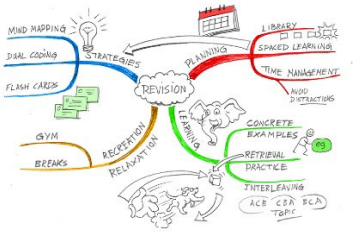
Hart School Geography – Summer Revision Pack

Inside this pack you will find case study guides for each of our Paper 1 topics.

How can I use this pack?

Use the information to make dual coded mind maps for each major case study. (pictures will help you recall the key info!) 	**Create Flash cards to break down key facts and statistics linked to each case study** 
Read through Each Case study and highlight the key info within the text. 	**Answer the comprehension questions. Do it open book to begin with and then test yourself without help!** 
Complete the example 6-9 mark questions (make a plan first and then see how quickly you can answer). 	**Online resources: Use the internet to research each case study further or use an AI platform to help plan exam responses or find out more!** 

There will be fabulous rewards for examples of revision you have completed!

Have fun and work hard!

Case Study HIC Tectonic Hazard: 2011 Christchurch Earthquake (New Zealand)

1. Description of Location and Reason for the Tectonic Hazard

The 2011 Christchurch earthquake struck on **February 22nd, 2011**, with a magnitude of **6.3** on the Richter scale. Its **epicenter** was located **10 km southeast of Christchurch**, in the Canterbury region of New Zealand's South Island, at a shallow depth of **5 km**. This shallow depth amplified the shaking's intensity in the city.

New Zealand lies on the **Ring of Fire**, a highly active tectonic zone where the **Pacific Plate** converges with the **Indo-Australian Plate**. The earthquake occurred along the **Greendale Fault**, a previously unmapped fault line that was stressed by the **magnitude 7.1 earthquake** in September 2010. This earlier event weakened the region's crust, increasing the likelihood of another significant seismic event.

---

2. Effects of the Earthquake

Primary Effects:

- **Social:**
  - **185 people died**, making it New Zealand's second-deadliest earthquake since 1931.
  - About **2,000 people were injured**, including many with severe crush injuries and fractures.
  - **Over 100,000 homes** were damaged, with **10,000 requiring demolition**, leaving thousands homeless.
  - Iconic structures such as the **Christchurch Cathedral** and the **CTV building** collapsed, the latter causing **115 deaths**.
- **Economic:**
  - The earthquake caused approximately **NZ$40 billion (US$29 billion)** in damages, one of the most expensive disasters in New Zealand's history.
  - Over **50% of buildings** in the central business district were severely damaged or destroyed.
  - Thousands of businesses were forced to close, resulting in significant job losses.
  - Christchurch's port, Lyttelton, suffered heavy damage, disrupting trade.
- **Environmental:**
  - Liquefaction affected **over 400,000 tons of silt**, flooding streets, and destabilizing building foundations.
  - Landslides and rockfalls occurred in the **Port Hills**, destroying homes and damaging roads.
  - Many rivers and water systems were contaminated, leading to environmental degradation.

Secondary Effects:

- **Social:**
  - Ongoing stress and trauma led to a significant increase in **mental health issues**, including **PTSD** and depression.
  - **20% of Christchurch's population** temporarily relocated, with some leaving permanently.
  - The education system was disrupted as **163 schools** sustained damage, some requiring relocation or rebuilding.
- **Economic:**

    - Tourism to Christchurch declined sharply, reducing the city's revenue from international visitors.
    - The local economy suffered long-term setbacks due to the slow reconstruction of infrastructure and businesses.
    - Insurance payouts exceeded **NZ$15 billion**, impacting global insurance markets.
- **Environmental:**
    - Increased flood risks due to damaged riverbanks and changes to land levels in coastal areas.
    - Permanent changes to the landscape, including new fault scarps and unstable slopes.

---

3. Responses to the Earthquake

Immediate Responses:

- The **New Zealand government** declared a **national state of emergency** within hours, enabling quick resource deployment.
- Over **1,500 urban search and rescue personnel**, including teams from **Australia, Japan, the UK, and the USA**, were deployed to assist in search-and-rescue operations.
- Emergency shelters were set up, housing **thousands of displaced residents**, while over **30,000 chemical toilets** were distributed to address sanitation needs.
- The **New Zealand Red Cross** and other charities provided water, food, and medical care to affected communities.

Long-Term Responses:

- The government established the **Canterbury Earthquake Recovery Authority (CERA)** to manage the **NZ$40 billion rebuilding program**.
- **Stricter building codes** were introduced, ensuring that all new structures were designed to withstand future earthquakes.
- **80% of the central business district** was demolished and redeveloped, transforming Christchurch’s urban landscape.
- Educational campaigns and earthquake preparedness drills became widespread, including improvements to **GeoNet**, New Zealand’s earthquake monitoring network.
- Mental health services were expanded to support affected residents, with programs addressing trauma and community resilience.

Comprehension Questions: 2011 Christchurch Earthquake Case Study

Location and Cause

1. Where did the 2011 Christchurch earthquake occur, and what was its magnitude and depth?
2. Which tectonic plates are involved in the Christchurch region, and what is the name of the fault line responsible for the earthquake?
3. Why was Christchurch particularly vulnerable to this earthquake?

Primary Effects:

4. How many people died and were injured in the earthquake?
5. What percentage of homes and buildings in Christchurch were damaged or destroyed?
6. Which iconic buildings were severely affected, and how many deaths occurred in the CTV building collapse?
7. How much economic damage (in NZ dollars) was caused by the earthquake?

Secondary Effects:

8. What were the main social consequences of the earthquake in terms of population movement and mental health?
9. How did the earthquake impact Christchurch's economy, particularly tourism and insurance?
10. Name

Immediate Responses:

11. What actions did the New Zealand government take immediately after the earthquake?
12. Name three countries that sent urban search-and-rescue teams to Christchurch.
13. What measures were taken to provide shelter and sanitation to displaced residents?

Long-Term Responses:

14. What organization was established to oversee the rebuilding of Christchurch, and how much was the estimated cost?
15. How was Christchurch's central business district transformed after the earthquake?
16. What steps were taken to improve disaster preparedness in New Zealand following the event?

Example 9 Markers:

1. **"Assess the effectiveness of different management strategies in reducing the impacts of a tectonic hazard."**
2. **"To what extent are the impacts of tectonic hazards greater in poorer countries than in richer countries?**
3. **"Evaluate the extent to which the primary effects of tectonic hazards are more significant than their secondary effects."**
4. **"Discuss the importance of monitoring, prediction, and planning in reducing the impacts of volcanic eruptions."**
5. **"Examine the role of human factors in increasing the vulnerability of people to tectonic hazards."**
6. **"To what extent can technology reduce the impact of tectonic hazards in both HICs and LICs?"**

Case Study: 2015 Nepal Earthquake (Gorkha Earthquake)

1. Description of Location and Reason for the Tectonic Hazard

The **2015 Nepal earthquake**, also known as the **Gorkha earthquake**, struck on **April 25th, 2015**, with a magnitude of **7.8** on the Richter scale. The **epicenter** was located near the village of Barpak, in the Gorkha District, approximately **80 km northwest of the capital, Kathmandu**. The earthquake occurred at a relatively shallow depth of **15 km**, intensifying the destructive power.

The earthquake happened due to the collision of the **Indian Plate** and the **Eurasian Plate**, a tectonic process that also created the Himalayas. The Indian Plate is moving **2 cm per year** under the Eurasian Plate at a **convergent plate boundary**, generating enormous stress. The sudden release of this stress caused the earthquake. Nepal's location within an active seismic zone and its mountainous terrain make it particularly vulnerable to earthquakes.

---

2. Effects of the Earthquake

Primary Effects:

- **Social:**
  - **8,841 people were killed**, and over **22,000 were injured**.
  - **Over 600,000 homes** were destroyed, leaving **approximately 3 million people** homeless.
  - The **UNESCO World Heritage Sites** in Kathmandu Valley, including the Dharahara Tower and Patan Durbar Square, were heavily damaged.
- **Economic:**
  - The total cost of damage was estimated at **$5 billion**, nearly **25% of Nepal's GDP**.
  - **50% of shops** in Kathmandu were destroyed, affecting livelihoods and access to essential goods.
  - Many roads and trails, vital for rural trade, were blocked by landslides.
- **Environmental:**
  - Landslides and avalanches were triggered across the mountainous regions. The avalanche at **Mount Everest's Base Camp** killed **19 climbers**, the deadliest day in Everest's history.
  - The Langtang Valley was completely buried by a massive landslide, killing **250 people**.
  - Rivers were blocked by landslides, raising concerns about flooding.

Secondary Effects:

- **Social:**
  - Lack of clean water, food, and medical supplies led to outbreaks of diseases such as **cholera**.
  - Thousands of families were forced to live in makeshift shelters for months.
  - Education was disrupted as **7,000 schools were destroyed**.
- **Economic:**
  - Tourism, a major contributor to Nepal's economy, declined by **40%** in the year following the earthquake.
  - Agricultural productivity was severely affected as fields were destroyed and farmers lacked resources to recover.
- **Environmental:**
  - Frequent aftershocks (including a significant **7.3-magnitude quake on May 12th**) caused further destruction and hindered recovery efforts.

    - Deforestation increased in some areas as wood was used for reconstruction and fuel.

---

3. Responses to the Earthquake

Immediate Responses:

- Nepal's government declared a **state of emergency** and appealed for international assistance.
- **90% of Nepal's army** and police were deployed for rescue operations.
- International aid poured in, including:
    - **£73 million** from the UK, which also sent over **30 tons of humanitarian aid**.
    - **India** and **China** sent rescue teams and medical supplies.
    - The **United Nations** and organizations like the **Red Cross** provided temporary shelters, clean water, and medical care.
- Rescue operations in rural areas were severely hampered by blocked roads and damaged infrastructure.
- Helicopters were used to evacuate injured climbers from Everest Base Camp and to deliver supplies to remote areas.

Long-Term Responses:

- The **Post Disaster Needs Assessment (PDNA)** estimated that **$6.7 billion** would be required for full recovery.
- The **Nepalese government**, with help from international organizations, launched a **rebuilding program**, focusing on more earthquake-resistant structures. By 2021, **50% of damaged homes** had been rebuilt.
- Schools and hospitals were reconstructed with improved seismic standards.
- The government introduced **"Build Back Better"** policies to strengthen resilience against future disasters.
- **Tourism campaigns** were launched to revive the industry, including the **Visit Nepal 2020 campaign** (later disrupted by the COVID-19 pandemic).

Summary

The 2015 Nepal earthquake illustrates the devastating impacts of tectonic hazards on LICs (Low-Income Countries). With widespread loss of life, economic disruption, and environmental degradation, the disaster highlighted Nepal's vulnerability due to its geophysical setting and limited resources. However, international aid and community resilience played crucial roles in both the immediate response and long-term recovery.

Comprehension Questions: 2015 Nepal Earthquake Case Study

Location and Cause

1. Where was the epicenter of the 2015 Nepal earthquake, and how far was it from Kathmandu?
2. What was the magnitude and depth of the earthquake?
3. Which two tectonic plates were involved in causing the earthquake, and what type of plate boundary was it?

4. What long-term geological process has been caused by the collision of the Indian and Eurasian plates?

Primary Effects:
5. How many people were killed and injured during the earthquake?
6. What percentage of homes were destroyed, and how many people were left homeless?
7. Name two UNESCO World Heritage Sites damaged by the earthquake.
8. How much economic damage (in dollars) was caused by the earthquake?
9. What environmental disaster occurred at Mount Everest Base Camp, and how many people did it kill?

Secondary Effects:
10. What diseases broke out after the earthquake due to poor sanitation?
11. How was Nepal's tourism industry affected in the year following the earthquake?
12. What impact did the earthquake have on education in Nepal?
13. How did aftershocks, including the May 12th quake, hinder recovery?

Immediate Responses:
14. What percentage of Nepal's army and police were deployed for rescue operations?
15. Name three countries or organizations that provided significant international aid.
16. How was aid delivered to remote areas, and what challenges were faced during rescue operations?

Long-Term Responses:
17. What was the estimated cost of rebuilding Nepal after the earthquake?
18. Describe the "Build Back Better" policy and its goals.
19. What steps were taken to make schools and hospitals more resilient to future earthquakes?
20. How did Nepal try to revive its tourism industry after the disaster?

Example 9 Markers:

7. **"Assess the effectiveness of different management strategies in reducing the impacts of a tectonic hazard."**
8. **"To what extent are the impacts of tectonic hazards greater in poorer countries than in richer countries?**
9. **"Evaluate the extent to which the primary effects of tectonic hazards are more significant than their secondary effects."**
10. **"Discuss the importance of monitoring, prediction, and planning in reducing the impacts of volcanic eruptions."**
11. **"Examine the role of human factors in increasing the vulnerability of people to tectonic hazards."**
12. **"To what extent can technology reduce the impact of tectonic hazards in both HICs and LICs?"**

Case Study: Typhoon Haiyan (2013)

Context

- **Location**: Typhoon Haiyan, known locally as *Yolanda*, struck the Philippines, a Southeast Asian archipelago prone to tropical storms due to its location in the Western Pacific.
- **Date**: Landfall occurred on **November 8, 2013**.
- **Category**: Classified as a **Category 5 Super Typhoon** on the Saffir-Simpson scale, one of the most powerful tropical storms ever recorded.
- **Affected Areas**: Tacloban, Leyte, and Samar were among the hardest-hit regions, with 14 million people affected across **46 provinces**.

Cause and Origin

- **Formation**: Typhoon Haiyan originated from a low-pressure area in the Pacific Ocean on **November 2, 2013**. Warm ocean waters (above **26.5°C**) and the Earth's rotation caused the development of the typhoon.
- **Path**: It intensified rapidly, fueled by sea temperatures of **30°C**, minimal wind shear, and moisture-laden air. The storm traveled westwards, gaining strength, before making landfall with winds of **313 km/h (195 mph)** and storm surges exceeding **5 meters**.

Primary Impacts

Social

- Over **6,300 deaths**, with most fatalities due to storm surges in low-lying areas like Tacloban.
- **600,000 displaced** and **1.1 million houses** damaged, including 40,000 completely destroyed.
- Widespread damage to infrastructure left **90% of Tacloban city destroyed**, leaving survivors with no access to clean water, power, or healthcare.

Economic

- Estimated damages totaled **$5.8 billion USD**.
- Agricultural devastation: **1.1 million tonnes of crops** destroyed, including rice, corn, and coconut, affecting the livelihoods of farmers.
- Tacloban's airport, a key economic hub, was severely damaged, hindering transport and trade.

Environmental

- Storm surges caused widespread flooding, contaminating farmland with **saltwater** and destroying habitats.
- Thousands of trees uprooted, contributing to increased **CO_2 emissions**.
- Oil spills from damaged vessels polluted coastal waters.

Secondary Impacts

Social

- Outbreaks of diseases like **cholera** due to contaminated water supplies.
- Trauma and psychological effects on survivors, especially those who lost family members.

Economic

- Long-term disruption to fishing and agriculture, affecting income for millions.
- Loss of tourism revenue in key areas like Tacloban, slowing economic recovery.

Environmental

- Recovery of ecosystems delayed by saltwater intrusion into soil.
- Marine life impacted by oil spills and debris pollution.

Responses

Immediate Responses

- The **Philippine government declared a state of emergency**, deploying military and police to prevent looting.
- International aid provided by organizations like the **Red Cross**, which delivered food, water, and medical supplies.
- **UN humanitarian agencies** launched appeals, raising over **$300 million USD**.

Long-term Responses

- **"Build Back Better" initiative** launched by the Philippine government, focusing on improved infrastructure and housing designed to withstand future typhoons.
- Mangrove replantation projects to protect against storm surges.
- Improved weather forecasting and warning systems implemented, with greater emphasis on evacuation planning.
- Investments in education and public awareness campaigns about disaster preparedness.

Evaluation

The devastation caused by Typhoon Haiyan highlighted the vulnerability of developing countries to natural disasters. While the immediate international response was significant, long-term rebuilding efforts underscored the importance of resilience and sustainable development in disaster-prone areas.

Comprehension Questions: Typhoon Haiyan Case Study

Context

1. Where is the Philippines located, and why is it prone to tropical storms?
2. When did Typhoon Haiyan make landfall, and how strong was it on the Saffir-Simpson scale?

3. Which regions in the Philippines were most affected by Typhoon Haiyan?
4. What conditions contributed to the formation and intensification of Typhoon Haiyan?
5. What was the wind speed of Typhoon Haiyan when it made landfall?
6. How high were the storm surges associated with Typhoon Haiyan?

Primary Impacts

7. How many people lost their lives as a result of Typhoon Haiyan?
8. What percentage of Tacloban city was destroyed by the typhoon?
9. How did the typhoon affect agriculture in the Philippines?

Secondary Impacts

10. What diseases spread in the aftermath of Typhoon Haiyan, and why?
11. How did the typhoon impact the fishing and agriculture industries in the long term?
12. What environmental damage did the oil spills cause after the typhoon?

Responses

16. What measures did the Philippine government take immediately after the typhoon?
17. Which international organizations provided aid, and what kind of assistance did they offer?
18. What was the "Build Back Better" initiative, and what was its purpose?
19. How did Typhoon Haiyan highlight the vulnerability of developing countries to natural disasters?
20. What steps were taken to improve disaster preparedness and resilience in the Philippines after the typhoon?

Example 9 Markers

1. **"Evaluate the impacts of a tropical storm on a specific country you have studied."**
2. **"To what extent do immediate responses play a more significant role than long-term responses in reducing the impacts of tropical storms?"**
3. **"Assess the extent to which human and physical factors contributed to the severity of a tropical storm you have studied."**
4. **"The impacts of tropical storms are primarily economic." To what extent do you agree with this statement?**
5. **"Discuss the importance of management strategies in mitigating the effects of tropical storms, using examples from a case study you have studied."**
6. **"The success of responses to tropical storms depends on accurate prediction and planning." Assess the validity of this statement using evidence from a case study.“**
7. **"Examine how the physical geography of an area influences the severity of tropical storm impacts. Use evidence from a case study you have studied."**
   (Consider factors like coastal location, low-lying areas, and local infrastructure, using Typhoon Haiyan as an example

Case Study Summary: Cannock Chase - A Small-Scale Ecosystem

Location and Context

Cannock Chase is located in Staffordshire, England, approximately 20 miles north of Birmingham. It is an Area of Outstanding Natural Beauty (AONB), spanning about 68 square kilometers. Historically, Cannock Chase was part of a medieval hunting forest, but today it comprises heathland, deciduous and coniferous woodland, and grassland. The area attracts visitors for its scenic beauty, recreational opportunities, and ecological significance.

Cannock Chase is a small-scale ecosystem that illustrates the delicate balance and interconnectivity between flora, fauna, and the environment. It is a popular case study for the AQA GCSE Geography specification, highlighting ecosystems and biodiversity on a local scale.

Flora

Cannock Chase supports a variety of plant species due to its diverse habitats:

- **Heathland Plants**: Heather, gorse, and bilberry dominate the heathland areas. These plants are adapted to acidic, nutrient-poor soils and survive harsh conditions by storing nutrients and water in their roots and leaves.
- **Woodland Trees**: Oak, birch, and Scots pine are common in the forested areas. Deciduous trees like oak shed their leaves in winter to conserve energy, while evergreen species like Scots pine retain needles to photosynthesize year-round.
- **Grassland Vegetation**: Grass species such as fescues and meadow grasses thrive in the open areas, providing essential food sources for grazing animals.

Fauna

The fauna of Cannock Chase reflects its varied habitats:

- **Mammals**: Deer, foxes, badgers, and bats are common. Deer play a key role in shaping the landscape by grazing, while badgers contribute to soil turnover by digging burrows.
- **Birds**: Buzzards, woodpeckers, and the rare nightjar inhabit the Chase. The nightjar, a ground-nesting bird, is well-camouflaged in heathland areas, blending in with the dry, bracken-covered ground.
- **Insects**: Bees, butterflies, and dragonflies thrive in the heathland and woodland glades. Bees and butterflies are crucial for pollinating plants, ensuring the regeneration of flora.
- **Reptiles and Amphibians**: Grass snakes and common frogs are found in wetter areas and ponds, playing a role in pest control by feeding on insects.

Interconnections and Adaptations

The ecosystem at Cannock Chase demonstrates the interdependence of its components:

- **Heathland Plants and Insects**: Heather and gorse provide food and habitat for bees and butterflies. In turn, these insects pollinate plants, supporting their reproductive cycles.
- **Trees and Birds**: Woodlands offer nesting sites and food for birds like woodpeckers, while birds help control insect populations and disperse seeds.
- **Grazing Animals and Plant Growth**: Grazing by deer and rabbits maintains open heathland areas, preventing overgrowth of trees and shrubs and allowing light to reach smaller plants.

- **Adaptations to Soil and Climate**: Plants like heather and Scots pine have adapted to thrive in poor soils and seasonal climate variations, ensuring the stability of the ecosystem.

Threats and Conservation

Human activities such as recreation, habitat fragmentation, and climate change pose threats to Cannock Chase. Conservation efforts aim to protect this delicate ecosystem through:

- Heathland restoration programs to prevent the encroachment of woodland.
- Controlled grazing schemes to maintain habitat balance.
- Wildlife corridors to support species movement and reduce habitat fragmentation.

Comprehension Questions: Cannock Chase

1. Where is Cannock Chase located, and what is its designation as a protected area?
2. What was Cannock Chase originally used for in medieval times, and how has its use changed today?
3. What are the three main types of habitats found within Cannock Chase?
4. Which plant species dominate the heathland areas of Cannock Chase, and how are they adapted to the environment?
5. Name three types of animals commonly found in Cannock Chase and explain one way they interact with their habitat.
6. What makes the nightjar a unique bird species in Cannock Chase, and how is it adapted to its habitat?
7. How do grazing animals like deer and rabbits help maintain the balance of the Cannock Chase ecosystem?
8. What are some human activities that pose a threat to the ecosystem of Cannock Chase?
9. What specific strategies are being used to conserve the heathland habitat in Cannock Chase?
10. How have plants such as heather and Scots pine adapted to the poor soils and seasonal climate variations of Cannock Chase?

Example 6-9 Markers

1) "Explain the interdependence of biotic and abiotic components in a small-scale ecosystem you have studied."
(You should refer to specific examples of plants, animals, and their environment, such as Cannock Chase.)
2) "Assess the importance of conservation efforts in managing small-scale ecosystems."
(Use a case study such as Cannock Chase to evaluate the successes and challenges of conservation strategies.)
3) "To what extent are human activities responsible for the changes in small-scale ecosystems' "
(Refer to examples from a small-scale ecosystem like Cannock Chase, discussing both human and natural factors.)
4) "Discuss the ways plants and animals are adapted to thrive in a small-scale ecosystem you have studied."
(Include specific examples of flora and fauna from Cannock Chase and how these adaptations support ecosystem balance.)
5) "Evaluate the impact of management strategies in maintaining biodiversity in a small-scale ecosystem."
(Use a case study such as Cannock Chase to analyse the effectiveness of strategies like heathland restoration and controlled grazing.)

Case Study: The Amazon Rainforest

Physical Characteristics of the Tropical Rainforest

The Amazon Rainforest spans approximately 5.5 million square kilometers, covering parts of nine countries, with about 60% located in Brazil. It is the largest rainforest in the world, accounting for 10% of the Earth's known species and producing 20% of the planet's oxygen.

- **Climate**: Annual rainfall averages 2,300mm, with no dry season, and temperatures are consistently between 25–30°C.
- **Biodiversity**: The Amazon hosts over 16,000 tree species and 390 billion individual trees, as well as 2.5 million insect species, 1,300 bird species, and 400 mammal species.
- **Canopy Structure**: The rainforest is layered:
    - **Emergent Layer**: Tallest trees like the kapok reach 60 meters.
    - **Canopy Layer**: Dense foliage, intercepting up to 90% of sunlight.
    - **Understory and Forest Floor**: Limited light supports small plants and nutrient recycling.

Interdependence of Climate, Water, Soils, Plants, Animals, and People

The Amazon's ecosystem functions as a highly interconnected system:

- **Climate and Water**: The forest drives regional rainfall through evapotranspiration, with 50–75% of rain recycled within the basin.
- **Soils**: Amazon soils are nutrient-poor due to rapid leaching, but constant leaf litter decomposition replenishes nutrients.
- **Plants and Animals**: A giant otter preys on fish that live in the river's nutrient-rich floodwaters, while trees like the Brazil nut depend on bees for pollination and agouti rodents to disperse their seeds.
- **People**: Indigenous groups, such as the Yanomami, rely on the forest for food, medicine, and shelter. Their traditional knowledge sustains the forest's resources.

Adaptations of Plants and Animals

- **Plants**:
    - **Drip Tips**: Found in trees like rubber trees, these shed excess water to prevent fungal growth.
    - **Buttress Roots**: Trees like the kapok have wide, shallow roots to support their tall height and maximize nutrient absorption.
    - **Epiphytes**: Orchids and ferns grow on larger trees to access sunlight and moisture.
- **Animals**:
    - **Camouflage and Nocturnal Habits**: The sloth moves slowly and blends with its surroundings to avoid predators.
    - **Specialized Diets**: Toucans use their long beaks to access fruit in the canopy.
    - **Arboreal Lifestyle**: Spider monkeys swing between trees using their prehensile tails.

Problems and Issues with Changing Biodiversity

- **Species Loss**: The Amazon is home to around 10% of known species. Habitat destruction threatens 137 species daily.
- **Indigenous Impact**: Indigenous groups like the Kayapo lose land and biodiversity that sustains their traditional ways of life.

- **Global Effects**: Reduced biodiversity destabilizes ecosystems, threatening ecosystem services such as carbon sequestration.

Changing Rates of Deforestation

Deforestation rates have varied:

- In the 1990s, deforestation averaged 20,000 square kilometers annually.
- A peak of 27,772 square kilometers was recorded in 2004.
- By 2012, government policies reduced deforestation to 4,571 square kilometers annually.
- Recent years, particularly under weakened environmental policies, have seen rates climb again, with 13,235 square kilometers deforested in 2021.

Causes of Deforestation

1. **Subsistence and Commercial Farming**:
    - Cattle ranching accounts for 70% of deforestation. Brazil is the largest exporter of beef, generating billions annually.
    - Soybean farming expanded with 35 million hectares of the Amazon now cleared for crops.
2. **Logging**:
    - Selective logging for hardwoods like mahogany and cedar is valued at $13 billion annually. Illegal logging is widespread.
3. **Road Building**:
    - The Trans-Amazonian Highway (4,000 km) facilitates access to remote areas but increases deforestation for agriculture and settlements.
4. **Mineral Extraction**:
    - Mining for gold, iron ore, and bauxite has destroyed large swathes of forest, with over 10,000 illegal miners in Yanomami territory alone.
5. **Energy Development**:
    - Hydroelectric dams like Belo Monte flooded 400 square kilometers of forest, displacing wildlife and people.
6. **Settlement and Population Growth**:
    - Migrants drawn by government incentives clear land for homes and farming. Brazil's Amazonian population grew by 23% from 2000 to 2010.

Impacts of Deforestation

1. **Economic Development**:
    - Brazil earns billions annually from agriculture, logging, and mining. However, deforestation leads to long-term losses in biodiversity and ecotourism potential.
2. **Soil Erosion**:
    - Without tree roots, heavy rainfall washes away 55 million tons of topsoil annually, degrading land for farming.
3. **Climate Change**:
    - The Amazon stores 120 billion tons of carbon. Deforestation releases CO2, contributing to global warming.

Importance and Value of the Tropical Rainforest

- **Local**: Provides food, water, and medicinal plants to over 30 million people in the basin.
- **National**: Drives Brazil's economy through agriculture, mining, and tourism.
- **International**: The Amazon absorbs 2 billion tons of CO2 annually, regulating global weather patterns and mitigating climate change.

Sustainable Management of the Rainforest

1. **Selective Logging and Replanting**:
   - Ensures only mature trees are felled. In Pará, replanting programs have restored 700,000 hectares of degraded land.
2. **Conservation and Education**:
   - National parks like Tumucumaque (39,000 square kilometers) protect biodiversity. Educational initiatives raise awareness of sustainable practices.
3. **Ecotourism**:
   - Lodges like the Cristalino Jungle Lodge in Brazil attract tourists while funding conservation.
4. **International Agreements**:
   - Programs like the Amazon Fund (established with $1 billion from Norway) finance sustainable development and deforestation monitoring.
5. **Debt Relief:**

   - Debt for environment policies such as the USA forgiving $13.5 million in debt in exchange for Brazil protecting areas of rainforest. This is an example of how HICs can support NEEs and LICs in protecting areas such as the Amazon

Example 6 Markers

1. Explain how the Amazon Rainforest provides economic opportunities for people. Focus on logging, farming (e.g., cattle ranching, soy farming), mining, and ecotourism.

2. Assess the impacts of deforestation in the Amazon Rainforest on the environment. Consider biodiversity loss, contribution to climate change, soil erosion, and river pollution.

3. Explain how deforestation in the Amazon can affect local and global climate. Include reduced carbon storage, increased greenhouse gases, and disruption of water cycles.

4. Evaluate the effectiveness of strategies used to manage the Amazon Rainforest sustainably. Discuss ecotourism, selective logging, conservation projects, international debt reduction schemes (e.g., debt-for-nature swaps). Balance pros and cons.

5. Discuss how deforestation in the Amazon creates conflicts between different groups of people. Include indigenous groups, farmers, logging companies, environmentalists, and the government.

Comprehension Questions

1. **Location**:
   Which countries does the Amazon Rainforest span, and what percentage of it lies in Brazil?
2. **Size and Global Importance**:
   How much oxygen does the Amazon Rainforest produce, and what percentage of the Earth's species does it host?
3. **Canopy Layers**:
   What are the four main layers of the Amazon Rainforest, and what is a key feature of each?
4. **Climate and Water Cycle**:
   How does the Amazon Rainforest recycle its rainfall, and what percentage of rain is recycled within the basin?

5. **Nutrient Cycle**:
   Why are Amazon soils considered nutrient-poor, and how is nutrient recycling maintained?
6. **Indigenous Communities**:
   How do indigenous groups like the Yanomami depend on and contribute to the sustainability of the rainforest?
7. **Plant Adaptations**:
   Describe two specific adaptations of plants like the kapok tree or rubber tree to the rainforest environment.
8. **Animal Adaptations**:
   How do sloths and spider monkeys adapt to their rainforest habitat?
9. **Biodiversity Loss**:
   How many species are estimated to be lost daily due to deforestation in the Amazon?
10. **Cultural Impacts**:
    How does deforestation affect indigenous groups such as the Kayapo?
11. **Rates of Deforestation**:
    What were the highest and lowest annual deforestation rates recorded, and in which years did they occur?
12. **Causes of Deforestation**:
    Which economic activity accounts for the largest percentage of deforestation in the Amazon?
13. **Infrastructure Development**:
    How has the construction of the Trans-Amazonian Highway contributed to deforestation?
14. **Climate Change**:
    How does deforestation in the Amazon contribute to global climate change?
15. **Soil Erosion**:
    What role do trees play in preventing soil erosion, and what is the estimated amount of topsoil lost annually?

Case Study: The Thar Desert

Location and Context

- The Thar Desert is located in the north-west of the Indian subcontinent, spanning India and Pakistan.
- It covers an area of approximately 200,000 square kilometers, making it the world's most densely populated desert, with over 80 people per square kilometer.
- The majority of the desert lies in Rajasthan, India, and it stretches into Pakistan's Sindh province.
- The Thar Desert is bordered by the Aravalli Hills to the east and the Indus River plain to the west.
- **Climate**: The Thar Desert experiences extreme temperatures, ranging from 50°C in summer to below freezing in winter. Annual rainfall is low, averaging 120-240 mm, with frequent droughts.
- **Landscape**: The desert features sand dunes, gravel plains, rocky outcrops, and salt flats. Vegetation is sparse, dominated by thorny shrubs, acacia trees, and xerophytic plants.

Animal and Plant Adaptations

Plants:

- **Thorny Shrubs and Acacia Trees**: These plants have small, waxy leaves to reduce water loss and long roots to access deep groundwater.
- **Cactus**: Stores water in its fleshy stem and has spines instead of leaves to reduce transpiration.
- **Khejri Tree**: Provides shade, fodder, and fuelwood, and its deep roots stabilize sand dunes.

Animals:

- **Camels**: Adapted to survive for long periods without water, store fat in their humps, and have wide feet for walking on sand.
- **Desert Foxes**: Burrow to escape the heat and are nocturnal to avoid high daytime temperatures.
- **Peacocks**: National bird of India, it thrives in the Thar Desert, feeding on seeds and insects.

Opportunities for Economic Development

1. **Mining**:
    - The Thar Desert has valuable minerals like gypsum (used in construction), feldspar (used in ceramics), phosphorite (used in fertilizers), and kaolin.
    - Barmer district is rich in crude oil, contributing to India's energy needs.
2. **Energy Production**:
    - The Thar Desert has become a hub for renewable energy, particularly solar and wind energy. The Bhadla Solar Park in Rajasthan is one of the largest solar farms in the world.
    - Wind farms near Jaisalmer, such as the Jaisalmer Wind Park, produce clean energy.
3. **Agriculture**:
    - Despite harsh conditions, irrigation from the **Indira Gandhi Canal** has transformed parts of the desert, enabling the cultivation of crops like wheat, cotton, and mustard.
    - Livestock rearing, particularly goats and camels, supports the rural economy.
4. **Tourism**:

- The Thar Desert attracts tourists with its unique landscapes, cultural festivals, camel safaris, and historic cities like Jaisalmer, known as the "Golden City."

Challenges for Economic Development

1. **Extreme Temperatures**:
   - High temperatures make it difficult to work outdoors and cause water to evaporate quickly, limiting agricultural productivity.
2. **Water Scarcity**:
   - Limited and unreliable rainfall results in severe water shortages for drinking, irrigation, and industrial use.
3. **Accessibility**:
   - The desert's terrain and sparse infrastructure make transportation and communication challenging in remote areas.
4. **Environmental Degradation**:
   - Overgrazing, deforestation, and mining activities lead to land degradation, reducing productivity and biodiversity.

Processes Leading to Desertification:

1. **Overgrazing**: Excessive grazing by livestock damages vegetation, exposing soil to erosion.
2. **Deforestation**: Removal of trees for fuelwood and farming increases soil erosion.
3. **Climate Change**: Rising temperatures and decreasing rainfall exacerbate aridity and reduce vegetation cover.
4. **Unsustainable Farming**: Over-cultivation exhausts soil nutrients, leading to reduced fertility.

Management Strategies:

1. **Afforestation**:
   - The **Desert Development Programme** promotes tree planting, especially drought-resistant species like the Khejri tree, to stabilize sand dunes and improve soil fertility.
   - Shelterbelts (rows of trees) reduce wind speed and protect farmland from erosion.
2. **Water Management**:
   - **Indira Gandhi Canal**: Provides irrigation water to over 3,000 square kilometers of the desert, supporting agriculture and drinking water supply.
   - **Johads**: Traditional rainwater harvesting systems collect and store water for local use.
3. **Sustainable Farming**:
   - Use of drip irrigation reduces water wastage and ensures efficient crop irrigation.
   - Rotational grazing prevents overgrazing and allows vegetation to recover.
4. **Renewable Energy**:
   - Investment in solar and wind energy reduces dependency on fossil fuels, promoting sustainable economic activities without degrading the land.
5. **Education and Awareness**:
   - Local communities are trained in sustainable farming practices and water conservation techniques to reduce desertification.

Comprehension Questions: Thar Desert

1. **Location**:
   Where is the Thar Desert located, and which countries does it span?
2. **Population**:
   Why is the Thar Desert significant in terms of population density compared to other deserts?

3. **Climate**:
   What are the temperature extremes and average annual rainfall in the Thar Desert?
4. **Landscape**:
   What are the main physical features of the Thar Desert's landscape?
5. **Plant Adaptations**:
   How do plants like the Khejri tree and cactus survive in the harsh desert environment?
6. **Animal Adaptations**:
   What adaptations help camels and desert foxes survive in the Thar Desert?
7. **Mining**:
   What minerals are found in the Thar Desert, and how do they contribute to economic development?
8. **Energy Production**:
   Why is the Thar Desert suitable for solar and wind energy production, and what are examples of energy projects in the region?
9. **Agriculture**:
   How has the Indira Gandhi Canal transformed agriculture in the Thar Desert?
10. **Tourism**:
    What features make the Thar Desert a popular tourist destination?
11. **Water Scarcity**:
    How does limited rainfall affect drinking water, agriculture, and industry in the Thar Desert?
12. **Environmental Degradation**:
    What human activities contribute to land degradation in the Thar Desert?
13. **Causes of Desertification**:
    What are the main causes of desertification in the Thar Desert?
14. **Afforestation**:
    How does the Desert Development Programme aim to combat desertification?
15. **Sustainable Farming**:
    What farming practices are being promoted to reduce the risk of desertification?

Example 9 markers

-Hot deserts provide more opportunities than challenges for development." To what extent do you agree? ***Use a case study (e.g., Thar Desert) to consider economic opportunities (e.g., mining, tourism, energy) vs. challenges (e.g., water supply, extreme temperatures, inaccessibility***

-Evaluate the effectiveness of strategies used to reduce desertification.*Focus on methods like afforestation and tree planting (Great Green Wall), appropriate technology, irrigation techniques, and sustainable land management.*

-Explain how plants and animals are adapted to survive in hot desert environments. ***Use specific examples such as cacti (water storage, spines), camels (humps, long eyelashes), and nocturnal animals.***

Case Study: Holderness Coast (East Yorkshire, UK)

- **Where is it?**
  The Holderness Coast is on the **northeast coast of England**, in **East Yorkshire**, between **Flamborough Head** in the north and **Spurn Head** in the south.
- **Length:** Around **61km** of coastline.
- **Why is it important?**
  It is the **fastest eroding coastline in Europe**, retreating at an average of **1–2 metres per year** – in some places, up to **10m/year**!

Physical Features

Geology (Rock Type)

- The cliffs are mainly made of **boulder clay (glacial till)** – soft, loose and easily eroded.
- **Chalk** is found at **Flamborough Head** – more resistant to erosion.

Processes

- **Erosion** (hydraulic action, abrasion) rapidly wears away the soft cliffs.
- **Longshore drift** moves sediment **southwards** along the coast.

Erosional Landforms

1. Headlands and Bays

- **Flamborough Head** is a **chalk headland** – resistant to erosion.
- **North Bay and South Bay** are eroded into the softer rock around it.

2. Caves, Arches and Stacks

- At **Flamborough Head**, erosion creates features like:
  - **Caves**, e.g., formed by wave attack along joints.
  - **Arches**, e.g., developed from caves meeting through a headland.
  - **Stacks**, e.g., remains of collapsed arches (e.g., **Selwicks Bay**).

Depositional Landforms

1. Beaches

- Formed where waves lose energy – some beaches are narrow due to strong erosion.

2. Spit

- **Spurn Head Spit**: a long **sand and shingle spit** formed by **longshore drift** depositing material.
  - Grows across the Humber Estuary.
  - Has **salt marshes** behind it due to deposition.

Coastal Management

Hard Engineering

1. Rock Armour (Rip Rap) – Mappleton

- Large boulders placed at base of cliffs to absorb wave energy.
- Pros: Reduces erosion, protects cliffs and village.
- Cons: Expensive, may cause erosion **further down coast** due to interrupted longshore drift.

2. Groynes – Mappleton

- Wooden/stone fences built at right angles to the coast.
- Trap sediment, creating **wider beaches**.
- Pros: Slows erosion near Mappleton.
- Cons: Starves beaches **down-drift**, increasing erosion elsewhere (e.g., **Cowden**).
-

Soft Engineering

1. Managed Retreat – Spurn Head

- Allowing nature to take its course by not defending certain areas.
- Pros: Creates natural habitats (salt marshes), lower cost.
- Cons: Loss of land, impacts local communities (e.g., lifeboat services once located at Spurn Head).

Top Tip for Revision

Use the acronym **H.E.D.G.E.S.** to remember Holderness:

- **H**ard Engineering (Groynes, Rock Armour)
- **E**rosion (rapid due to boulder clay)
- **D**epositional Landforms (Spurn Head Spit)
- **G**eology (boulder clay + chalk at Flamborough Head)
- **E**rosional Landforms (Headland, Stack, etc.)
- **S**oft Engineering (Managed retreat at Spurn Head)

Comprehension questions

1. Where is the Holderness Coast located?
2. What type of rock is most of the Holderness cliffs made from?
3. What is the average annual rate of erosion along the Holderness Coast?
4. Name the resistant rock type found at Flamborough Head.
5. Which erosional landform is found at Selwicks Bay?
6. What is the main process that moves material south along the Holderness Coast?
7. What is the name of the spit found at the southern end of the Holderness Coast?
8. What natural feature forms behind Spurn Head due to deposition?
9. What is the purpose of groynes at Mappleton?

10. How can groynes cause problems further along the coast?
11. What is rock armour and what is its function?
12. Why is managed retreat used at Spurn Head?
13. What are two benefits of managed retreat?
14. What are two disadvantages of hard engineering at Holderness?
15. How does geology influence the rate of erosion at Holderness?

Example 6-9 Markers

Explain how geology influences coastal landforms at the Holderness Coast.
(Mention boulder clay, chalk at Flamborough Head, formation of features like headlands, bays, and stacks.)

Assess the effectiveness of hard engineering strategies used at Mappleton.
(Mention rock armour and groynes, positives (protects cliffs), negatives (erosion down coast).

Explain how depositional processes have created landforms along the Holderness Coast.
Focus on longshore drift, Spurn Head spit, salt marshes behind it.

Evaluate the impact of coastal management on people and the environment at Holderness.
Balance positives (protection of villages) vs negatives (erosion elsewhere, disruption of habitats).

Case Study: The River Tees (North East England)

Background Information & Location

- **Where is it?**
  The **River Tees** is in **north-east England**, flowing **east** from its source in the **Pennines** to the **North Sea at Middlesbrough**.
- **Length:** Approx. **137 km**.
- **Source: Cross Fell**, Cumbria (approx. 893m altitude).
- **Mouth: Tees Estuary**, near **Middlesbrough** and **Hartlepool**.

River Course & Landforms

Upper Course – *Near Cross Fell, Pennines*

- **Processes:** Vertical erosion dominates. Transportation by **traction**.
- **Landforms:**
  - **V-shaped valleys** and **interlocking spurs**
  - **High Force Waterfall** – *21m high*, formed where **hard Whin Sill rock** overlays softer limestone.
  - **Gorge** forms as waterfall retreats.

Middle Course – *Around Barnard Castle*

- **Processes:** Lateral erosion, transport by **saltation and suspension**.
- **Landforms:**
  - **Meanders** develop.
  - **River cliffs** on outer bends; **slip-off slopes** on inner bends.
  - Valley begins to widen.

Lower Course – *Yarm to Teesmouth*

- **Processes:** Deposition dominates, mainly **suspension and solution**.
- **Landforms:**
  - **Floodplains**
  - **Levees** (natural embankments)
  - **Tees Estuary** – features **mudflats and sandbanks**, vital for wildlife.

River Management: Flood Management Strategies

Hard Engineering

1. Tees Barrage – *Stockton-on-Tees*

- Completed in **1995** at a cost of **£54 million**.
- **Location:** Near the mouth of the river at **Stockton**.
- **Purpose:**
  - Controls **tidal flooding** and **storm surges** from the North Sea.
  - Keeps water levels consistent, reducing flood risk in **Stockton**, **Middlesbrough**, and surrounding areas.
  -
- **Additional Benefits:**
  - Improved water quality.
  - Attracts tourists and water sports (e.g. rowing and kayaking).
- **Effectiveness:** High – long-term protection and boosts the local economy.

- **Disadvantages:** Expensive to build and maintain, visual pollution, fish migration disrupted

Yarm Flood Hard Defences

- A market town **prone to flooding**, located on a meander.
- **Defences built in the 1990s**, including:
  - **Embankments** and **flood walls**
  - **Flood gates** to allow vehicle access
  - **Gabions** (wire cages filled with rocks) to prevent erosion
- **Cost:** Over **£2.1 million**
- **Effectiveness:** Successful at reducing flood risk in the town.
- **Disadvantages:** Visually intrusive, ongoing maintenance required.

Soft Engineering

Land-Use Zoning – *Tees Valley Areas*

- Restricts new developments on the natural **floodplain**, particularly near **Yarm** and **Stockton**.
- **Effectiveness:**
  - Reduces the number of properties at risk.
  - Keeps vulnerable land for agriculture or open space.
- **Disadvantages:**
  - Limits housing and commercial development in high-demand areas.

Afforestation – *Upper Teesdale*

- **Tree planting** increases **interception** and reduces **surface runoff**.
- **Encouraged by the Environment Agency** as part of sustainable catchment management.
- **Effectiveness:**
  - Reduces flood peaks and supports biodiversity.
  - Long-term environmental benefits.
- **Disadvantages:**
  - Takes time to grow and become effective.
  - Less useful in preventing large-scale flooding than hard engineering.

Comprehension Questions.

Location & Background

1. **Where is the source of the River Tees located?**
2. **Which sea does the River Tees flow into at its mouth?**
3. **Approximately how long is the River Tees?**

River Landforms & Processes

4. **What type of erosion is dominant in the upper course of the River Tees?**
5. **Name the waterfall found in the upper course of the River Tees.**
6. **How tall is High Force Waterfall, and what rock type is it formed on?**
7. **What landform is created by the retreat of High Force Waterfall?**

8. **What type of erosion becomes more dominant in the middle course of the River Tees?**
9. **Name one landform caused by lateral erosion in the middle course.**
10. **What depositional features are found in the lower course of the River Tees?**

River Management & Flood Control

11. **Where is the Tees Barrage located, and what is its main purpose?**
12. **How much did the Tees Barrage cost to build?**
13. **What engineering methods were used in Yarm to prevent flooding?**
14. **What is one soft engineering strategy used in the River Tees catchment to reduce flooding?**
15. **Why is afforestation in the upper course an effective flood management strategy over the long term?**

Example 6 markers

-Explain the formation of a waterfall and gorge using a named example.
Include processes of erosion (hydraulic action, abrasion), layers of rock (e.g., Whin Sill and limestone), collapse of overhang, and retreat of waterfall forming a gorge.

-Describe the landforms created by erosion and deposition in the middle and lower course of a river. Use a named example.
Include meanders, ox-bow lakes, floodplains, levees – link to features on the River Tees.

-Assess the effectiveness of hard engineering strategies used to manage river flooding. Use a named example.
Use examples like the Tees Barrage and flood walls in Yarm. Consider protection vs cost and environmental impact.

-Explain how soft engineering strategies help to manage river flooding.
Use a named example and discuss afforestation and flood plain zoning.