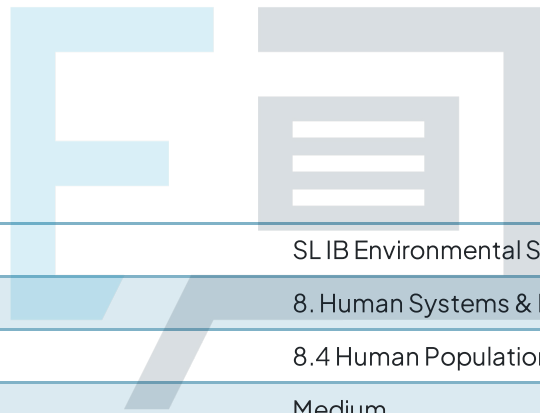




# 8.4 Human Population Carrying Capacity

## Mark Schemes



Course	SL IB Environmental Systems & Societies (ESS)
Section	8. Human Systems & Resource Use
Topic	8.4 Human Population Carrying Capacity
Difficulty	Medium

# Exam Papers Practice

To be used by all students preparing for  
SL IB Environmental Systems & Societies (ESS)  
Students of other boards may also find this useful

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### Indicative Content

The concept of an *ecological footprint* and its significance in assessing human population impacts can be explained as follows:

Any **four** from the following:

- An ecological footprint / EF measures the area of land and water needed to support a specific / particular / defined human population; [1 mark]
- At a specific / particular / defined / given standard of living; [1 mark]
- An ecological footprint / EF includes the consumption of resources / the area required to provide all the resources needed by a particular population; [1 mark]
- And waste assimilation / the area required for the assimilation/removal of (all) wastes (produced by that population); [1 mark]
- An ecological footprint / EF reflects a population's demand on natural resources; [1 mark]
- An ecological footprint / EF assesses sustainability (of a population) by comparing their ecological footprint/EF to the available biocapacity (of a given area); [1 mark]
- An ecological footprint/EF takes into account food production / energy consumption / land use / waste production; [1 mark]
- A higher ecological footprint / EF indicates higher environmental impact / potential overshooting of carrying capacity; [1 mark]
- If the ecological footprint / EF of a human population is greater than the land area available to it, this indicates that the population is unsustainable / exceeds the carrying capacity of that area; [1 mark]
- Ecological footprints / EFs vary among countries due to differences in lifestyle / consumption patterns / industrial activity; [1 mark]
- Ecological footprints / EFs can serve as a tool to promote sustainability / inform policy decisions; [1 mark]

Indicative Content	Commentary
<p>Other factors that may affect the size of a country's ecological footprint include:</p> <p>Any <b>three</b> from the following pairs of answers:</p> <ul style="list-style-type: none"> <li>• Food consumption; [1 mark]</li> <li>• The greater it is, the greater the footprint <b>OR</b> increased food consumption requires more agricultural land, leading to deforestation / habitat loss, which contributes to a larger ecological footprint; [1 mark]</li> </ul> <p style="text-align: center;"><b>OR</b></p> <ul style="list-style-type: none"> <li>• Carbon waste / carbon dioxide from burning fossil fuels; [1 mark]</li> <li>• The greater it is, the greater the footprint <b>OR</b> higher carbon emissions from burning fossil fuels intensify the greenhouse effect / climate change, requiring more resources for adaptation/mitigation efforts, therefore increasing the ecological footprint; [1 mark]</li> </ul> <p style="text-align: center;"><b>OR</b></p> <ul style="list-style-type: none"> <li>• Carbon fixation by local vegetation; [1 mark]</li> <li>• The greater it is, the smaller the footprint <b>OR</b> greater carbon fixation by plants through photosynthesis helps offset carbon emissions, contributing to a smaller ecological</li> </ul>	<p>The <b>ecological footprint</b> is a measure of the environmental impact of an individual, community, city, region, or even a whole country in terms of the natural resources and ecosystem services required to support their consumption and waste generation</p> <p>It quantifies the amount of biologically productive land and water area needed to meet the resource demands and absorb the waste generated by a given population</p>



footprint by reducing atmospheric carbon levels; [1 mark]

OR

- Industrial activity; [1 mark]
- The greater it is, the greater the footprint **OR** increased industrial output contributes to resource consumption / waste generation, increasing the ecological footprint; [1 mark]

OR

- Transportation efficiency; [1 mark]
- The greater it is, the smaller the footprint **OR** improved transportation efficiency reduces energy consumption / carbon emissions, leading to a smaller ecological footprint; [1 mark]

OR

- Renewable energy adoption/use; [1 mark]
- The greater it is, the smaller the footprint **OR** shifting to renewable energy sources reduces carbon emissions / resource extraction, reducing the ecological footprint; [1 mark]

OR

- Waste management practices; [1 mark]
- The more efficient, the smaller the footprint **OR** effective waste management reduces waste

accumulation / resource depletion,  
decreasing the ecological footprint;  
[1 mark]

OR

- Population density; [1 mark]
- The greater it is, the greater the footprint **OR** higher population density leads to increased resource demand / waste production, resulting in a larger ecological footprint; [1 mark]

OR

- Urbanisation rate; [1 mark]
- The higher it is, the greater the footprint **OR** rapid urbanisation often leads to increased resource consumption / energy use, contributing to a larger ecological footprint; [1 mark]

Exam Papers Practice

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Indicative Content	Commentary
<p>Estimating carrying capacity is problematic for human populations and differs from other species because:</p> <p>Any <b>four</b> from the following:</p> <ul style="list-style-type: none"> <li>• Human populations can modify their environment in order to (artificially) increase/inflate their carrying capacity; [1 mark]</li> <li>• Human carrying capacity is highly dynamic</li> </ul>	<p>The <b>carrying capacity for human populations</b> is a concept that refers to the maximum number of individuals that a given environment or ecosystem can support over the long term without degrading the natural resource base</p>



OR influenced/determined by many complex / interconnected / highly changeable factors e.g. cultural / economic / technological factors; [1 mark]

- Human innovation e.g. technological advancements / new agricultural practices, can significantly alter carrying capacity, making it difficult to predict/estimate; [1 mark]
- (However) for other species, carrying capacity is influenced/determined by resource biotic factors/interaction and abiotic factors/interactions / resource availability; [1 mark]
- Other species are (often) in greater balance with their ecosystem/habitat / have less ability to modify their environment; [1 mark]
- Human populations have the potential to overshoot their carrying capacity due to innovation/technology/healthcare; [1 mark]
- Human migration / the movement of people across regions or countries can lead to (relatively rapid) shifts in carrying capacity, as people adapt to new environments/resources; [1 mark]
- Global trade/interconnectedness / modern transportation / trade networks mean that resources can be imported and exported, influencing the carrying capacity of different regions; [1 mark]
- Cultural attitudes/practices/traditions/beliefs/values can shape resource use / (greatly) affect the carrying capacity of a population; [1 mark]
- Populations of other species show much greater similarity in behaviour(s) / resource use so easier to estimate the carrying capacity of whole species; [1 mark]

and ecosystem services

It represents the sustainable population size that a region or planet can maintain given the available resources and environmental conditions

factors that influence the carrying capacity for human populations:

- Resource Availability
- Technology and Efficiency
- Environmental Health
- Waste Absorption
- Social and Economic Factors
- Climate and Climate Change
- Sustainability Practices
- Cultural and Lifestyle Choices
- Population Growth Rate

- Human populations may influence ecosystems in ways that create feedback loops e.g. global warming / climate change, either increasing or decreasing human carrying capacity over time; [1 mark]
- Government policies / political decisions e.g. land use regulations / environmental protection laws / population control measures, can (significantly) impact carrying capacity; [1 mark]

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#### Indicative Content

The terms *ecological footprint* and *carrying capacity*, and the relationship between them, can be outlined as follows:

- The *carrying capacity* is the maximum human population / number of humans / "load" that can be sustainably supported by a given environment / ecosystem / area; [1 mark]
- (Whereas) the *ecological footprint* is the area (of land and water) required to support a (defined) human population (at a given standard of living); [1 mark]

And any **one** from the following:

- As the ecological footprint of a human population / individual humans within populations increases, the carrying capacity decreases (if other factors e.g. area / resource availability stay the same); [1 mark]
- Carrying capacity and ecological footprint are the inverse of each other **OR** carrying capacity =  $1 \div$  ecological footprint; [1 mark]