Geography - Tectonics 3.2 & 3.3

3.2 - Variations in disaster risks caused by earthquakes and volcanic eruptions across places

^ why disaster risks caused by earthquakes and volcanic eruptions vary across places

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Factors that affect the extent of tectonic disaster risks across places(EARTHQUAKES)

EARTHQUAKES

1. nature of hazards: duration & time of shaking

a. duration of shaking

— **longer the ground shakes = more damaging earthquake**

— buildings/bridges = **long period of stress** **(more likely to collapse)**

— people likely to be **trapped under collapsed infrastructure** = **more injuries & loss of life**

— eg. 2011 **Tohoku, japan = 9 minutes** earthquake = massive damage to buildings

b. time of shaking

— influences the **activities carried out by people** and **how they respond** when the earthquake strikes

— **@ night = asleep = less alert = unable to evacuate quickly**

— @ work / school = more alert = able to evacuate quickly

— less likely to be trapped = less injuries / loss of life

— eg. 1995 Kobe, japan = @ 6am = many asleep = trapped at home = more than 6000 lives lost

2. vulnerable conditions: quality of building design / construction & soil + rock properties

a. quality of building design / construction

— **earthquakes itself do not kill people, buildings do**

— poorer building design & construction = more vulnerable the buildings are to collapsing = more trapped people (= >die) = disaster risks higher

— vulnerable = **low quality materials** (zinc - rigid / **unable to withstand shaking**) = **don't follow building codes set by authorities** = **lack earthquake-resistant features** (reinforced steel walls)

— eg. 2010 Haiti = buildings made of **poor-quality materials (concrete pillars holding up buildings were poorly reinforces)** = **more than 90%** of buildings destroyed - 220000 lives lost

b. soil & rock properties

— potentially open the area up to other earthquake hazards (liquefaction)

— liquefaction = soil is loose and saturated then is shaking

— softer soil = higher disaster risks (seismic waves travel from hard rocks > soft soil = waves get amplified)

— pass from rock > soil = waves slow down & get bigger

— soft & loose soil shake more intensely than hard rocks = increase likelihood of buildings & bridges collapsing (solid rocks - compact = shake less intensely

— buildings = vulnerable to collapse (sink into liquefied soil - tip over)

— people = likely to be trapped in collapsed buildings (more injuries and loss of life)

— eg. 2010 Haiti = **seismic waves were amplified = collapse of many buildings** = 220000 people lost their life

3. exposure: population density & distance from epicentre

a. population density

— number of people per unit of area

— **higher the population density = greater the number of people & buildings exposed** to earthquakes

— large amounts of people located within buildings = more people located within buildings = trapped = loss of lives

— eg. 1995 Kobe, japan = densely populated industrial city (3000 people per km) = 6000 people killed

b. distance from epicentre

— nearer the city is to epicentre = greater number of people / buildings

<u>exposed to the hazard</u> = greater disaster risk (more people are trapped - loss of life)

— city nearer to epicentre = less energy absorbed by rocks (before seismic waves reach the city) = seismic waves reaching the city will be stronger = violent shaking

— buildings/bridges more likely to collapse (loss of life)

— eg. 2010 Haiti, epicentre = 2.5km west of city = 220000 deaths

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Factors that affect the extent of tectonic disaster risks across places (VOLCANIC ERUPTIONS)

VOLCANIC ERUPTIONS

1. nature of the hazard: <u>type of magma</u>

— high / low silica magma

— type of magma = eruption is explosive / effusive - affecting the extent of disaster risk

a. high silica magma

— more viscous

— explosive eruption

— highly destructive pyroclastic flows = widespread damage to infrastructure = significant injuries / loss of life

— explosion of volcanic materials = strike people / properties = injuries / loss of life

— eg. 2010 Indonesia = pyroclastic flows (3kms down the heavily populated mountain sides) > volcanic bombs (spread over a distance of 10km) > 350 killed

b. low silica magma

— less viscous

— gentle/effusive eruption

— lava flows far from the volcano before cooling + rarely kill people (can avoid the pathway of lava)

— damage infrastructure / properties = over large areas (within the geographic region of the volcano)

— eg. 2018 Kilauea, Hawaii = 24 injuries = $800m property damage

2. Vulnerable Conditions: <u>availability of surface + groundwater & prevailing wind conditions</u>

a. availability of surface & groundwater

— greater the availability of surface & groundwater = more likely lahars can develop

- — increases the vulnerability of people / properties = increasing disaster risks (**lahars - landslides**) = **bury / destroy properties** = more injuries / loss of life

— large quantities of water

- — rapid **melting of snow** / ice (on volcano's summit before/during eruption)
- — **groundwater** release through cracks / fracture during eruption
- — existing river / **lakes nearby**
- — heavy rainfall

— eg. 1991 Indonesia, triggered by heavy rain (monsoon season) = destroyed 100000 homes

b. prevailing wind conditions

— **strength and direction of prevailing winds** = affect the distribution of **<u>ash fall & tephra</u>** = influence extent of disaster risk

- — ash fall & tephra = carried to human settlements

— larger area affected = higher number of people / properties vulnerable

- — heavier / larger particles deposited close to volcano
- — **<u>finer ash particles</u>** = smaller and lighter = **<u>carried & deposited hundreds/thousands kilometres away from the volcano (people likely experience health issues - respiratory problems)</u>**
- — properties = damaged (weight of the ash accumulated on roofs - collapse)
- — crops = destroyed
  - — eg. 1991 Philippines eruption = ash fall & tephra = spread a large distance (fast wind speed) = 90000 hectares of damaged farmland

3. exposure to volcanic eruptions: presence of human settlements

— **<u>presence of human settlements</u>** = increase exposure of people / properties to volcanic hazards = increase disaster risks caused by volcanic eruptions

— **however.. people choose to live near volcanoes?**

- — **volcanic soil = rich & fertile (ideal for farming)**
- — **geothermal energy = harnessed to produce electricity**
- — **valuable minerals = sulphur (can be mined)**
  - — eg. mount Sinabung (Indonesia) = active volcano (several explosive eruptions) = **many continue to live & work within restricted zone** (3km) = fertile soil for farming

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summary of conditions that influence the disaster risks that occur

EARTHQUAKES:

1. duration
2. time
3. quality of building/infrastructure
4. soil and rock (type of ground)
5. population density
6. distance from epicentre

VOLCANIC ERUPTIONS:

1. type of magma
2. availability of surface and groundwater
3. prevailing wind
4. presence of settlement

3.3 - Effectiveness of strategies in building community resilience to earthquakes & volcanic eruptions

^ strategies in building **community resilience** are important for communities living in **hazard-prone zones to resist, adapt and recover from the impacts of disasters in a timely & efficient manner**

How to strengthen community resilience:

— the strategies to build community resilience

1. land use planning = reduce exposure
2. hazard-resistant designs = reduce vulnerability
3. developing monitoring + warning systems = reduce vulnerability

4. disaster response & recovery = increase preparedness

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1. land use planning (reduce exposure)

— control & minimise development in high risk areas = decrease potential loss of lives / damage to properties

— using hazard maps = **strict guidelines to control development are implemented**

— hazard maps = **identify areas at risk & use data on past earthquakes**

— suggest levels of risk = **indicate the likely extent of disasters**

— eg. 1933 Japan tsunami = land use planning implemented = residential land use on coastal areas (shifted to higher ground)

— (linked) 2011 Japan earthquake = houses on higher ground = not destroyed

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2. hazard-resistant designs (reduce vulnerability)

— earthquake resistant building designs = withstand ground shaking (prevent from swaying too much (trapped) = reduce loss of lives)

— use shock absorbers / dampers = absorb vibrations

— use diagonal cross braces = reinforce buildings = retain building shape

— eg. Taipei 101 (skyscraper) = in earthquake prone zone = has weighted damper near top of building (balance out ground shaking) = reduce building swaying/collapsing

3. developing monitoring + warning systems (reduce vulnerability)

— monitoring/warning systems = set of devices = **detect seismic waves & ground deformation**

— help to **make predictions & send warnings** about potential hazards = people can **evacuate to a safer place**

— **Earthquake Early Warning (EEW)** system = uses sensors & monitors

— seismic waves detected > alerts sent to devices (inform people when seismic waves might reach them) = advance warning to people = critical in saving lives (gives people/ authorities time to respond & evacuate) > sensors identify risk areas = allowing aid to be directed where most needed)

— eg. 2011 Tohoku, Japan = monitoring & warning systems detected strong tremors = sent out signal to stop bullet train = saved thousands of passengers

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4. increasing preparedness - disaster response & recovery

— being prepared = **knowing what to do in the event of a tectonic hazard, avoid dangers**

a. **raising public awareness of hazards through education**

<u>**— provide people with the knowledge of the hazards**</u> + how to respond

— eg. take temporary shelter from volcanic ash / seal doors and windows

b. **first aid training**

<u>**— enables people to administrate basic medical care for the injured**</u>

<u>**— eg. keep them mobile = able to evacuate**</u>

c. **conducting evacuation drills**

— enables people to be familiar with evacuation procedures / routes

— eg. <u>**reduce likelihood of getting trapped in collapsed buildings**</u>

— volcanic eruptions

— familiarise on avoiding areas downwind of the volcano = avoid volcanic ash

— tsunamis

— familiarise on designated tsunami inundation zones / marked evacuation routes = avoid tsunami waves

— eg. 2011 Tohoku, Japan earthquake & tsunami = almost all 3000 students survived = school has disaster prevention education = responded quickly (evacuated to higher ground - away from tsunami)

+ increasing preparedness = developing plans to ensure people can get back to their lives asap

^ eg. plans for makeshift shelters & provision of medical care / food / water

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Challenges in strengthening community resilience:

1. extent of the community's resources

2. capability of the community to organise itself for disasters

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1. extent of the community's resources

— lack of resources (technological / financial resources) = cause challenges in building community resilience

— influence the ability of the community to reduce vulnerability & recover from the impact of disaster

- — eg. investing in hazard-resistant building designs (not enough $ to do so)

— **developing countries** often lack resources to build community resilience

- **— governments of developing countries = choose to prioritise economic developments (instead of preparing/dealing with disasters)**
  - — eg. Bangladesh, a developing country (very vulnerable to impacts of earthquakes)
    - **— 30% of their people live below the poverty line**
    - **— but, country's resources devoted to economic developments**

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2. capability of the community to organise itself for disasters

^ limit community's ability to respond/recover

— capability of a community to organise itself, limited by

- **— lack of effort to educate & train the community to respond/recover**
- **— political instability (civil unrest)**
- **— corruption = loss of funding meant to built community preparedness**
  - — eg. 2010 Haiti
    - — no measures put in place to educate them on what to do
    - — no network of community healthcare workers (limited medical response)
    - — chaos / unrest = survivors found it hard to recover from the disaster