health outcomes.

The effects of climate and environmental change, such as increasing temperatures, sea-level rises, changing patterns of precipitation, and more severe extreme weather events are expected to influence key determinants of human health, including access to clean water, sufficient food and adequate shelter. These effects can also directly and indirectly aggravate political and civil conflicts; destabilize agriculture, housing, and economies; and exacerbate health risks for vulnerable populations, in particular women and children. The social destabilization caused by drought, flood, famine, and diseases that follow crises, including epidemics, may aggravate political and civil conflicts as those affected compete for essential resources. Addressing these challenges demands global and multi-sectoral coordination across borders.