# DP IB Geography: SL

Your notes

## Hazard Risk & Vulnerability

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# Case Study: Mount Merapi

## Mount Merapi earthquake facts

- Name – Mount Merapi
- Location – Java, Indonesia
- Date – 25th October–30th November 2010
- Magnitude – VEI 4
- Plate boundary – Destructive plate boundary where the Indo-Australian plate is subducting below the Eurasian plate
- Type of volcano – Stratovolcano or composite

## Location of Mount Merapi




*Location of Mount Merapi*

**Impacts of the 2010 Eruption of Mount Merapi, Indonesia**

| | Primary impacts | Secondary impacts |
|---|---|---|
| Social | 353 deaths<br><br>Injuries and illness e.g. sulphur dioxide gas caused skin irritation and breathing problems<br><br>Damage to over 19,000 homes and properties<br><br>Displacement of 350,000 people | Nearly half of the people affected by the eruption suffered mental health issues e.g. stress, anxiety, depression<br><br>Disruption to services such as healthcare and education<br><br>Disruption to religious and traditional practices |
| Economic | Economic losses of £450 million due mainly to impact on farming, tourism and manufacturing<br><br>Destruction of property and infrastructure e.g. 30 bridges were damaged<br><br>Disruption of trade and economic activity e.g. about 2500 flights cancelled | Food prices increased due to destruction of crops and livestock<br><br>Slower economic growth and development due to closure or relocation of businesses, decline in tourism, damage to crops etc.<br><br>Tourism fell by 30% (domestic tourists) and 70% (international tourists) |
| Environmental | Destruction of biodiversity, habitats and ecosystems e.g. over 200 hectares of forest were damaged<br><br>Poor air and water quality | Acid rain damaged ecosystems<br><br>Long-term pollution of land and rivers |
| Political | Pressure on government to co-ordinate emergency response<br><br>Social unrest, looting and political instability | Conflicts over government response and food shortages e.g. some residents claimed that the compensation scheme was inadequate and unfair |


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## Factors affecting vulnerability

- The number of deaths, injuries and displacement of population was high during and after the eruption
- People were vulnerable to the impacts of the hazard
- People refused to leave their homes, which made them more vulnerable to the impacts of the eruption

- The reasons people stayed included:
  - Caring responsibilities for elderly parents
  - Responsibilities for livestock
  - Long-term residency and a subsequent unwillingness to leave
  - Cultural beliefs
- Population density in the area has increased
- Local people don't always believe that scientific monitoring is accurate, relying instead on traditional warning signs
- Communication regarding the dangers of the eruption was slow and ineffective


Your notes

# Case Study: Cumbre Vieja

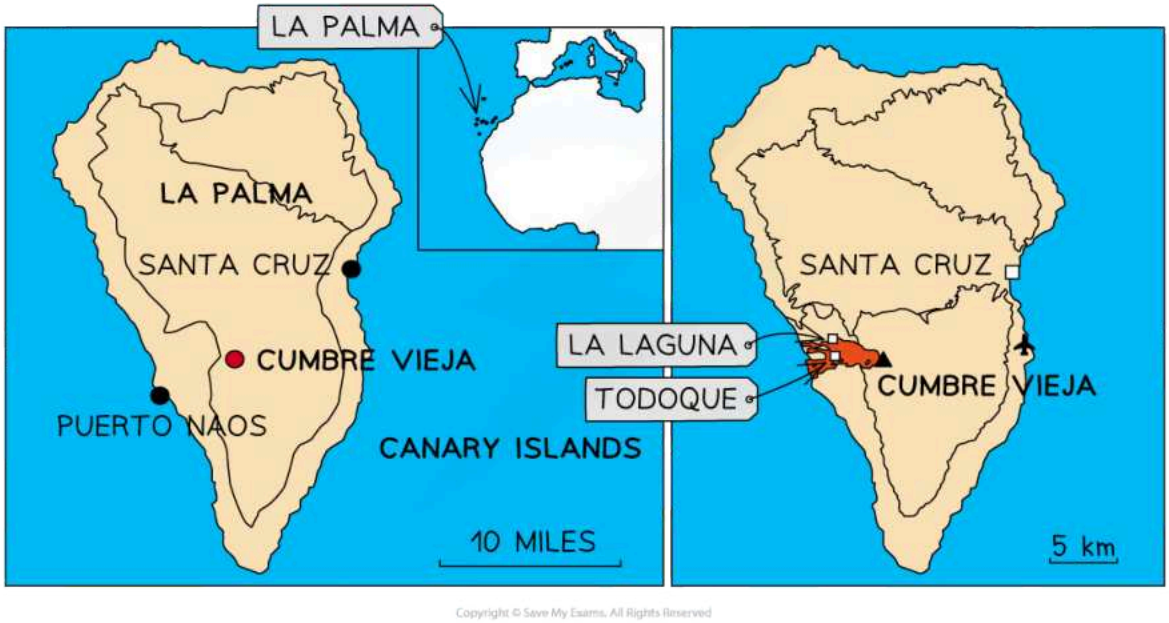
## La Palma, Spain

- Part of the Canary Islands, La Palma is located in the Atlantic Ocean off the coast of North Africa
- The Canary Islands are an [popover id="RAr2r~3MbVY7biGB" label="autonomous region"] of Spain
- There are 33 volcanoes across the Canary Islands, 10 of which are in La Palma

## Cumbre Viejo earthquake facts

- Name – Cumbre Viejo
- Location – La Palma, Spain
- Date – 19th September–December 2021
- Magnitude – VEI 2 or 3
- Plate boundary – Magma plume (hotspot)
- Type of volcano – Cinder cone (basaltic lava)

### Location of Cumbre Vieja Volcano





***Location of Cumbre Vieja Volcano***

## Primary impacts

- Almost 1500 houses were destroyed by the lava flow
- Over 1500 other buildings such as churches, shops and schools were destroyed
- The lava flow cut across the coastal highway and covered 1000 hectares
- The water supply was cut off for almost 3000 people
- 400 hectares of banana farms were destroyed
- Almost 1300 hectares of land were affected
- There was one death

## Secondary impacts

- Air traffic was suspended on a number of occasions due to ash in the atmosphere
- Over 1000 people were evacuated after the eruption began on the 19th September
- A further 5600 people were evacuated over the next few weeks
- About 20,000 people were exposed to the eruption and its effects

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## Factors affecting vulnerability


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- Although many buildings were impacted by the eruption, deaths and injuries were minimised as a result of:
  - Evacuation plans
  - Suspension of air traffic
- La Palma also has a **Local Hazard Mitigation Plan**, which aims to reduce the impacts of any hazard event
- People are encouraged to have an emergency kit ready in case of eruptions
- Insurance cover means that recovery from a hazard event is more rapid
- La Palma has well-trained and equipped emergency services

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# Case Study: Nepal

- Nepal is one of the poorest countries in the world with a **Gross Domestic Product (GDP)** per capita of under $1000 in 2015
- Located between China and India, Nepal is a **landlocked** country
- In 2015, 80% of the population lived in rural, often remote, communities
- In April 2015 at 11.26 a.m., Nepal was struck by an earthquake of magnitude 7.8
- The epicentre was 80km northwest of **Kathmandu** in the **Gorka district**
- The focus was shallow at only 15km beneath the surface
- Over 300 aftershocks followed the main earthquake

## Location of the Nepal earthquake

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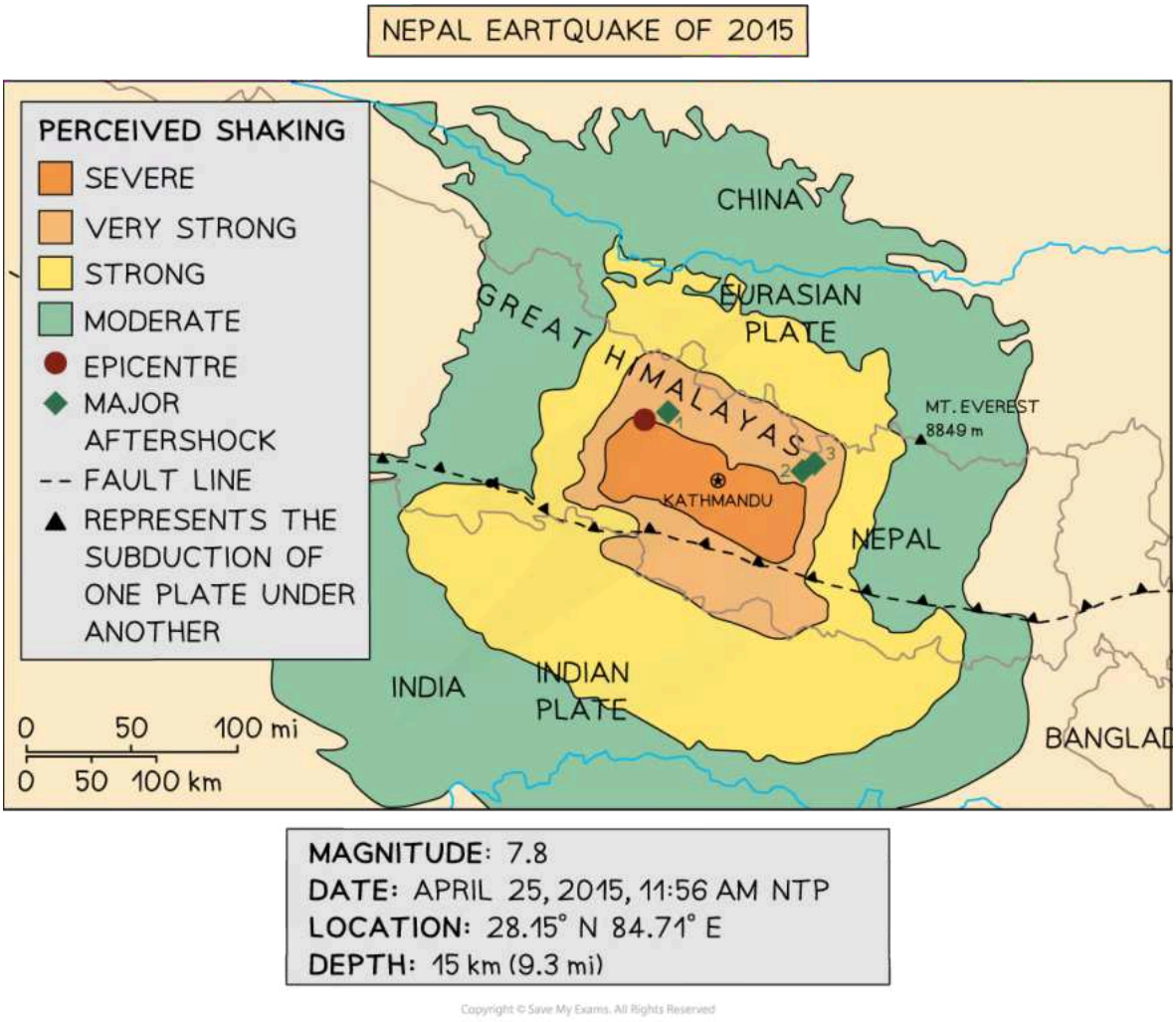



*Location of the Nepal earthquake*

## Cause

- Nepal is located on a collision boundary between the Indian and Eurasian plates

## Effects

- Approximately **9000 deaths**
- Over **20,000 people injured**
- Electricity and water supplies cut
- **7000 schools** and **1000 health facilities** damaged or destroyed

- Almost **3.5 million** people made homeless
- Offices, shops and factories destroyed, meaning people unable to make a living
- UNESCO world heritage sites destroyed, as well as many temples
- A loss of tourist income, which Nepal is reliant on
- Avalanches on Mount Everest and in the Langtang Valley
- Landslides, which blocked roads and rivers
- Damages estimated at between $7 and $10 billion; about **35% of the GDP**


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## Immediate responses

- There were donations of money and aid from around the world totalling $3 billion, including $3.3 million from China and $51 million from the UK
- Many countries sent aid in the form of:
  - Temporary shelters
  - Medicines
  - Food
  - Water
  - Clothing
  - Search and rescue teams
  - Medical staff
- 90% of the Nepalese army were mobilised
- Tent cities were set up in Kathmandu for those made homeless
- **A GIS crisis-mapping tool** was used to co-ordinate the response
- **A $3 million grant** was provided by the **Asian Development Bank** for emergency relief

## Long-term responses

- Landslides were cleared and roads repaired to restore access to remote rural communities
- Schools were rebuilt
- Earthquake drills were introduced to provide people with education about what to do in the event of an earthquake
- Stricter building codes were introduced with more enforcement

- $200 million was provided by the Asian Development Bank for rebuilding
- A new government task force was set up to plan for future earthquake events

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## Factors affecting vulnerability

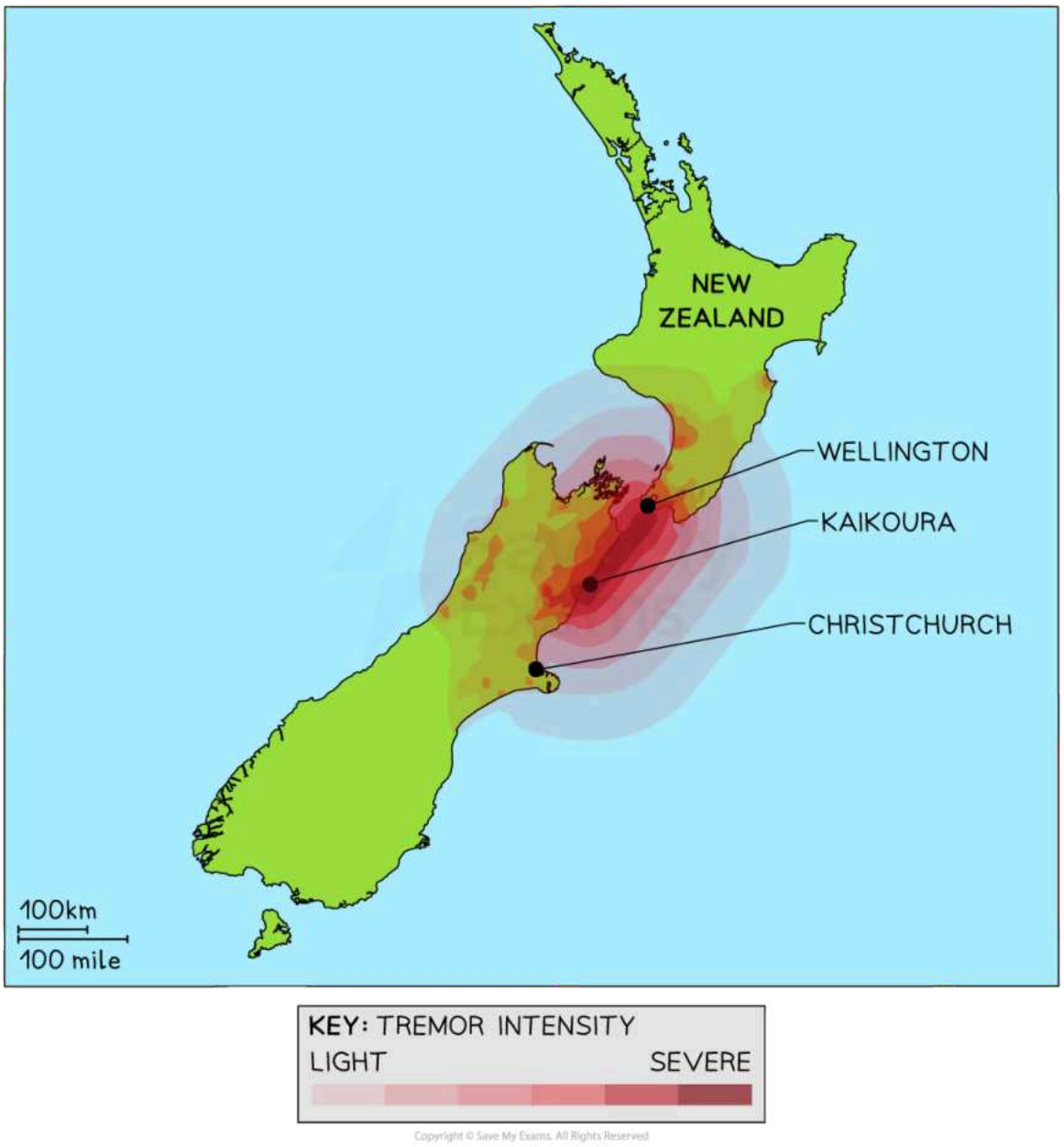
- Vulnerability is higher in Nepal due to a range of factors:
  - Many people affected live in remote, rural areas, which means:
    - Communication and education about the risks of earthquakes are limited
    - In the event of a hazard these areas are difficult to reach
  - The city of Kathmandu is densely populated, so more people are affected
  - There were building codes but these were not always enforced or followed:
    - Buildings are often built using low-quality materials and are usually not earthquake-resistant
  - Nepal is a mountainous area, which increases the risk of landslides and avalanches
  - There is a lack of education regarding the risks of earthquakes

# Case Study: New Zealand

- New Zealand is one of the wealthiest countries in the world, with a **Gross Domestic Product** of US$40,058 in 2016
- It is located to the south-east of Australia
- On 14th November 2016, it was struck by a magnitude 7.8 earthquake
- The epicentre was 15km north-east of Culverden and 60km south-west of Kaikōura
- The focus was shallow, only 15km below the surface
- By the 17th November, there had been over 2000 aftershocks

## Location of the New Zealand earthquake

Your notes




*Location of the New Zealand earthquake*

## Cause

- New Zealand is located on a destructive boundary between the Indian-Australian and Pacific plates

## Effects

- **Two** deaths
- Over 50 people injured
- Temporary homelessness of 60 people
- Over 2000 buildings were damaged or destroyed, including some in the capital city, Wellington
- Power, water and telecommunication cut off to Kaikōura and surrounding communities
- Approximately **11,000 landslides**:
  - Destruction of **390km of road and railway**
  - Kaikōura and surrounding communities were completely cut off for 16 days
- Uplift of the coastline by 5.5 metres in some areas:
  - Kaikōura's harbour was affected by the uplift, meaning boats could not leave or enter the harbour
  - Disruption of the coastal breeding areas for dolphins, seals and sea birds
- A tsunami followed the earthquake, reaching up to 6.9 metres in Goose Bay
- Insurance costs reached $2.27 billion
- The cost to the government reached almost $3.5 billion

## Immediate responses

- National Crisis Management Centre activated
- Tsunami warnings were issued for coastal areas via sirens, texts and social media
- Local states of emergency declared
- Helicopters and ships provided emergency supplies and evacuated vulnerable people
- Search and rescue teams dispatched

## Long-term responses

- Improvements to the tsunami warning procedure
- Road routes were repaired between one month and one year after the event
- The main rail route reopened after two months but full repair took over a year
- Improvements to the building regulations made to assess existing buildings for earthquake resistance
- Kaikōura's harbour was rebuilt; taking over a year to complete


Your notes

## Factors affecting vulnerability


Your notes

- The vulnerability of the population is reduced due to a range of factors, including:
  - Planning and preparation for earthquake events
  - Education about what to do during and after an earthquake event
  - Emergency services are well-trained and equipped
  - People at risk were rapidly evacuated from the affected areas
  - Building quality and materials are of a high standard, reducing the risk of collapse
  - As a HIC, New Zealand can afford the repairs and rebuilding, reducing recovery time
  - A tsunami warning system gives people time to evacuate from areas at risk

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# Case Study: Vargas, Venezuela

## Vargas mass-movement facts

- Location – Vargas state, Venezuela
- Date – 15-16th December 1999
- Cause – Rainfall 40-50% above the usual average
- Events – Rainfall triggered flows of soil and debris
- Type of mass movement – Fast-moving debris flow

## Hazard event

- Thousands of debris flows moved rapidly down the steep-sided mountains and narrow canyons
- The debris flow included boulders up to 10 metres in diameter
- In some places, the deposits created by the debris flow were several meters thick
- The debris flow speed was estimated at between 3 and 14.5 metres per second

## Impacts

- Rain caused many mudslides, landslides and debris flows across the region
- There were between 10,000-50,000 deaths (many people were never found, and whole families were buried by the mudslides or swept out to sea)
- Over 150,000 people were made homeless
- Towns including **Cerro Grande** and **Carmen de Uria** were completely buried or swept away
- Over 70% of the population in Vargas state were affected
- The debris flow and mudslides destroyed many squatter settlements
- Bridges and roads were destroyed
- The seaport at **Maiquet** was affected, leading to hazardous material leaking from containers
- Crops were destroyed
- Economic damage was estimated at US$3.5 billion

- Communication systems were destroyed
- Supplies of food and water were affected for months
- Looting occurred across the region, meaning martial law had to be implemented for over a year

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## Factors affecting vulnerability

- The debris flows killed thousands of people as a result of a range of factors:
  - High population density in the coastal areas
  - Disorganised urban growth
  - Poor quality buildings – many of the areas affected were **squatter settlements**
  - Corruption amongst government and public officials, which allowed homes to be built in vulnerable areas
  - In 1999, the government stopped collecting rainfall information:
    - This data was used to maintain bridges, reservoirs and other infrastructure
  - Lack of warning – no evacuation orders were issued
  - The government ignored a report from the Civil Defense Agency that urged them to declare a state of emergency 12 hours before the main debris flows

# Case Study: Ponzano, Italy

## Ponzano facts

- Location – Ponzano, Italy
- Date – February 2017
- Cause – Combined effect of earthquakes and snowmelt leading to saturated soil and intense rainfall (81mm in four days)
- Type of mass movement – Slow-moving landslide

## Hazard event

- The rate of landslide movement averaged one metre per day for two weeks
- Ponzano village in the north-east of Italy, about 30km north of Venice

## Impacts

- An estimated 7 million $m^3$ of material moved

- Over 100 people evacuated from 35 houses
- Collapse of several buildings
- Agricultural land around the village becoming unsafe to cultivate

## Factors affecting vulnerability

- Low population density
- The slow movement of the landslide made evacuation easy
- The landslide was monitored and tracked by the Civil Protection Department
- Emergency services supported people to recover property from evacuated buildings
- Psychologists were provided to support people's mental health

### Examiner Tips and Tricks

When considering hazard events it is important that you can explain why vulnerability varies between and within communities.


Your notes