

Examples for AO3 Essay Questions
Topic 3 | Disaster Risk Management

3.1 Sustainable development through disaster risk management

a. Earthquakes

1. 2004 Indian Ocean Earthquake and Tsunami (M_w 9.3)



- Environmental: The earthquake and tsunami destroyed coastal ecosystems and habitats. In Indonesia, it was estimated that **30% of coral reefs** and **35% of wetlands** were damaged.
- Economic: The earthquake and tsunami resulted in **\$13 billion** in damage, as tourist destinations like Maldives, Thailand and Sri Lanka experienced a downturn of visitors due to the damage (tourism). In Aceh, Indonesia, over **600,000 people** lost their fishing-related jobs.

- Social:
 - The disaster resulted in the death of **227,000 people** and **millions homeless** across **14 countries** (spread of disaster).
 - Many survivors experienced post-traumatic stress disorder (PTSD).
 - It pushed the proportion of people **living below the poverty line** in Aceh, Indonesia from **30% to 50%**.
- Evacuation: in **Patong, Phuket**, a 10 years old girl, **Tilly Smith**, having learnt about signs of tsunami at school, recognised the receding sea and alerted the security guard, saving hundreds of lives.
- Prevention: after the earthquake, Thailand implemented a comprehensive earthquake and tsunami warning system (to assure tourists) including **tsunami buoys** in Andaman Sea, **130 warning towers** across **6 southern provinces**, and a network of **seismic stations** and **sea-level monitoring stations**.

2. 2010 Haiti earthquake (M_w 7.0)



- Challenge:

- Haiti **lacked the finances** to invest in earthquake-resistant buildings, hence **many buildings** collapsed and most of the city was destroyed (*compared to Chile's stronger earthquake of M_w 8.8 but only 500 people died due to having earthquake-resistant buildings*).
- The community in Haiti was not able to **organise itself** for disasters as there were **no measures or education**. No network of community healthcare workers. Poor law enforcement and corruption.
- **Lack of resources** (*financial and technological resources*) led to critical **shortage of ambulances** and **heavy machinery** to remove rubble from collapsed buildings. The rescue team had to remove tons of rubble manually with hammers or rods to pull the trapped people.
- **Lack of community resilience** as people **couldn't organise themselves** for disasters, hence there was **unrest** and **chaos** as survivors found it hard to take care of themselves and recover from the disaster.

- Vulnerability:

- Many buildings in Haiti are made of **poor-quality materials**, hence 90% of buildings near to the epicentre were destroyed in the earthquake.
- Large areas of Port-au-Prince lie on layers of **soft soil** -> seismic waves were amplified.
- Distance from the epicentre: the epicentre was only **25km** away from the west of Port-au-prince (with high population density of **24,912 people** per square km).
- Environmental: landslides bury and destroy trees and forest, exacerbating **deforestation**. The debris also entered **waterways and rivers**, polluting them.
- Economic: the total economic damage of **\$7.8 billion**, and GDP growth rate decreased by **3.8%**.
- Social: **220,000 people** died. **1.5 million** people became homeless. The destruction of homes and infrastructure led to widespread **job losses** and **food shortages**.

- Disaster Management: As water supply was disrupted in the capital city Port-au-Prince, the **International Committee** of the **Red Cross** provided water supply for **12,000 people** by trucking water daily.

3. 2011 Tohoku Earthquake (M_w 9.0)



- Nature of earthquake: The earthquake lasted for **6 minutes**, causing massive damage to buildings. (usually an earthquake only lasts for less than 1 minute).
- Vulnerability:
 - As a developed country, Japan had **more earthquake-resistant buildings** -> lower death toll, and **recovered more easily** due to **available resources**.
 - During the earthquake, nearly all **3000 students** of **Kamaishi city** survived the earthquake and tsunami, as schools have *disaster prevention education programmes* with *evacuation drills* -> They were able to respond quickly and evacuate to **higher ground**, away from the tsunami. (community resilience)

- Environmental:

- In Sendai Plain, over **11,000 hectares** of farmland was flooded with seawater -> killed vegetation and hindered agriculture.
- Over **561 square km** of coastal land was **inundated** by the tsunami.
- The earthquake and tsunami triggered **nuclear meltdown** of reactors at *Fukushima Daiichi Nuclear Power Plant*. **Radioactive water** leaked into the Pacific Ocean, causing **water pollution**.

- Economic:

- An estimated **\$361 billion** in property damage, and total recovery cost was about \$122 billion.
- With **insurance payout (prevention strategy)**, over **\$47 billion** was incurred.

- Social:

- Over **160,000 people** lost their jobs in sectors like fishing and agriculture.
- **19,000 people died** and **450,000 people** became homeless. Survivors suffered from **mental illnesses** due to trauma, losing their loved ones, or unemployment.

- Disaster Management:

- *Search and Rescue efforts:* Following the earthquake, the **Japanese Self-defense forces** mobilised approximately **100,000 personnel**, including around **500 specialists** from countries like The UK, USA and Germany.
- *Recovery:*
 - + About **500,000 people** were displaced after the earthquake and tsunami. By **2016**, the majority have been rehoused in settlements with enhanced **tsunami-proof features**.
 - + In the port town of **Rikuzentakata**, the ground level of sites for new houses was raised by **10 metres**.
 - + Two more **protective seawalls** that are **3 metres** and **12.5 metres** high were built

- Community Resilience:

- *Reducing exposure through Land Use Planning:* After the **1993 tsunami**, residential land use on coastal areas, such as the **Touni-hongo village**, were

shifted to **higher ground** -> During the 2011 earthquake, the houses on higher ground were **not destroyed by tsunami**.

- *Reducing vulnerability through early warning systems:*
- + The **monitoring and warning system** saved thousands of passengers in **19 bullet trains** which were running at **top speeds**. All trains were able to **stop** before the earthquake struck.
- + Just **3 minutes** after the first earthquake, tsunami warnings were announced, which allowed people to have sufficient time to evacuate, as the tsunami only struck about **20 minutes** after the earthquake.

4. 1995 Great Hanshin earthquake in Kobe, Japan (M_w 6.9)



- Nature of hazard (time of shaking): The earthquake occurred in the early morning at around **6 am**. As many people were asleep, they were **trapped at home** (compared to the 2000 Tottori Earthquake (M_w 6.7), happened at 1.30 pm with 0 death)

- Exposure:
 - Population density: there was a high density of **3,000** people per square km.
 - Distance from epicentre: The epicentre was only **20km** away from the **centre of Kobe** (exposure).
- Social: **6,000 lives lost and 40,000 people injured**. Volunteers from all over Japan converged in Kobe to help victims of the earthquake by providing food and mental support (social and psychosocial services).

5. 2015 Nepal Earthquake (M_w 7.8)



- Economic and Social: over **600,000 buildings** were destroyed. **9,000 people** died.
- Challenge (stakeholder):
 - After the earthquake, the government created a new public body, the **National Reconstruction Authority (NRA)** to oversee rebuilding.

- Due to **political disagreements**, it took nine months to appoint a leader for the NRA, hindering recovery works.

6. 2018 Sulawesi Earthquake in Palu, Indonesia (M_w 7.6)



- Environmental:
 - The earthquake triggered **7063 landslides**, contributing to the intensity of the tsunami.
 - **Soil liquefaction** was extensive in Palu, leading to **mudflows** and the *submerging of buildings and infrastructure*.
- Social: Over **4,000 people died**. More than **70,000 homes** were damaged, forcing tens of thousands of homeless people to live in shelters and tents.
- Disaster Management:
 - **Social and psychosocial services:** following the earthquake, organisations like **The Salvation Army** and **Post Crisis Counselling Network (PCCN)** provided

mobile clinics and **trauma healing sessions** to support survivors who faced psychological issues to deal with the loss of their family members.

7. 2020 Aegean Sea Earthquake in Turkey (M_w 7.0)



- Disaster risk management:
 - Search and rescue efforts: More than **8,000** search, rescue and first aid teams were deployed and over **106 people** were rescued. With prompt and immediate response, only **119 people** died.
 - Insurance: **52%** of residential properties in Turkey have **earthquake insurance**.

b. Volcanoes

1. 1985 Nevado Del Ruiz eruption in Colombia, South America



- Released huge amounts of ash and volcanic rocks which melted snow and ice.
- There were many pyroclastic flows triggered, which mixed with the meltwater to form lahars.
- Fast-moving lahars moved down the slope and engulfed the town of Armero, killing more than 20,000 people.
- Rivers were highly muddied by the lahars, killing many fish.

2. 1991 Mount Pinatubo Eruption in The Philippines



- Nature of hazard:
 - Availability of surface and groundwater: Many **lahars** following the eruption were triggered by **heavy rain** associated with the **monsoon season**, destroying more than **100,000 homes**.
 - Prevailing wind conditions: The eruption resulted in **ashfall and tephra** spreading a **large distance** due to fast wind speed of over **20 m/s**. (Ashfall even travelled to Singapore).
- Environmental:
 - The eruption released a huge amount of ash that buried over **180 square km** of forests in ash of about **25 cm**.
 - The eruption released a huge amount of sulfur dioxide gas, which reacted with water to form sulfate aerosols that reflected sunlight away from Earth -> Caused a **temporary global cooling** of about **0.5°C**.
 - More than **90,000 hectares** of **damaged farmland** due to ashfall and tephra.

3. 2018 eruption of Kilauea in Hawaii (low silica lava):



- Economic: USD \$800 million in property damage
- Social: 24 injuries and 600 homes were destroyed. Many **highways** and **homes** were destroyed by **volcanic bombs**, disrupting services and rescue.

4. 2010 Eruption of Mount Merapi, Indonesia (high silica lava).



- Environmental:
 - The ash released covered a wide area, with some villages like **Bronggang** buried under **30 centimetres** of ash.
 - The eruption resulted in **pyroclastic flows** that travelled **3 km** down the heavily populated mountain sides.
 - **Volcanic bombs** spread over a distance of **10 km**.
- Disaster Management:
 - *Timely evacuation:* After a warning of Mount Merapi's imminent eruption was issued by scientists, Indonesia's authorities organised **massive evacuation efforts** that comprised over **700 evacuation centres**, evacuating more than **350,000 people**. This quick and massive evacuation was credited for saving over **10,000 lives** (only **341 deaths**).
 - Provision of social and psychosocial services: Many NGOs like **Mercy Relief** provided **clean water** for survivors (due to shortage of water) by constructing a **community water system** (worth \$58,600).

5. 2017 Mount Agung Volcanic Eruption (Bali, Indonesia)



- Vulnerability (availability of surface and ground water): a **tropical cyclone** resulted in **winds** and **higher rainfall** which resulted in **lahars** being directed towards popular beaches.
- Disaster Management:
 - *Provision of food:* after the eruption, locals, the government, and international NGOs collectively sent vehicles laden with food to help more than **75,000 people** who evacuated from the island.

6. 2010 Mount Sinabung Eruption in Indonesia



- Exposure/Challenge by stakeholder: Although Mount Sinabung is an active volcano, and there were several explosive eruptions since 2010, many people **continue to live and work** within the restricted zone **3km** from the volcano (due to the fertile volcanic soil, favourable to agriculture).
7. Other examples for provision of basic social and psychosocial services to affected communities:
- Water: After the 2010 Mount Merapi eruption, many NGOs like **Mercy Relief** provided **clean water** for survivors (due to shortage of water) by constructing a **community water system** (worth \$58,600).
 - Food: After the **2017 Mount Agung** eruption in Indonesia, stakeholders such as the government and international NGOs provided food for more than **75,000 evacuees**.

- Healthcare: After the **2018 Fuego eruption** in **Guatemala**, **World Vision**, an international charity, provided **30,000 boxes** of **medical supplies** and **1,000 hygiene kits** to affected communities.