



Geogo Crunches!

Issue 2

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1a) Describe how earthquake magnitude and intensity can be measured. [9]

Introduction

- Magnitude is measured by the Richter scale
- Intensity is measured by the Mercalli scale

Body

- Mercalli scale
 - Intensity: strength of shaking produced by an earthquake at a certain location and is determined from effects on people, structures and the environment
 - Interpretation dependent on
 - Variations in population density
 - Intensity may be underestimated in sparsely populated areas
 - Building materials and methods
 - Building codes
 - Type of soil that buildings are built on
 - Distance from epicentre
 - Intensity decreases with increasing distance from epicentre
 - Hence there is subjectivity involved
 - Measured on a scale of I (not felt by people) to XII (total damage, objects thrown into air)
 - Different intensity values are obtained at different locations around an earthquake
- Richter scale
 - Magnitude: amount of energy released at source of an earthquake
 - Logarithmic scale of which there is no maximum value
 - Each division represents a 10-fold increase in ground motion associated with the earthquake, and about 30 times increase in energy released
 - Measured on a scale from 1 to 9 plus (no maximum value indicated)
 - Measured using a scientific reading from a seismography
 - One earthquake gives one magnitude value

Conclusion

- Richter scale is used more commonly than the Mercalli scale as it eliminates subjectivity
- Other intensity scales like Shindo Scale in Japan and other magnitude scales like the body wave magnitude
- Seismologists now favour the moment-magnitude scale which measures energy released by the earthquake more accurately and provides the most accurate means of comparing large earthquakes

1b) Discuss to what extent can the earthquakes be predicted and its effects mitigated. [16]

Introduction

- Stand: Earthquakes can be predicted so long as the government is willing and able to put measures in place to do so. However, primary effects of an can be more effectively mitigated than secondary or tertiary effects.

Body

- Earthquakes can be predicted
 - Availability of scientific knowledge and tools
 - Eg. tiltmeter, seismic monitoring, recurrence intervals
 - Eg. GPS system used to monitor shifts in rocks along the San Andreas Fault
 - Eg. Changes in well water level and content like in the Tangshan earthquake
 - Dependent on the ability of the government to implement these measures
 - Japan and US have the financial capability to do so since they are very developed economically compared to countries like Indonesia where they probably have to depend on other nations to help them set up warning systems
 - DCs, having more educated people, would have the technological knowhow to operate and analyse scientific data compared to LDCs
 - Dependent on the government's priorities
 - LDC governments like that of Zimbabwe would probably place famine and epidemics as their top priority rather than earthquakes because those are pertinent issues concerning the day-to-day survival of citizens
 - DC governments can look past such basic issues and hence place earthquake hazards of a higher priority
- Earthquakes cannot be predicted with 100% accuracy
 - We must recognise that predictions do have a degree of uncertainty. It is with the availability of scientific knowledge and tools that the degree of uncertainty is greatly reduced, but not completely eliminated.
 - Prediction methods like unusual animal behaviour (eg. missing cats and dogs) are not scientifically sound
- Earthquake effects can be mitigated
 - With the increased accuracy of earthquake predictions, the effects of earthquakes can be more easily mitigated
 - Primary effects: effects directly due to the occurrence of the earthquakes
 - Can mitigate
 - Shaking of buildings
 - ❖ Can retro-fit structures (eg. Golden Gate Bridge)
 - ❖ Can build earthquake-proof buildings using isolated base technology to allow the building to move in the opposite

- direction to the earthquake motion so that the building does not shake as violently as it is supposed to (eg. Japan)
- Evacuation based on hazard mapping
 - ❖ Probabilistic approach to show hazard occurrence levels of various areas
 - ❖ To evacuate high-risk areas
 - Public education
 - ❖ Have earthquake drills and basic life support skills taught to students and employees alike (eg. Japan) so that people know how to react to an earthquake
 - Tsunamis: large wave caused by abrupt displacement of water
 - ❖ Warning systems in place and tell-tale signs like sea level receding before a tsunami arrives
 - ❖ But will need to involve public education and drills before that so that the government and its people will have ample time to respond to any warning
- Earthquakes difficult to mitigate due to earthquakes of huge magnitudes
 - Primary effects
 - Liquefaction: occurs when water-saturated sediment is reorganised due to violent shaking (eg. Mexico City)
 - Will need the cooperation of the government to redo its entire urban planning so that they do not build its cities on reclaimed land or land with loose soil, but this is difficult to achieve
 - Eg. In the case of Mexico City, instead of mitigating the problem of liquefaction, the government is actually trying to develop the economy further, which means more buildings will be built on land prone to liquefaction
 - Secondary effects: effects due to improper maintenance of rescue efforts
 - Spread of diseases due to drop in hygiene level
 - Need to ensure that survivors have proper access to sanitation and clean resources
 - More human lives lost due to the lack of survival facilities
 - Rescue or relief efforts are often hampered due to shortages of supply of food / water / healthcare facilities especially if governments do not have surpluses to draw from
 - Damaged infrastructure might disrupt relief efforts → need more time to get to victims
 - Tertiary effects
 - Damage to the economy
 - Due to decline in tourism
 - Due to trade deficit: increased borrowing leading to national debts which hampers economic growth
 - Failure of businesses as communications are interrupted and productions stopped

- Can depend on foreign aid but aid is not permanent, hence economy still takes a very long time to recover and rebuild its infrastructures
- Earthquake effects difficult to mitigate due to the lack of cooperation from the government (similar points to the difficulty in prediction)
 - Mindset of government
 - 'Soto ichi' Japanese mindset which perhaps stemmed from their culture of pride during the Kobe earthquake
 - Efforts to mitigate secondary and tertiary effects severely hampered due to the lack of resources and manpower

Conclusion

- Successful management of earthquakes largely dependent on the cooperation of the government and the intrinsic factors of the earthquake
- With climate change causing extreme weather and tectonic anomalies, earthquake hazards may be increasingly difficult to predict or mitigate
- Sometimes attempts to mitigate earthquake effects may backfire (eg. controlled earthquakes to release rock strain periodically may trigger larger unexpected earthquakes)
- Preparedness is always the key to managing earthquakes or any other hazard for that matter