

IB ESS Exemplar Paper 2 Section B Responses

a) Distinguish, using examples, between the processes of succession and zonation [4]

Zonation is a change in the pattern of an ecosystem across a spatial gradient such as altitude or proximity to a water source. An example of this is the Shui Hau mudflats, where as distance from the ocean increases, salinity decreases which changes the species able to survive. The mudflats support small marine molluscs and crustaceans, and beyond the wrack line a small beach houses mangroves, which are able to withstand both fresh and saltwater. Further still, the land turns into an abandoned farmland, with non-salt tolerant species growing here. In contrast, succession is the change in organisms and diversity of a system over time as it progresses toward a climax community. Succession can be primary or secondary, and involves the colonisation of a bare substrate or existing soil by pioneer species. For example, the wildfires occurring in Yellowstone National Park allowed secondary succession to occur, with pioneer species like fireweed re-stabilising soils for larger species of plants like red fescue to continue to colonise. As plants decompose, the humus content of soils becomes richer, allowing the birch, oak and lodgepole pine trees of the original forest to return.

4/4 marks

b) Explain the relationship between soil ecosystem succession and soil fertility [7]

As the seral stages of succession progress, the soil fertility increase until the ecosystem becomes a climax community. In primary succession, soil fertility begins extremely low, as the soil ecosystem begins with a layer of parent material, usually bedrock, granite etc. seeds are blown in on the wind, and mosses and lichens colonise the parent material. Weathering of the rock occurs, both through wind and the growth life cycle of the pioneer species. When these species decompose, a thin layer of nutrients forms, making it easier for more plants to grow. Larger plants outcompete the pioneers, continuing to increase the nutrients and humus content of the soils as time progresses and decomposition occurs. The introduction of decomposers adds to the fertility of the soil system as they cycle nutrients and aerate the soil. Eventually the soil is extremely rich in nutrients and forms a closed climax community. Secondary succession differs in that there is already existing soil, which has been built up over many years and can often be very fertile already. While fertility may increase slightly over time as succession occurs and the site is re-colonised, the nutrient content of this soil system will not increase as sharply as during primary succession.

7/7 marks

c) Discuss the relationship between social systems and food production systems with the help of named examples [9]

Both social and food production systems are dynamic, with varying inputs, outputs and processes that influence each other, including economic systems and political power of

countries, differences in geographical location and labour, and cultural perspectives behind intrinsic value of ecosystems.

Firstly, a country's level of economic development heavily influences the outputs in food production systems as a whole. Higher income countries with typically more reliable access to a variety of food, experience food waste as an output due to an excess of food and inefficient distribution. Over $\frac{1}{3}$ of food in the US alone is wasted or thrown away, largely due to supermarket chains upholding stringent criteria on the aesthetic appearance of produce. Though food may be completely edible, it is often discarded. In lower income countries, the outputs of food production occurs due to improper storage and transportation facilities, resulting in food loss. In India, over 5% of all rice grown in the country becomes food loss as there is little reliable technology in rural communities to efficiently store crops for long periods of time. Thus, it is evident that the social system of a country's economic power limits their abilities to handle the stages of food production, demonstrating the ability of social systems to cause waste in the outputs of a linear food system.

Power of nations also plays a role in the type of crop or food produced, not just the wasted outputs. Kenya's food production system has been crippled by the power dynamic between low and higher income countries - Kenya no longer grows crops as its main source of income and food for its population, but grows billions of flowers that are exported and sold to HIC supermarket chains like Sainsbury's in the United Kingdom. As a result, Kenya has to import food from surrounding nations, raising issues of food security within their food system. Hence, trading relationships can debilitate a country's ability to produce food.

Arguably, political borders of established countries are a type of social system, which influences the geographical location of countries and thus the type of crops suited to grow there. The warm, tropical climates of the Philippines are suited for growing bananas, and results in a more efficient use of water and energy resources, compared to bananas grown in the dry, arid climate of the Southern US, where the virtual water footprint and thus the sustainability of the food system for growing bananas is reduced dramatically. As such, geographical location influences the sustainability and productivity of food systems.

Finally, different communities may place different ecosystem values onto the land used for food, altering the way food is produced. Indigenous groups are more likely to place cultural and intrinsic value of the crop land over its economic value, meaning they only engage in small scale, subsistence farming such as the way the Masai tribe cultivate their livestock. They use almost all parts of the cow in some way, creating a sustainable cycling of matter and nutrients within their herds that strengthens the relationships of the community to their food production. On the other hand, businesses value profit and the economic benefits of food production over other use values. They are more likely to engage in commercial farming, such as the commercial livestock production of bovine animals by agribusiness giant 'Cargill'. On such a large scale, food production is often highly wasteful and linear, which demonstrates how social values towards ecosystems alter the processes of food production.

In conclusion, food production systems can be made more or less efficient and sustainable by a variety of social systems, including economic development, closely tied to political and trade power, climate conditions and ecosystem values. However, these arguments tie into the level of development of a country in some way, suggesting that this is the biggest and most universal social system influencing food production.

9/9 marks

a) Outline four different ways in which the value of named resources have changed over time [4]

1. Coltan is a material found during the mining of tantalum, and its economic value has increased dramatically over time, as it is a vital component in cell phone circuitry. The digital age has caused the value of this resource to increase.
2. In contrast, whale oil is a form of natural capital that previously had great economic value in the 18th century as a fuel source, but has declined in the present due to modern bans on whaling.
3. Coral reefs have increased in their aesthetic and recreational value over time as ecotourism becomes more popular and awareness grows supporting the preservation of this ecosystem.
4. Sources of renewable energy like wind and solar have added indirect use value for future generations in light of climate change and a need to switch the energy mix.

3/4 marks

b) *The use of renewable resources is not always sustainable due to the activities involved in their production. Justify this statement for a named resource of renewable energy [7]*

Hydroelectricity is a form of renewable energy that draws into question the sustainability of this source. The processes involved both prior to, during and after the construction of hydroelectric dams impacts sustainability negatively.

Socioeconomic sustainability, particularly of citizens, is an issue during the construction of hydroelectricity plants. The Three Gorges Dam in China has huge electricity generation capacity, but displaced thousands of civilians during its construction as their land was bought by the government. These cities have become IDPs (Internally Displaced Peoples) or environmental refugees. As people settle close to bodies of water, this suggests further construction of hydroelectric dams will continue to displace individuals and communities, especially if insufficient financial assistance is given for relocation, making his process of hydropower development unsustainable.

The long term sustainability of hydroelectricity in relation to water security is also at risk. Not only do dams require many types of materials to construct and are often highly energy intensive, but evaporation of surface dam water decreases the sustainability of hydropower. In one year, the Three Gorges Dam lost over 15% of its surface waters due to evaporation during the process of water storage and release. As global temperatures rise, evaporation is likely to occur more and more frequently, which jeopardises both energy and water security for any countries reliant on hydropower. Thus, hydroelectricity is not always sustainable.

7/7 marks

c) *Increasing concern for energy security is likely to lead to more sustainable energy choices. Discuss the validity of this statement, with reference to named countries.*
[9]

Energy security is the safe, reliable access to a secure form of energy for all members of a population. Many countries experiencing energy security issues are attempting to increase the sustainability of their sources, but this is not without many challenges and barriers.

The economic development of a country impacts their ability to both focus and prioritise energy sustainability, as well as access to the necessary technology to do so. High income countries like Denmark have invested heavily into wind and tidal power, which provides enough electricity to be exported and sold to neighbouring countries. In contrast, economically developing countries and industrialising nations need quick and consistent access to fuel, which usually is fossil fuels due to their high energy content and widespread usage. They may prioritise economic development over making investments into renewables, even though that may be a more sustainable alternative to fossil fuels. Energy sustainability is also impacted by access to resources. Countries like Venezuela with plenty of oil reserves and an oil based economy have collapsed into energy crises due to lack of political stability and corruption. They may be aware of the need for sustainability, but are unable to work towards this due to their political and economic restraints, demonstrating that a mere concern for energy security isn't sufficient to increase sustainability.

On the other hand, intergovernmental organisations have attempted to establish agreements that obligate countries to make more sustainable energy choices. The UN, for example, has established the Sustainable Development Goals, which have been committed to by hundreds of countries. One of these goals revolves specifically around increasing energy security and sustainability for the future. Achievements towards meeting this goal have already been made, suggesting that the combined efforts of multiple countries in cohesion to enforce energy sustainability may contribute to the overall health of energy systems worldwide.

Despite this, energy security isn't the only issue facing nations, and must not be dealt with in isolation. Energy in Ethiopia is reliant on biomass and hydroelectricity, yet their insecurities cannot be addressed without also examining their economic water security and the impacts of

drought on their food production system. 90% of the country's workforce is involved in agriculture, and sustainable energy for crop production cannot be achieved if conflicts with Egypt over the water resources of the Nile (Ethiopia's main water resource) are not addressed. The nexus nature of food energy and water proves that concern for energy security alone cannot power future energy decisions.

In conclusion, energy security may be a valid issue in the forefront of sustainability talks today, but many factors including political corruption and economic development hinder sustainable choices, despite the efforts of IGOs to establish regulations on energy security and sustainability. Energy security cannot be handled in isolation, therefore in order for sustainable choices to be made in the future, all these issues must be addressed.

9/9 marks