Topic 5 Exam Practice [Answer]

Question 1

Q1 (a) Identify the soil profile that caused erosion during heavy precipitation

Answer to Q1 (a)

steep slope

Q1 (b) Outline one technique that could be used by farmers in hilly landscape to reduce soil erosion.

Answer to Q1 (b)

1. contour ploughing;
… slows down surface runoff;
… allows infiltration to occur;
… less sediment is washed into the rivers;
2. stone lines;
… slows down surface runoff;
… allows infiltration to occur;
… less sediment is washed into the rivers;
3. mulching;
… residue on the surface of the soil reduces rainfall impact;
... residue on the surface holds water, reducing runoff;
… less sediment is washed into the rivers;
4. terracing;
… flat steps on steep slopes slow down surface runoff;
… allows infiltration to occur;
… less sediment is washed into the rivers/ flat areas are more stable and the soil is less likely to slide down the slope;
5. planting trees/agroforestry/intercropping with trees;
...trees intercept precipitation/rainfall, reducing surface run-off / absorb water reducing run-off / increase infiltration due to root systems;
...roots stabilize/hold soil;
...reducing loss of nutrients/top soil;

Q1 (c) [AHL question] Based on the above photograph, identify dominant minerals found in the soil horizon in Brazil

Answer to Q1 (c)

Horizon A: top soil is rich in oxidised Fe and Al;

Horizon B is rich in Si

Q1 (d) With reference to the above photograph, outline how a negative feedback loop can impact the hilly landscape.

Answer to Q1 (d)

Steep slope receives heavy precipitation -->

--> soil erosion (landslide) occurs

--> sediment is builds up at the bottom of the hill

--> slope becomes less steep

--> landslide occurs less dramatic

Question 2

Q2 (a) Identify the type of agriculture with the highest CO2eq / Kg

Answer to Q12(a)

Livestock

Q2 (b) Outline two reasons why livestock from cattle has high CO2eq / Kg

Answer to Q2 (b)

Commercial cow farming uses larger land area and requires heating in winter. This uses additional energy source, often from burning fossil fuels;

Cattle produces another GHG called methane which contributes further to the CO2eq / Kg

Q2 (c) [AHL question] Evaluate how shifting human diet may affect the mitigation of the impact of food production on climate change

Answer to Q2 (c)

Shifting human dietary pattern towards plant-based would mean that the agricultural activities will shift to crop production instead of livestock. This means that it will lower the carbon footprint in terms of CO2eq / kg of the food production industry significantly. This result in lessen impact on climate change with proper sustainable practices.

On the other hand, plant-based diet may require additional processing and transportation. The misconception about food miles may result in the higher carbon emission than anticipated from crop production. For instance, growing green beans in Europe would require heating of greenhouse. This is energy intensive. Even though food miles measures the distance food travels, growing green beans in Kenya would be a more sustainable practice as there is lower fossil fuels combustion is needed and the fertile soil requires only organic fertiliser.

Question 3

Q3 (a) Calculate the percentage of nitrogen and phosphorus used in fertiliser by India in 2022

Answer to Q3 (a)

Total N and P = 120 + 47 = 167 kg

Percentage = (167 / 178) * 100 = 94%

Q3 (b) Outline key similarity and key difference of NPK in fertiliser between India and Ecuador

Answer to Q3 (b)

Both countries use fertiliser containing NPK and both have N as the largest portion

India's P is in larger portion or ratio to K whilst Ecuador's P is in smaller ratio to K

Q3 (c) Runoff from agricultural land can result in excess nutrients entering water bodies. State one management strategy that could control the release of agricultural runoff.

Answer to Q3 (c)

plant a buffer zone;
reduce the use of inorganic fertilisers / replace their use with organic fertilisers;
do not apply fertilisers in the rainy season;
keep animals away from waterways;
treat livestock wastewater (to reduce phosphates and nitrates);
contour ploughing/terracing/agroforestry/drip irrigation (to avoid run off);

Q3 (d) [AHL only] Outline using, named example, two roles of environmental law in food and agriculture

Answer to Q3 (d)

Coordinated global action - through binding international agreements, countries around the world can support each other in managing fertiliser use and pollution management. The presence of a mediator such as the UN, ASEAN etc can help to chair meetings and conferences to that new laws can be implemented in unique settings from . For example, the transboundary agreement in ASEAN was able to send symbolic message as well as promoting collaboration between nations in managing the issues.

Question 4

Q4 (a) State the type of agriculture above

Answer to Q4 (a)

Commercial and monoculture cropping

Q4 (b) To what extent the above agricultural type supports sustainability

Answer to Q4 (b)

Sustainable:

- Monoculture cropping often offers high annual yield. The practice is supported by technological advancement and useful fertiliser. This ensures consistent food supply which result in lowering food insecurity around the world

Unsustainable:

- Due to the high demand in crop such as cereal, commercial agriculture often uses heavy machinery that result in soil compaction. This degrades soil and may cause the agricultural activity itself to become unsustainable. In addition, the use of fertiliser may become unmonitored. For instance, excess amount of fertiliser used can cause soil degradation and even pollute nearby water bodies. As the result, food can become insecure and water stress can increase

Q4 (c) Cereal if mostly produced in Russia and Ukraine for the European market. Outline four properties of soil that makes it suitable for agriculture.

Answer to Q4 (c)

- particle size affects ability of soil to store/retain water necessary for productivity;
- high mineral content provides nutrients for healthy growth/productivity;
- high organic content / deep humus provides long term storage of nutrients (released through decomposition);
- air spaces provide more O2 to roots for growth/respiration / allow deeper penetration of roots;
- appropriate porosity allows soil to hold enough water for plant growth;
- better drainage prevents water-logging that inhibits growth/productivity;
- abundant biota help to aerate/break up the soil allowing for better root growth/recycle nutrients;
- microorganisms contribute to mineral-cycling promoting growth/productivity;
- neutral to slightly acidic pH is the optimal for most plants (6.0–7.5);
- low or no slope prevents water erosion / loss of soil;

Q4 (d) Some farmers decided to fallow the monoculture without planting leys. Outline why this fallowing is not sustainable

Answer to Q4 (d)

Bare soil is exposed to wind, climate and precipitation. Soil erosion takes place and soil can become desertified

Q4 (e) Suggest a suitable method to conserve the soil fertility of monoculture cropping without fallowing the above agricultural land

Answer to Q4 (e)

Use multiyear crop rotation - year 1: cereal, year 2: tomatoes, year 3: corn, year 4: legumes

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Question 5

Q5 (a) Identify the type of soil of soil Sample A

Answer to Q5 (a)

Step 1: Calculate the percentage of silt, clay and sand

- Percentage of sand = (2.2 / 3.7) * 100 = 59.5%
- Percentage of silt = (0.7 / 3.7) * 100 = 18.9%
- Percentage of clay = 100 - 59.5 - 18.9 = 21.6%

Step 2: Locate the percentages using the soil texture triangle

- The type of soil containing 60% sand, 19% silt and 21% clay is **sandy clay loam**

Q5 (b) Outline two transfers and two transformations in the soil

Answer to Q5 (b)

Transfer:

- Translocation - Movement of soil components in suspension. For example, in semi-arid region, evaporation from the surface of the soil causes water to move up from deep underground. This carries some minerals together with it
- Leaching - water percolate and carry together minerals to ground water level

Transformation:

- Nutrient recycling - microorganisms (bacteria and fungi decompose organic materials to be recycled by themselves and other organisms such as worms and plants
- Weathering and salinisation - rocks are weathered to smaller pieces and finally to suspension.

Q5 (c) [AHL only] Outline two factors of soil formation

Answer to Q5 (c)

- Parent Rock (Geology)
    - The nature of the parent material strongly influences soil characteristics. It determines the permeability and drainage capacity of the soil, the supply of mineral nutrients, and the acidity or alkalinity. Parent rock also affects the depth, colour, and texture of the developing soil.
- Climate
    - Climatic conditions regulate the rate of weathering of parent rock and the subsequent development of soil. Temperature influences chemical and physical weathering processes, while precipitation controls both the type of vegetation supported and the movement of water within the soil. Climate also determines the rate of organic matter decomposition and humus formation.
- Topography (Relief)
    - Relief influences soil development through altitude, slope steepness, and aspect. Higher altitudes are often associated with cooler temperatures and slower soil

formation, while steep slopes promote erosion and limit soil depth. Aspect influences microclimates, affecting vegetation cover and moisture retention.

- Organisms
    - Biological activity plays a critical role in soil development. Vegetation contributes organic matter through litter fall and root activity, while animals influence soil mixing and nutrient recycling. Microorganisms decompose organic matter, accelerating humus formation and facilitating nutrient cycling, as well as aiding in aeration and soil structure development.
- Time
    - Soil formation is an extremely slow process. It may take between 3,000 and 12,000 years for a sufficiently deep soil profile to develop that can support agriculture. Over long periods, the interactions of geology, climate, relief, and organisms lead to the establishment of distinct horizons and stable soil systems.

Q5 (d) Compare and contrast the impact of two named food production systems on climate change. [usually 7 marker question]

Answer to Q5 (d)

- Step 1: [max 2 points] state two food production systems with description;
    - Iowa corn production in mid-west USA is highly intensive, relying upon large machinery and inorganic nitrogen fertilizers
    - *eg* rice-fish farming in China is a low-intensity system managed by human labour, with few chemical inputs

- Step 2: weighing both systems using this key indicators;
    - use of machinery vs human labour
        - which one has high dependency on fossil fuels and how that would impact climate change
    - use of organic vs inorganic fertilisers
        - intensive energy needs of production of inorganic fertilisers/NOx released from use of inorganic fertilizers
    - animal vs plant production
        - animals require more land use due to position in food chain
    - types of greenhouse gases produced
        - *eg* both rice and animal production produce methane;

- Step 3: Provide case studies to support your points:
    - Rice-fish farming in Thailand vs cattle farming in US.
    - Both rice and cattle produce methane, a greenhouse gas [1].
    - Inorganic fertilisers used in cattle farming releasing nitrogen oxides into atmosphere [1].
    - Rice is fertilised naturally from fish faeces so has no direct impact on climate change [1].
    - Cattle farming involves use of heavy machinery / fossil fuels not used in rice fish farming [1].
    - Rice farming produces food at lower trophic level so absorbs carbon dioxide [1].
