EART62051 Human Impacts on the Biosphere

THE UNIVERSITY OF MANCHESTER · ENVIRONMENTAL SCIENCE · POSTGRADUATE

Full guide + ask Sia about EART62051

SIDE 1/2 MECHANISMS · PATHWAYS · CLASSIFICATIONS · KEY VALUES OPEN-BOOK EXAM SHEET Semester 1, 2026/27

0 · Exam Map OFFICIAL COURSE FACTS

Pres. 20% | Online exam · 80%

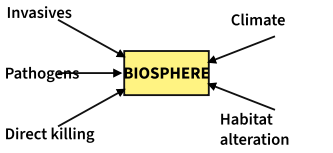
Assessed Group Presentation 20% · Online Exam (Assessed Task 2) 80%. The exam is invigilated online in the January examination period, answered within a 2-hour window: multiple choice, multiple answer, fill the gap, data analysis and short free-text.

PERMITTED MATERIALS — VERBATIM

"Open book online exam: worth 80% of unit marks." (EART62051 unit page, Canvas, 2026/27 1st semester) · "It is an open book exam meaning that you can bring pre-prepared notes (on paper or electronic)." (EART62051 unit page, Canvas, 2026/27 1st semester)

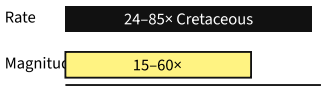
EXAM USE → *Classify the pressure; trace activity → process → ecological consequence; attach the correct value and unit.*

1 · Routes into the Biosphere C1 · CONCEPT MAP



Five routes by which human activity affects other species.

Biosphere = living organisms plus their ecosystems. ***Anthropocene*** = a proposed, not ratified, geological unit; recognition needs a stratigraphic signature. Evidence includes concrete, aluminium, plastics, greenhouse gases and plutonium fallout.



Rate and magnitude are different measures; Cretaceous loss ≈76%.

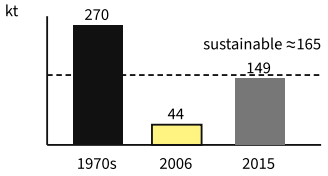
The last Cretaceous event is dated on the slide to 68.1–65.5 million years ago. **Rate** asks how quickly species disappear; **magnitude** asks what percentage is lost. Do not swap the two ranges.

Driver chain: needs + wants + population/urban growth → extraction → waste and habitat pressure. Attach an example to each route.

2 · Four Environmental Stresses C2 · CLASSIFY FIRST

STRESS	MECHANISM	LECTURE EXAMPLE
Exploitative	Removal exceeds population growth	North Sea cod
Eutrophic	Excess N/P → overgrowth	Fertiliser; sewage
Disruptive	Land, water or habitat continuity altered	Farming; urbanisation; mining
Chemical	Toxic substances introduced	Pesticides; metals; traffic

One activity can create several stresses: agriculture is eutrophic through fertiliser loss and disruptive through conversion; extraction is disruptive plus chemical. Name each mechanism.

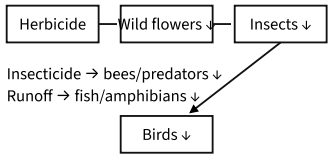


Mature cod (thousand tonnes): recovery after quotas remains incomplete.

PERCENTAGE CHANGE

```
(new - old) ÷ old × 100
Decline: (44-270)÷270 = -83.7%
Recovery: (149-44)÷44 = +238.6%
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Spawning stock = mature breeding population. Against 165 kt: 270=164%; 44=27%; 149=90%. Keep the denominator fixed.



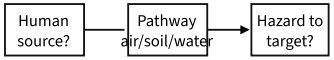
Chemical stress reaches non-target organisms via toxicity and lost food.

2b · Urban Community Response C2 · SHORT ANSWER

Avoider	Cannot persist in towns
Adapter	Uses towns but still needs countryside
Exploiter	Dominates urban habitat

Specialists lost + common exploiters gained → ***biotic homogenisation***: communities become more alike and less diverse. Greater Manchester: ≈3% urbanised around 1600; 46.5% urbanised land in 1997.

3 · Contamination → Pollution? C3 · EXACT DEFINITIONS



YES + HARM = POLLUTION

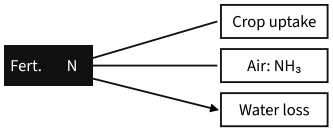
Contamination needs elevation; pollution also needs human input + hazard.

Contamination = substance above the natural background for that place or organism. ***Pollution*** = direct/indirect **human introduction** of a natural or synthetic substance liable to endanger health, harm organisms/ecosystems, damage structures/amenity, or obstruct lawful environmental use.

CASE	CLASSIFICATION
Volcano raises toxic material above background	Contamination, not pollution: natural source
Mining mobilises a naturally occurring metal	Pollution: human mobilisation + possible harm
Industrial emission reaches organisms	Pollution via source–pathway–target chain

TOXICITY AND BEHAVIOUR

	EXPOSURE	ANCHOR
Acute	Short, high concentration	Pesticide spill
Chronic	Prolonged, low concentration	Mercury

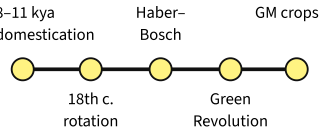


Dispersion example: applied nitrogen reaches crops, air and water.

Persistence prolongs damage; **dispersion** spreads exposure; **breakdown products** may remain harmful; **bioaccumulation** builds a pollutant in organisms and along food chains. More targets affected → greater significance. Quantify concentration against standards to decide action.

Waste is broken, worn out, contaminated, spoiled, scrap, effluent or unwanted surplus that must be disposed of. If unrecycled disposal is liable to cause harm, it becomes a pollutant. Plastic fragmentation creates micro-/nanoplastics; smaller is not gone.

4 · How Farming Intensified C4 · SEQUENCE → PRESSURE



Innovations increased output and added later environmental pressures.

STEP	GAIN	PRESSURE CARRIED FORWARD
Domestication	Reliable food species	Forest clearance, land conversion
Clover rotation	Biological N fixation; less fallow	Higher output and demand
Haber–Bosch	NH_3 from N_2 + H_2 at high T/P	N loss, eutrophication, acidity
Green Revolution	High-yielding varieties	Fertiliser, irrigation, pesticide
GM traits	Pest control	Trait-specific trade-offs

Fertile Crescent: wheat, barley, goats, sheep, pigs. Eighteenth-century tools included manuring, marling, liming, selective breeding, machinery and wetland drainage. Clover's symbiotic bacteria fix atmospheric N into organic forms, restoring soil N before cereals.

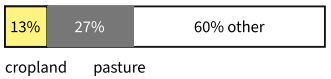
Domestication began independently in **24 regions** around 8,000–11,000 years ago. UK population rose 5.7→16.6 million from 1750 to 1850 alongside trebled food production; fallow land fell from 20% to 4%. Match each figure to the mechanism it evidences.

SINCE THE 1960S

```
Cereal output ×2; agricultural land ×1.10
Output per land = 2÷1.10 = 1.82 → +82%
N fertilisation ×8 · P ×3 · irrigation ×2 · pesticide use ↑
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EXAM USE → *Do not describe "more farming" only: name the input added and its later ecological cost.*

4b · Land Occupation C5 · KEY SPLIT

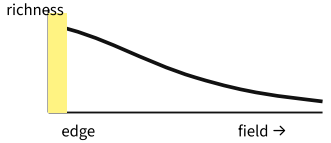


Farming covers ≈40% of land: one-third arable, two-thirds livestock.

5 · Habitat Loss & Agrobiodiversity C5 · SCALE → CONSEQUENCE

Demand includes food, fodder (soybean), palm oil, biofuel and industrial starch. Conversion removes whole ecosystems and carbon stores. UK woodland fell to ≈10%; grazing degraded uplands and wetlands were drained. Globally, >16 billion trees are cut yearly; tree numbers have fallen 46% since civilisation began.

SCALE	MECHANISM	OUTCOME
Landscape	Forest/grassland → crop/pasture	Specialists and large fauna lost
Field	Larger fields remove hedges/verges	Pollinator richness falls inward
Community	Generalists replace specialists	Homogenisation
Carbon	Clearance/fire releases stores	Loss of uptake + CO_2 release



Hedgerows and verges are biodiversity hotspots; richness falls with distance.

Agrobiodiversity = organisms adapted to agricultural landscapes that keep farms functioning, including pollinators and natural predators. Agriculture is ranked second to over-exploitation as a species threat; >5,000 Red List species are at risk from it.

Habitat loss is both an area effect and an **edge/fragmentation** effect: smaller isolated patches support fewer specialists, while open-field distance removes forage and nesting resources. Fodder demand means livestock pressure extends beyond pasture into cropland.

ABANDONMENT IS NOT RESTORATION

Observed abandoned land can have plant and insect diversity as low as intensive farmland; low-intensity traditional farming performs better. Native recovery is slow. ***Rewilding*** = active management towards a native state, including reintroductions. Remove pressure ≠ reverse history.

5b · Need vs Want C1 · DRIVER CHAIN

Needs (food, shelter) are essential; wants satisfy recreation, curiosity or aspiration. Both use natural resources. Population: 3.7 billion (1970) → 7.8 billion (2020); urban growth concentrates pollution and land-use change.

6 · Pesticides: Target → Food Web C6 · DIRECT + INDIRECT

PRESSURE	NON-TARGET EFFECT	FUNCTION LOST
Herbicide	Wild flowers and dependent insects ↓	Food/habitat; pollination
Broad-spectrum insecticide	Bees, ladybirds, spiders, lacewings ↓	Pollination; natural pest control
Persistent runoff	Fish/amphibians; behaviour/food web	Aquatic biodiversity
Machinery + tillage + chemicals	Soil organisms ↓	Organic matter; nutrient cycling

Neonicotinoid seed coatings negatively affect wild bees; neonicotinoids occurred in 75% of honey samples in a global survey. The three main compounds have been barred from outdoor EU use since 2018. Some insect-eating birds declined by up to 90% since the 1980s. State the intermediate link: fewer insects → less bird food.

7 · GM Crops: Trait, Not Verdict C7 · BALANCE BRANCHES

HERBICIDE-TOLERANT	Bt INSECT-RESISTANT
+ reduced tillage	+ spraying ↓
+ less erosion/fuel	+ predators ↑
− more herbicide	− pest resistance
− plant diversity	− gain may erode

PAIR BENEFIT + RISK BY TRAIT

Environmental judgement is conditional on the introduced trait and management.

2017: GM crops in 24 countries over ≈190 million ha; mainly soybean, maize, cotton and canola. Concerns: invasiveness; non-target effects; resistance; management/cropping changes; pathogen interactions.

Gene flow through pollen is possible, especially with dispersal, close relatives flowering together and fertile hybrids. Pollination does not prove persistence of the gene in later generations. A 2013 European academies report found no validated evidence of greater environmental harm than other breeding technologies; further research remains appropriate.

EXAM USE → *Conclude conditionally: distinguish the trait from the intensive farming system it supports.*

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DRILLS · WORKED APPLICATIONS · MULTIPLE-CHOICE TRAPS · FAST RECALL

Full guide + ask Sia about EART62051

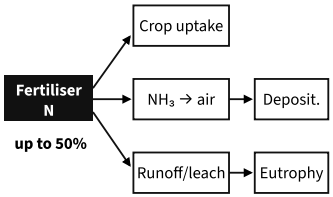
SIDE 2/2 NITROGEN · SOIL · WORKED DATA · WHICH-IS-TRUE CONTRASTS · ANSWER FRAMES

OPEN-BOOK EXAM SHEET

v2 · 2026-10-19

8 · Where Fertiliser Nitrogen Goes

C8 · PATHWAY MAP



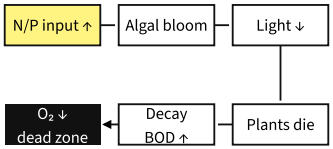
Applied N splits among crop uptake and losses to air and water.

Nitrification: $NH_4^+ \rightarrow NO_2^- \rightarrow$ mobile NO_3^-; produces soil acidity. **Denitrification:** $NO_3^- \rightarrow$ gases including N_2O. Other losses: ammonia from manure/fertiliser; runoff/leaching of ammonium, nitrate and organic N. Fertiliser dominates anthropogenic N input in major crop regions.

FORM/PROCESS	ROUTE OR CONSEQUENCE
NH_3	Volatilises to air; later deposition
$NH_4^+ \rightarrow NO_2^- \rightarrow NO_3^-$	Nitrification; acidity; nitrate mobile
$NO_3^- \rightarrow N_2O$	Denitrification; greenhouse-gas loss
Organic N / NH_4^+ / NO_3^-	Runoff or leaching to water

Keep form with route. "Nitrogen loss" alone is too vague for a mechanism answer.

Net anthropogenic N input is highest over major crop regions of North America, Europe and south-east Asia, with fertiliser the dominant source.

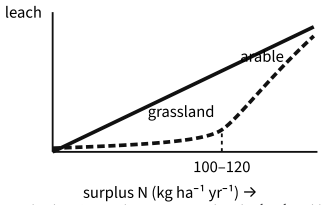


Eutrophication chain: decomposition, not the bloom alone, strips oxygen.

WHICH IS TRUE?	ANSWER
Bloom raises dissolved oxygen permanently	**False:** decay lowers O_2
Nitrate leaches readily	**True:** mobile product of nitrification
All fertiliser reaches crops	**False:** up to half may be lost
Dead zones are hypoxic	**True:** fish cannot survive

8b · Retention vs Leaching

C8 · READ BOTH CURVES



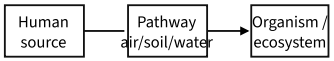
Grassland retains surplus to ≈100–120 kg N ha^{-1} yr^{-1}; arable leaches.

Natural grassland microbial communities use and retain surplus N efficiently; biodiversity-poor intensive arable monoculture leaches roughly in proportion to surplus. At **90 kg N ha^{-1} yr^{-1}**: expect little appreciable grassland leaching but substantial arable risk. Read the same x-value on both curves.

DEPOSITION ON LAND

Atmospheric N returns mostly with rainfall. It damages sensitive lichens/mosses, favours fast-growing N-tolerant grasses over specialists (e.g. Molinia replacing heather), lowers richness and alters insects, birds and microbes.

In water, toxins and nitrate may also compromise drinking water. In land answers, do not stop at "more growth": enrichment changes **competitive balance**, so rare low-N specialists lose even if total biomass rises.



QUANTIFY AT THE TARGET

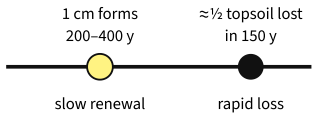
Use the supplied source–pathway–target model for deposited or leached nitrogen.

SOIL CONDITION	AVAILABILITY / TOXICITY
Near pH 6.5	Suitable nutrient balance for most plants
More acidic	P availability ↓; Fe, Mn, Cu may become toxic

SHORT ANSWER → *Give both branches: competition and soil chemistry; both reduce plant diversity.*

9 · Soil: Finite on Human Timescales

C9 · VALUES + MECHANISMS



Formation takes centuries; about one-third of soils are moderately/highly degraded.

Soil anchors plants, supplies nutrients through organisms, stores water and carbon, and regulates climate. Agriculture is the main degradation cause.

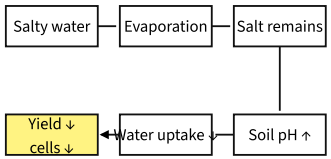
PROCESS	CAUSE	CONSEQUENCE
Acidification	NH_4^+ inputs/deposition; industry	Nutrient/metal balance altered
Erosion	Bare soil, overgrazing, deforestation, poor timing, damaged banks, no winter cover	Topsoil removed
Compaction	Heavy machinery	Infiltration ↓; runoff and N_2O ↑
C loss	Residues/roots removed; wetlands drained	Structure, water holding, microbes ↓; CO_2 ↑

WORKED REPLACEMENT

```
3 cm × 200–400 y cm⁻¹ = 600–1,200 years
Carry both ends of the range; keep the unit.
```

9b · Irrigation → Salinisation

C9 · PROCESS CHAIN



Aridity, coastal salt and poor drainage amplify irrigation salinity.

Agriculture uses ≈70% of freshwater. Irrigation salt—especially NaCl—remains after water evaporates. Effects: cellular toxicity, harder water uptake, higher pH and nutrient deficiencies. Responses: drainage, leaching and salt-tolerant crops; these manage rather than prevent the problem.

Animal products can carry large water footprints because their feed must also be grown; keep the denominator as litres per kilogram when comparing products.

10 · Four Compact Applications

WORKED DATA · SHOW UNITS

A · COD DECLINE AND RECOVERY

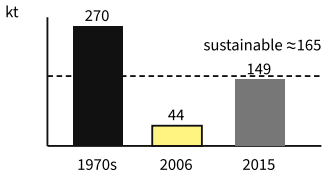
```
Decline = (44-270)÷270 = -0.837 → 83.7% fall
Recovery = (149-44)÷44 = 2.386 → 238.6% rise
149 vs 165 kt → 16 kt below sustainable
```

Conclusion: exploitative stress; quotas produced real but incomplete recovery. Trap: decline and recovery use **different starting values**, so their percentages are not symmetric.

B · URBAN TOTAL FROM SHARE

```
Today: 4 bn ÷ 0.52 ≈ 7.7 bn
2050: 6 bn ÷ 0.60 = 10 bn
Urban +50%; total ≈+30%
```

Urban numbers grow faster than total population; expect concentrated pollution and land-use pressure. Trap: divide by 0.52, not 52.



Use the cod bars to check decline, recovery and the fixed benchmark.

C · INTENSIFICATION

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Output factor ÷ land factor = 2÷1.10 = 1.82
≈82% more cereal per unit land
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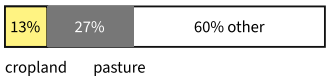
Name linked inputs: N ×8; P ×3; irrigation ×2; more pesticide. Do not subtract 10% from 100%.

D · AGRICULTURAL LAND SPLIT

```
Cropland = ⅓×40% ≈ 13%
Pasture = ⅔×40% ≈ 27%
Other land ≈ 60%
```

Livestock occupies about twice the land of crops; fodder adds further demand. Fractions describe the **40% agricultural share**, not all land.

PROMPT	CORRECT DENOMINATOR
Change over time	Old / starting value
% of sustainable stock	165 kt every year
Total from urban share	Decimal share, 0.52 or 0.60
Output per unit land	Output factor ÷ land factor

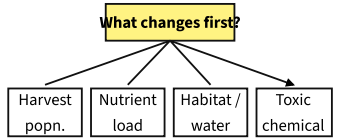


The land bar checks that fractions apply to the 40% farmed share.

11 · Multiple-Choice Traps

WHICH STATEMENT IS TRUE?

TEMPTING CLAIM	CORRECT CONTRAST
Anthropocene is an official epoch	**Proposed**; formal status needs stratigraphic evidence
Any above-background substance is pollution	That is contamination; pollution also needs human input + hazard
Natural substances cannot pollute	Human mobilisation can make a natural substance a pollutant
Acute = highly toxic substance	Acute describes short, high exposure; chronic = prolonged, low exposure
Urban adapters dominate without countryside	Exploiters do; adapters retain some countryside need
Abandoned farmland restores automatically	It may remain as poor as intensive farmland; rewilding is active
GM crops are uniformly good/bad	Impacts are trait- and management-specific
Successful gene transfer ensures persistence	Pollination does not ensure later selection/maintenance
N enrichment benefits all plants	Competitors win; specialists, lichens and mosses decline
Compaction increases infiltration	Infiltration ↓; runoff and N_2O ↑
Salinity is removed by evaporation	Water leaves; salt accumulates
Percentage rise reverses an equal fall	Different denominator; calculate each interval separately



EXPLOIT. EUTROPH. DISRUPT. CHEMICAL

Classifier: identify the first changed state, then name every mechanism present.

For "multiple answer", test each option independently. A scenario may legitimately map to two stresses; selecting only the most visible pressure is not enough.

MC RULE → *Reject answers that reverse a direction, omit the human-source condition, or mix evidence from different GM traits.*

12 · Short-Answer Frames

CAUSE → EVIDENCE → CONSEQUENCE

CLASSIFY A PRESSURE

"[Activity] causes **[stress]** because it changes **[state/process]**. This leads to **[ecological consequence]**, evidenced by **[value/example]**."

EXPLAIN A MECHANISM

Input/driver → immediate process → intermediate change → organism/community response → ecosystem outcome

Eutrophication: fertiliser/sewage N → bloom → light loss → mortality → decomposition/BOD ↑ → oxygen ↓ → hypoxia/dead zone.

Pesticide cascade: herbicide removes flowers + broad-spectrum insecticide removes insects/predators → pollination and control ↓ → insect-feeding birds lose prey.

Acidification: added NH_4^+ → nitrification → H^+ → pH ↓ → nutrient availability shifts + metals become toxic → sensitive plants decline.

Salinisation: saline irrigation + evaporation/poor drainage → salt accumulation → osmotic stress + toxicity + pH ↑ → nutrient deficiency/yield loss.

EVALUATE A CLAIM

"The claim is **conditional.** Benefit: … through …. Risk: … through …. Overall, outcome depends on [trait / threshold / management / timescale]."

For Bt: fewer broad-spectrum sprays and more predator insects *versus* target-pest resistance. For herbicide tolerance: reduced tillage/erosion *versus* more herbicide and lower plant diversity.

INTERPRET DATA

1. Name axes, units and groups.
2. State direction/pattern and a numeric contrast.
3. Calculate with the correct denominator.
4. Connect pattern to mechanism; do not claim unsupported causation.
5. Finish with ecological meaning and any threshold.

If asked to compare, state both groups and the size/direction of the difference. If asked to explain, follow the causal chain. If asked to evaluate, give evidence on both sides and a conditional conclusion.

FAST-RECALL VALUE	MEANING
24–85×; 15–60×	Modern extinction rate; magnitude vs Cretaceous
40% = 13% + 27%	Farmed land = cropland + pasture
75%; 2018	Honey samples with neonics; EU outdoor bar
Up to 50%	Applied fertiliser N may be lost
100–120 kg N ha^{-1} yr^{-1}	Grassland retention threshold