

Earthquakes & volcanoes

EARTHQUAKE - NEPAL

EXPLAIN THE CAUSES OF AN EARTHQUAKE

- Gorkha earthquake in Nepal struck the Gorkha district, located west of Kathmandu on 25th April 2015 at 06:11 UTC / 11:56 am local time.
- 7.8 magnitude on MMS

PLATE / BOUNDARY - convergent plate margin b/w. Eurasian and Indian tectonic plates

The earthquake was caused by the subduction of Indo-Australian plate below the Eurasian plate.

MOVEMENT : As the plates move towards each other they get struck, and friction and pressure builds up.

PRESSURE RELEASED / JOLTING

The pressure between the plates is so great that the plates jolt free releasing the pressure in the form of energy.

SHOCK WAVES / VIBRATION : This energy is passed by the seismic waves to the surface of the earth.

① VOLCANO INDONESIA

EXPLAIN THE CAUSES OF A VOLCANIC ERUPTION

→ Mt Merapi 18-10 western
Indonesian
time

- October 26, 2010

5.6 magnitude on Richter
scale

- Caused by the subduction
of Indo - Australian plate,
beneath Eurasian Plate

Plate boundary - lies on the
destructive plate margin
and is part of the Pacific ring of fire.

Convection currents - heat
from the core makes magma
in the mantle rise towards
the crust causing plates to move.

Subduction - The Indo-Australian plate subducted beneath the less dense Eurasian plate, causing friction.

Pressure - Due to the friction there is increase in the temperature and pressure. The magma rises to the surface through cracks in the crust. The cooling lava and ash build up to form a volcano.

~~Build up of pressure, pressure released. Plates jolting.~~

~~Shockwaves / vibrations.~~

Melting of crust

VOLCANO - INDONESIA

DESCRIBE THE IMPACTS OF A VOLCANIC ERUPTION

Mt Merapi is a volcano located in South-east Asia in the country of Indonesia. It is 1700 m high and has been active since 1500.

DEATHS : Last eruption in 2010 killed 347 people. 20,000 farmers displaced and 577 severely injured.

DAMAGE TO PROPERTY : More than 2000 homes destroyed; 278,000 people evacuated.

CROPS LOSS : Volcanic bombs & hot gases up to 800°C spread 11 km

away damaging crops such as rice fruits etc leading to food shortages.

Destruction of vegetation : Ash

fell 30 km away and 5 km into the sky. Layer of ash was 2-4 cm thick on ground land along with this the pyroclastic flow 3 km down the mountain destroyed 200 hectares of forest land.

ANIMALS / loss of habitat : 138 cattle dead, extensive animal casualties.

WATER SUPPLIES contaminated. underground water pipes damaged. & Electricity lines also damaged.

DAMAGE TO TRANSPORT : Mud flow blocked roads and 2500 flights were cancelled.

DUST CLOUDS / POLLUTION : Acid rain as SO_2 reacted with moisture. Ash reflecting sunlight accelerated global warming. Volcanic ash in atmosphere $\rightarrow$ greenhouse effect.

INCREASED FLOODING

SOIL INFERTILE : Pyroclastic flow

POSITIVE

Fertile soils : Volcanic ash makes soils fertile and promotes agriculture.

TOURISM : Hot springs, spectacular hiking trails. Geotourism.

MINING: sulphur ores

MANAGED

- 210 evacuation centres set up in tents
- 1600 people volunteers and military part of national aid response. Aid helped farmers replace livestock.
- 26822 people moved to safer houses permanently.

*** ECONOMIC IMPACT** = £ 450

million. 3000 buildings damaged. many forced to take up jobs initiated by government such as cleaning volcanic ash. (due to loss of livelihoods.)

Rivers

BENEFITS OF LIVING CLOSE TO RIVER MEKONG RIVER

- Longest river in Southeast Asia & 7th longest in Asia.
- Length = 2700 miles
- Begins at Qinghai Province, China & drains into South China Sea, South of Ho Chi Minh City
- Drains more than 33,000 square miles of land

→ Fishing

- Supports one of largest inland fisheries: accounts for $\frac{1}{4}$ th of global freshwater catch.
- imp for economies of LMB countries (Lower Mekong Basin) - Thailand, Laos, Cambodia, Vietnam.
- total economic value = \$17 bil
- × 18% of Cambodia's economy & 12.8% of Laos' economy

→ Irrigation

- Mekong region = Asia's rice bowl; 2014, LMB countries produced 100m tonnes of rice = 15% world total.
- provides 70% tropical fruits to Vietnam.

→ Domestic water supply

- 70 mil + ppl live within LMB
- × 80% households depend directly on river → strong trade/transport links

→ HEP

- 2019: 89 HEP projects
- × 2040: HEP to generate 30000+ MW

→ Tourism

- Mekong river cruises (6-11 days)
- natural beauty & diverse landscapes: 20000 types of plants + 2500 animal species.

HAZARDS OF LIVING
CLOSE TO RIVER
MEKONG RIVER

→ Building dams

- has increased salinity of soil & displaced large no. of ppl.
- decline in fish stocks

→ Erosion

- btwn 1990 - 2014 volume of alluvial soil has dropped by 50%.
- Vietnam govt spent \$470 mil to prevent erosion, since 2016

→ Difficulty in crossing river

- due to rapids, waterfalls, seasonal variation

→ Mosquitoes/crocodiles

- dengue, malaria, etc.
- deadly siamese crocodiles, snakes, bats

→ Flooding: every yr

- ~~ex~~ Cambodia & Vietnam account for 2/3 of total annual flood damage
- 2001, severe flood killed 300.

→ Drought

- decreasing annual fish stock, yield of rice, etc.
- Cambodia: water capacity for irrigation operating at just 20%.
- transport along river difficult.

CAUSES OF FLOODING OF A RIVER

BOSCASTLE - CONFLUENCE OF RIVER VALENCY & RIVER JORDAN

- On 16 Aug 2004, devastating flood swept through the village of Boscastle.
- It is located in England, at the confluence of river Valency & river Jordan

→ Lack of management techniques

- no flood defences in the village
- flood defences were due to be upgraded in Oct 2004, but work on them hadn't yet started.

→ Heavy rain/storms

- 16 Aug: 2 month's worth of rain in few hours; 200mm

→ Impermeable/saturated soil & rock

- thin soils made of peat $\therefore$ quickly became saturated.
- bedrock composed of impermeable mudstones/sandstones; no percolation

→ Steep river valleys

- acted like funnels for water & carried it to Boscastle

→ High tide

- heavy rain coincided w/ high tide in the bay; reduced rate at which water could exit river.

→ Deforestation (no interception)

- in valley sides for agriculture

→ Urban Development

- Many buildings, narrow floodplain
- Sewer & drainage system was old & had less capacity: quickly flowed into river
- debris was trapped by a bridge; water pressure caused the bridge to collapse, and created a 2nd wave of water.

(PTO)

IMPACTS OF FLOODING
BOSCASTLE - CONFLUENCE
OF RIVER VALENCY &
RIVER JORDAN

- Deaths / injuries: no fatalities; emergency response team was quick & 100 ppl evacuated.
- Damage to housing / property
 - 58 buildings damaged
 - Church filled w/ 6ft mud + water
 - 50+ cars swept away
- Damage / closure to workplaces
 - village did not reopen to residents & visitors until May 2005: loss of business & tourism.
- Damage to crops / farmland
 - many landowners lived there; reliant on farming
- Economic impacts
 - Total economic damage = £50 mil
 - £10 mil spent on upgrading flood defences.
- Water supplies contaminated: debris & fuel from cars flowed out to sea.

ATTEMPTS TO MANAGE RIVER FLOODING

CONFLUENCE OF RIVER VALENCY & RIVER JORDAN

- In Aug, 2006 construction of the Flood Defence scheme started on River Valency
- £10 mil was spent on upgrading Boscastle's flood defences.

→ Monitoring/early warning/evac

- Environment Agency introduced flood warning system (sensors)
- invested in methods to predict heavy rainfall *

2 new sewage pumps

→ Dredging/widening

- £0.8 mil spent on widening & deepening ~~area~~ River Valency

→ Overflow channels/spillways

- braided channels created in river Jordan to divert water

→ Raising height of banks/levees flood defence walls constructed

→ Afforestation + clearing debris

- Landowners encouraged to maintain vegetation & plant trees
- Tree management scheme was introduced: dead trees removed to prevent them being swept away / causing blockages

→ Other developments *

- bridges rebuilt higher & wider to allow flow underneath
- car parks raised so cars not swept away; surfaces made of permeable material

Coasts

ATTEMPTS TO MANAGE COASTAL EROSION

KERALA

- State on southwest edge of India
- 590 km of coast
- acc to study in Nov 2018, 60% of coastline is under erosion
- 9 coastal districts, of which Thiruvananthapuram is most prone

HARD ENGINEERING METHODS

- ✗ Efforts to control erosion through hard eng. methods began 100yrs ago
- 53% of coast = 'Artificial coast'
- 106 groynes & 25 breakwaters
- Seawalls, rip raps, revetments, groynes = ~~310 km of coastline~~
- 2022, Pinarayi Vijayan (chief min) inaugurated new coast protection prjct: seawall made of tetrapods (concrete structures) + ~~network of groynes~~ → To provide relief to Chellanam district (heavily affected by cyclone Tauktae, 2021)
- Phase 1 of prjct: 7km stretch. Seawall from Chellanam harbour to Puthenthode Beach.
- Geo tube model: giant tubes filled w synthetic fabric along coast

SOFT ENGINEERING METHODS

- 'Shore management plan' by govt. to protect coast through eco-friendly solutions: beach nourishment, mangroves, sandy beaches
- May 23, 2016: Wildlife Trust of Ind: launched mangrove restoration prjct in Kannur

HOW COASTAL EROSION AFFECTS PEOPLE

KERALA

- Loss of land: 650 acres of land has been eroded from the shore in 14 yrs → Thiruvananthapuram
- Damage to housing
 - heavily impacts fishermen + families: downtrodden
 - 110 families in Valiyathura lost their homes
 - families forced to live in school buildings: few toilets, no beds
 - govt ~~relocated~~ faces challenge of relocating 30,000+ families
- Loss of tourism
 - beach access restricted; esp impacts Kannur
- Cost of management
₹1500 crore allocated
- Unable to insure property
bcoz its natural process that's impossible to prevent; hard to find insurance to cover it.

NATURAL HAZARDS FACED BY PEOPLE IN COASTAL AREAS

KERALA

→ High waves / freak waves:

'kallakadal' (rogue waves)
cause rampant erosion &
flooding on coast.

→ Tsunami

- 26 Dec 2004
- affected sewage systems + groundwater supplies
- 187 villages in Allepey district affected.
- > 1924 ha of mangrove affected
- 1,54,000 houses damaged
- 177 human lives lost.
- Damage worth ₹ 2371.02 crore

→ Tropical storm } from other
→ Coastal erosion } case studies

DESCRIBE THE IMPACTS OF A TROPICAL STORM ON A COASTAL AREA

KERALA

- ✗ Kerala hit by 5 cyclones in last 127 yrs.
- Cyclone TAUKTAE developed over Southeast Arabian sea on 13th May 2021.
- causes extreme heavy rainfall, strong winds and tidal waves that affected Kerala from 14-15 May.

→ Death / injury

- 11 ppl died: falling trees & posts, lightning, drowning, shocks
- 22 severely injured

→ Damage to homes / property

- > 500 houses in Chellanam destroyed
- 80 schools affected

→ Flooding

- Kozhikode: 155 mm rainfall
 - Kannur: 147 mm rainfall
- May 16
- flash floods

→ Impact on agriculture

- esp destroyed rubber, banana, coconut crops.
- 24,433 hectare perennial crop lost

→ Impact on fishing industry

- damaged boats, nets, fish farms
- total loss: ₹ 1,40,88,874 (one crore)

→ Disruption of power supply:

- many power lines snapped.
- total loss: ₹ 21.44 crore.

WHY PEOPLE LIVE
ALONG THE COAST

JAMAICA

→ Work in tourism industry

- 15% of GDP in 2016
- 60% of jobs
- employs approx. 200 000 locals

→ Industry / port / trade

- mining: 4% of GDP (large producer of alumina & bauxite)
- strategic location: close to large markets in North Am. + emerging markets in Latin Am.

→ Fishing: exported \$13.5 mil of fish in 2022

→ Leisure activities

- nightlife in Montego Bay
- surfing, sailing, kayaking

→ Climate: warm all yr-round; moderating influence of sea

→ Peaceful / retirement

- good affordability ∴ popular spot for retirees
- rent is 70% lower than US

→ Scenic beauty

- Montego Bay has scenic beaches
- Blue mountains ~~range~~ ~~at range~~

→ Flat land / farming: primary source of income; export crops → coffee, banana

CORAL REEF

GREAT BARRIER REEF

- largest living structure on earth
- total area = same size as Japan / Italy ;
visible from space.

FEATURES

- Composition: consists of 3000 individual coral reefs.
- Biodiversity
 - 9000 species of marine life; each plays role in maintaining healthy reef system
 - 400 types of coral
 - vegetation: 200,000 hectares mangrove + sea grasses
- Locational features: located in Coral Sea (Pacific Ocean), off the coast of Queensland, Au.

FORMATION

- coral animals floated around in Ocean & attached themselves to rocks
- animals build skeleton made of CaCO_3 from seawater
- over time skeletons & shells cemented toghr to form large limestone deposits
- colonised by plants, sponges, etc.
- (conditions required for formation)

Climate & Vegetation

CHARACTERISTICS OF RAINFOREST VEGETATION

ECUADORIAN AMAZON

- Home to around 40,000 plant species, with around 400 billion trees.

→ Emergent

- 200 ft, straight, smooth, unbranched
- exposed to sunlight, strong wind
- eg. Brazil nut & kapok tree
- buttress - nutrients, leverage

→ Canopy

- dense: blocks sun, rain, wind; protects soil
- drip-tips
- Yasuni & Cuyabeno regions have many low, epiphyte-covered trees
- food reserve: acai palm + fig tree
- laced together by lianas / woody vines

→ Parasitic species

- Rafflesia (corpse flower)
- 150 species of strangler fig

→ Undergrowth

- trees stunted; lack of sunlight
eg. palms, philodendrons.
- dark, still, humid

CHARACTERISTICS OF RAINFOREST ECOSYSTEM

ECUADORIAN AMAZON

- 40,000 plant species, 1300 bird species,
3000 types of fish, 427 mammal species,
2.5 million diff insects.

→ Emergent

- kapok tree : creamy white / pink flowers - scent attracts bats
- pollination through dispersion (wind)
- animals fly / glide - bats, birds
- predators: white-tailed hawk, harpy eagle

→ Canopy

- spider monkey etc make shrill sound - trees dull sound
- seeds in sweet fruit - animals eat and droppings have seeds
- macaws, toucans - fruits
- 1000s of insect species

→ Undergrowth

- jaguar, green mamba snake camo
- humidity - amphibian moist skin

→ Soil

- weathered; no K, Ca, Mg minerals
- rapid nutrient cycling
- decomposers (termites, scorpion, worms)
- pigs, armadillos eat them.
- leopards eat rats & lowland pacas

→ River

boto dolphin, black caimans, alligators

WHY DEFORESTATION HAS TAKEN PLACE

ECUADORIAN AMAZON

- Between 1990 and 2018, Ecuador lost 4.9 million acres of forest due to large scale deforestation.

→ Logging

- \$402 mil worth timber export in 2020.
- Locals in Pastaza river basin harvest balsa trees - easy to
- to supply pulp for paper industries
- timber industry - 3rd of annual deforestation

→ Ranching: highlands, beef farming

→ Road Building

- gov sponsored highway projects
- 9500+ km roads ($1.5 \times$ earth radius)

→ Commercial agriculture

- good climate for palms
- 10000 hectare near Shushufundi cut 30 yrs ago by Palmeras de Ecuador.

- Development schemes: Agrarian Reform + Green Revolution

→ Settlement building

→ Mining

- gold, copper, silver
- mining concessions: Mirador mine (southern Ecuador)
- encouraged by gov due to crisis

→ Dam building

eg. Coca Codo Sinclair Dam

→ Tourism: Cuyabeno Wildlife Reserve

IMPACTS OF DEFORESTATION ON LOCAL NATURAL ENVIRONMENT AND LOCAL PEOPLE

EWADORIAN AMAZON

→ Extinction, food chains

- Earth's endangered Creatures site: 9 reptile + 192 amphibian species close to extinction
- food chains + ecosystems disrupted

→ Soil erosion

- unsheltered soil
- causes landslides - elevated areas (Draula) road to Quito (cap.) destroyed in landslide

→ flooding, impact on ppl

- Banks of Bobonaza river: 100s homeless; loss of food, supplies
- floods threaten Sarayaku, Pacayaku, Teresa Mama tribes
- capacity of Pante Dam (largest HEP generator) reduced by $\frac{1}{2}$: electricity shortages in cities.
- Pastaza River Basin affected

→ Lack of jobs, migration

- due to extreme climate, floods agriculture impossible
- Provinces of Loja & Manab most impacted. 1000s families migrated to urban areas for jobs.

IMPACTS OF DEFORESTATION

GLOBAL
EXAMPLES

→ Buildup of CO₂

- forest = 'carbon sink'
- 1.5+ bil tonnes CO₂ released per yr coz of deforestation.
- Amazon & Congo: more CO₂ generated than absorbed.

→ Global warming

→ rising sea levels

→ Shifts in rainfall patterns

} Indonesia

→ Soil erosion

- Java (Indonesian island) lost 770 metric tonne of topsoil 1980s

→ Water cycle

- regional rainfall in Amazon reduced
- Haiti lost 98% forests: severe floods in 2004.
- 2 mil hectare forest in Africa disappear per year: worsened water crisis (esp. Kenya)

→ Melting of ice caps/glaciers

eg. in Mount Kilimanjaro for past 30-40 yrs

→ Loss of habitat

- threat to orangutans in Malaysia

CHARACTERISTICS OF DESERT CLIMATE

SAHARA DESERT

→ Seasonal range

- hot summer = ~~12°C~~ 50°C
- cold winter = ~~55°F~~ (5°F in Tibesti Mt.)
12°C (-15°C)

→ Diurnal range

- no cloud cover, no insolation

→ Low precipitation

- ~~30 mm per yr~~ 76 mm per yr
- 2 periods: Dec → Mar, Aug (thunder storm)

→ Latitude

- 23° N of equator ∴ overhead sun
- Hadley cell: convection cell where air rises at equator and sinks 30° N and S.
- ∴ dry subtropical.

→ Rainshadow effect

- By Atlas Mts. (NW) & Ethiopian Highlands (SE)
- windward side of Atlas: water vapour rises from Atlantic, descends in leeward ∴ dry

→ Trade winds

- trade wind desert
- Sirocco / Ghibli (hot air) originates & produces hot, dusty, dry sand storms

→ currents: cool canary current near coast - high density (can't carry H₂O)

CHARACTERISTICS OF DESERT ECOSYSTEM VEGETATION

SAHARA DESERT

- Home to 500 plant species, 70 mammal species, 300 bird species, 100 reptile species + many species of spiders + scorpions.

CHARACTERISTICS
OF EQUATORIAL CLIMATE
ECUADORIAN AMAZON

→ Temperature

- avg temp: 25°C all year
- during dry season, daytime temp can go above 35°C .

→ Precipitation

- March → July: wet season; most prec
- July → Dec: decline in amt of rain
- avg: 200 days w/ rain showers
- divided into 3 continental regions: Costa (coast), Sierra (mountains), Oriente (East)
- Northern coast & Oriente: wettest regions (3000-6000 mm annual)
- Small area of dry climate at Santa Elena Peninsula along Southern coast: 100-1000mm

→ Lack of seasons

- annual temp range: $7-10^{\circ}\text{C}$

→ Reasons for climate

- Latitude: Ecuador btwn 1°N & 5°S .
- low atm press
- evap & transp
- convec. rainfall daily around 4 p.m.
 - H_2O vap. condense, cumulus, (build up of clouds), saturate, sky clear at end of day.