M11/4/ENVSO/SP2/ENG/TZ0/XX/M

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# MARKSCHEME

## May 2011

## ENVIRONMENTAL SYSTEMS AND SOCIETIES

## Standard Level

## Paper 2

19 pages

# General Marking Instructions

*Assistant Examiners (AEs) will be contacted by their team leader (TL) through Scoris™, by e-mail or telephone – if through Scoris™ or by e-mail, please reply to confirm that you have downloaded the markscheme from IBIS. The purpose of this initial contact is to allow AEs to raise any queries they have regarding the markscheme and its interpretation. AEs should contact their team leader through Scoris™ or by e-mail at any time if they have any problems/queries during the marking process.*

If you have any queries on **administration** please contact:

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**1.** Follow the markscheme provided, award only whole marks and mark only in **RED**.

**2.** Where a mark is awarded, a tick/check (✓) **must** be placed in the text at the **precise point** where it becomes clear that the candidate deserves the mark. **One tick to be shown for each mark awarded**.

**3.** Sometimes, careful consideration is required to decide whether or not to award a mark. In these cases write a brief annotation to explain your decision. You are encouraged to write comments where it helps clarity, especially for re-marking purposes. Use a text box for these additional comments. It should be remembered that the script may be returned to the candidate.

**4.** Personal codes/notations are unacceptable.

**5.** Make sure that the question you are about to mark is highlighted in the right hand window.

**6.** Where an answer to a part question is worth no marks, put a zero in the right hand window.

**7.** If a candidate has attempted more than the required number of questions within a paper or section of a paper, mark all the answers. Scoris™ will only award the highest mark or marks in line with the rubric.

**8.** Check **every** page carefully.

**9.** Mark positively. Give candidates credit for what they have achieved and for what they have got correct, rather than penalizing them for what they have got wrong. However, a mark should not be awarded where there is contradiction within an answer. Make a comment to this effect using a text box or the "CON" stamp.

**10.** "NR" should only be used once a script is completely marked and for complete questions not attempted.

# Subject Details: Environmental Systems and Societies SLP2 Markscheme

## General

A markscheme often has more marking points worthy of a mark than the total allows. This is intentional. Do **not** award more than the maximum marks allowed for part of a question.

When deciding upon alternative answers by candidates to those given in the markscheme, consider the following points:

- Each marking point has a separate line and the end is signified by means of a semicolon (;).
- An alternative answer or wording is indicated in the markscheme by a "/". Either wording can be accepted.
- Words in ( … ) in the markscheme are not necessary to gain the mark.
- Words that are underlined are essential for the mark.
- The order of points does not have to be as written (unless stated otherwise).
- If the candidate's answer has the same meaning or can be clearly interpreted as being the same as that in the markscheme, then award the mark. Where this point is considered to be particularly relevant in a question it is emphasized by using ***OWTTE*** (or words to that effect).
- Mark positively. Give candidates credit for what they have achieved, and for what they have got correct, rather than penalizing them for what they have got wrong.
- Remember that many candidates are writing in a second language. Effective communication is more important than grammatical accuracy.
- Occasionally, a part of a question may require a calculation whose answer is required for subsequent parts. If an error is made in the first part then it should be penalized. However, if the incorrect answer is used correctly in subsequent parts then **follow through** marks should be awarded. Indicate this with "**ECF**", error carried forward.
- Units should always be given where appropriate. Omission of units should only be penalized once. Indicate this by "**–1(U)**" at the first point it occurs. Ignore this, if marks for units are already specified in the markscheme.
- Do not penalize candidates for errors in significant figures, unless it is specifically referred to in the markscheme.

## SECTION A

**1.** (a) (i) (region) 1/Skåne **and** (region) 8/Stockholm; ***[1]***

(ii) intensive agriculture / high proportion of land used for agriculture / high use of fertilizers;
densely populated areas/proximity to city / so intensive use of land / lots of phosphates released in detergents; ***[2]***

(b) (i) the enrichment of a body of water with nutrients/fertilizers / when excess fertilizers/nutrients run off/flow into a lake or river; ***[1]***
*Do not accept "enrichment with minerals".*
*The word "enrichment" is not necessary for the mark but should be implicit if not stated explicitly.*

(ii) positive feedback involves increasing deviation from the mean/equilibrium / feedback that amplifies/increases change;
increased nutrients lead to increased organic matter which, as it decays, leads to increased nutrients; ***[2]***
*Do not credit responses which simply describe or explain the process of eutrophication.*
*Award credit for a response that does not include a definition of positive feedback but develops the example to illustrate positive feedback.*

(iii) *Production*: ***[1 max]***
collaboration with local farmers to adopt different farming practices;
try to minimize the impact on the environment by encouraging people to be restrained;
use of organic fertilizers/manure on agricultural fields;
practice of mixed cropping/crop rotation so less fertilizers are needed;
educational campaigns to encourage people to use less detergent/more environmentally friendly detergent;
*Accept any reasonable suggestion which leads to regulating and reducing production/use of the pollutant.*

*Release*: ***[1 max]***
policy/legislation/standards imposing limits on/reducing amount of fertilizer permitted;
plant a buffer zone between the fields and the water to absorb any run-off;
developing an alternative to phosphates in detergents;
ban/limit/reduce detergents containing phosphates (it is present to help the performance of the detergent in hard water);
introducing measures for extracting the pollutant from waste emissions;
stop leaching of slurry (animal waste) or sewage from their sources;
divert/treat/clean sewage waste;
*Accept any reasonable suggestion which leads to regulating and reducing the pollutant at the point of emission.*

*Long-term impacts:* ***[1 max]***
reintroduction/restocking of fish and other animal species;
using technology to screen water to remove pollutants;
pumping air/aerating through lakes to avoid the low oxygen conditions;
pumping/dredging sediments/mud from the river/lake beds;
remove excess weeds physically or by herbicides/algicides; ***[3 max]***
*Accept any reasonable suggestion which leads to cleaning up pollutant and restoring ecosystems.*

*Note: There may be some overlap between responses for production and release, but do not credit the same point twice.*

(c) (i) toads are most abundant on sandy soils / toads are least abundant on till/ clay soils; ***[1]***

(ii) toads hibernate in deep burrows which they dig, (and this is easier in sandy soils);
easier to dig/dig deep burrows;
(sandy soils are) more aerated so toads can breathe underground; ***[1 max]***
*Do not accept "habitat is sand dunes".*

(d) *Approach*: ***[1]***
focus on collaboration with local community/farmers / emphasis on value of ecosystem rather than an individual species;

*Evaluation*: ***[2 max]***
in highly populated biosphere reserves, involving people in decision making is crucial;
if people can see the ecological value of an undamaged ecosystem they are more likely to work to protect that ecosystem;
individual species cannot survive if the ecosystem, which is their habitat, is degraded;
preserving the ecosystem ensures that ecological services (*e.g.* climate regulation) are maintained;
preserving the ecosystem ensures that a greater variety of species/environments are preserved than in a species-based approach;
*Accept other reasonable responses.*

*Accept other interpretations of the "approach" taken towards conservation.*
*e.g. Approach:* ***[1]***
the focus/environmental value system in the Biosphere reserve is on people as environmental managers;

*Evaluation:* ***[2 max]***
managing agricultural systems maintains diversity of habitats and landscape;
but there is a need to reduce the impact of agricultural waste; ***[3 max]***

*Evaluation must be related specifically to the approach.*
*Do not credit a general evaluation of conservation or Biosphere reserves.*

(e) correlation between Common Spadefoot Toad population trends and ozone trends;
however correlation does not necessarily imply causation;
decline in ozone leads to an increase in ultraviolet (UV) penetration which impacts amphibians;
UV penetration is (probably) not the only factor linked to the decline in Common Spadefoot Toad populations;
eutrophication may also account for decline in populations; ***[3 max]***

*Do not credit responses which simply describe the connection unless a correlation is identified.*

(f) (i) $\left(12.6\,\% + 7.8\,\% = 20.4,\ \frac{6260 \times 20.4}{100} = \right) 1277;$ ***[1]***

*Do not accept decimal places. Figures refers to number of species which should be a whole number.*

(ii) not all species have been discovered/identified yet / may be cryptic species;
amphibians are likely to be less easy to find than species in some other groups;
taxonomy of amphibians not always well defined due to lack of information and study;
speciation is a dynamic process so number of species is not a constant; ***[1 max]***
*Award **[1]** for two correct responses.*

(iii) population size / quality of habitat / reduction in population size / number of mature individuals / geographic range / degree of fragmentation / area of occupancy / probability of extinction; ***[1 max]***
*Award **[1]** for any two of the above.*

(iv) *Economic*: ***[1 max]***
humans may want to use them as a resource later on *e.g.* new medicines/ food;
ecotourism benefits from higher rates of diversity;
selective breeding requires high genetic diversity;

*Ecological*: ***[1 max]***
ecosystems with high levels of diversity are generally more stable/resilient;
healthy ecosystems are more likely to provide ecological services *e.g.* pollination / flood prevention;
high species diversity leads to high interdependence / species diversity should be preserved as it can have knock-on effects on the rest of the food chain;

*Ethical*: ***[1 max]***
other species have the right to exist/intrinsic value regardless of human need;
we have a responsibility to safeguard resources for future generations; ***[3 max]***

*Accept other reasonable arguments.*
*Do not accept statements of belief such as "it is cruel to kill animals" or "it is morally wrong". Statement must be an argument for preserving species diversity not an argument for preserving individual species or individual animals.*

(g) *Award **[2]** for two separate ways in which global warming can have an effect rather than two effects of **one** change due to global warming.*
more extreme weather conditions *e.g*. drier summers and wetter winters with an increased risk of flooding;
may lead to drier climatic conditions and wetlands drying out;
rising sea levels could lead to coastal flooding/salt water intrusion;
warmer temperatures could lead to biome shifts *e.g*. conifers being outcompeted by broad leaf trees;
vulnerable species *e.g.* amphibians become extinct as they are unable to adapt to rapid changes in environmental conditions;
farming practices in agro-ecosystems may need to change to adapt to new climate conditions *e.g.* increased irrigation; ***[2 max]***

*Accept other reasonable responses.*
*Responses must identify the change due to global warming **and** relate it to the effect on the ecosystem.*
*Do not accept a list of the effects of global warming. e.g. "may lead to drier climatic conditions and wetlands drying out" will gain a mark, but "wetlands drying out" will not.*

## SECTION B

**General Essay Markscheme**

Each essay is marked out of ***[20]*** of which ***[2]*** are for clarity of expression, structure and development of ideas.

***[0]*** Quality of expression, structure and development is poor.
***[1]*** Quality of expression, structure and development is limited.
***[2]*** Quality of expression is clear, structure is good and ideas are well developed.

*Do not penalize candidates for writing in bullet pointed lists – if this technique is used appropriately i.e. to summarize or outline a list of points within an essay at an appropriate point. However, a candidate who has not shown **any** evidence of being able to write a paragraph with a developed, logical line of reasoning would not be able to achieve maximum marks.*

**2.** (a) *Definition of pollution:* ***[2 max]***

pollution is the addition of a substance/agent produced by human activity to an environment / pollution is a substance added to the environment resulting in negative effects;
at a rate greater than that at which it can be rendered harmless / which has an appreciable effect on the organisms within it;

*Distinguishing between point and non-point source pollution:* ***[3 max]***

non-point source pollution is the release of pollutants from numerous, widely dispersed origins;
whereas point source pollution is the release of pollutants from a single, clearly identifiable site;
point source pollution is easier to manage/clean up than non-point source pollution;
*e.g.* of point source pollution would be pollution from an outflow pipe, whereas non-point source pollution might be from vehicles; ***[4 max]***

(b) *Award up to **[2 max]** for naming specific atmospheric pollutants.*
*Award **[4 max]** for explaining the effects of each of these pollutants on terrestrial environments.*

*Named atmospheric pollutant: **[1]***
*e.g.* stratospheric ozone depletion, caused by CFCs;

*Explanation of negative effect on terrestrial ecosystem: **[2 max]***
can lead to an increase in UV radiation leading to mutation;
which can lead to health problems such as sunburn/skin cancers/eye cataracts/aging/wrinkling of skin/leukaemia/speeding up onset of AIDS;
photosynthesis in some species can be inhibited;
coral reef bleaching;
bacteria in soils can be killed, leading to changes in soil quality;
some organisms are particularly vulnerable *e.g.* phytoplankton/insects;
this can have knock-on effects through the food chain;

*Named atmospheric pollutant: **[1]***
*e.g.* acid deposition, caused by $SO_2$/ $NO_x$;

*Explanation of negative effect on terrestrial ecosystem: **[2 max]***
can reduce nutrient levels/fertility in soils;
damage to tree roots / acid fogs can also lead to a reduction in foliage/canopy density as tree health declines;
ability of terrestrial vegetation to cope with stress *e.g.* frost/drought/pests is reduced;

*Named atmospheric pollutant: **[1]***
*e.g.* photochemical smog contains pollutants like $NO_2$/PAN/ozone/$O_3$;

*Explanation of negative effect on terrestrial ecosystem: **[2 max]***
which can stop plant growth ($NO_2$);
or even be poisonous to plants (PAN)/ground-level ozone/$O_3$;

*Named atmospheric pollutant: **[1]***
*e.g.* global warming, caused by $CO_2$/ $CH_4$/methane;

*Explanation of negative effect on terrestrial ecosystem: **[2 max]***
lead to biomes shifting as climates change;
can lead to extinction of species as they cannot adapt quickly enough to cope with changes to their environments; ***[6 max]***

*At least two specific atmospheric pollutants must be identified.*
*Award **[3 max]** if only one atmospheric pollutant is mentioned.*
*Award **[4 max]** if atmospheric pollution issues are explained but specific atmospheric pollutants are not named.*

(c) the main cause of the release of many atmospheric pollutants is the burning of fossil fuels in transport/industry/power generation;
reducing fossil fuel combustion can therefore be a direct/effective way of limiting release of pollutants;
reducing domestic demand for electricity by energy saving methods *e.g.* halogen lightbulbs/improved insulation;
reducing fossil fuel combustion by switching to renewable energy methods;

recycling refrigerants has helped to limit the release of ozone-depleting substances leading to stratospheric ozone depletion;
recycling rubbish can limit the amount of waste that needs to be incinerated which reduces emission of pollutants;
reusing resources limits the amount that need to be produced meaning fewer pollutants released in industrial processes;

these strategies on their own are sometimes not enough to cope with the effects of atmospheric pollution;
sometimes clean-up strategies are needed *e.g.* application of lime to acidified lakes;
sometimes the process of recycling can release atmospheric pollutants;
recycling needs to be economically viable / there needs to be a market for the goods;
reducing use of resources is often the hardest/least attractive solution due to inertia/resistance to changes in consumption;
government intervention to set targets with legislation is most effective in affecting a reduction in emissions;
as global population increases, strategies to reduce per capita fossil fuel consumption may not necessarily lead to a reduction in absolute energy demand; ***[8 max]***

*Award **[6 max]** if only strengths **or** weaknesses of reducing, reusing and recycling are mentioned.*

*Expression of ideas*: ***[2 max]***

*Total*: ***[20]***

**3.** (a) *biodiversity*: ***[2 max]***
biological/living diversity per unit area;
made up of species, habitat and genetic diversity;

transect/quadrat/sampling method to collect data on number and abundance of species;
Simpson's/a diversity index is used to calculate (species) diversity;
then values are extrapolated for larger areas; ***[4 max]***
*Do not accept Lincoln index.*

(b) *Award **[1 max]** for a definition of unsustainable agricultural practices.*
agricultural practices are unsustainable if they damage natural capital/reduce the ability of the environment to yield crops/produce in the long term;
farming in a way which damages the environment;

*Direct loss of biodiversity*:
monoculture can lead to loss of species diversity;
pesticides can kill all species not just the species being targeted;
making silage/harvesting grass before flowering reduces pollination/seed production;
deforestation leads to loss of habitat diversity;

*Indirect loss of biodiversity*:
genetically modified (GM) crops can reduce species diversity as natural grasses are outcompeted;
removal of hedgerows to increase farm sizes can lead to habitat loss;
draining wetlands to provide more farmland can lead to the loss of habitats;
excessive application of inorganic fertilizers can lead to eutrophication of nearby water bodies and loss of species;
deforestation leads to loss of habitats and food sources for other organisms causing them to become extinct;
native species are outcompeted by domestic species (which have escaped captivity); ***[5 max]***

*Award **[3 max]** if only direct or indirect losses are explained.*
*Award **[3 max]** if effects of agricultural practices are appropriate but not correctly categorised as direct or indirect, or if categories are unclear.*

(c) *Award up to **[3 max]** for identifying factors*:
inequity of use / political conflict;
population size/growth / migration levels;
industrialization;
increased food production / irrigation;
socio-economic levels / levels of development;
cultural attitudes towards conservation/environmental education;
aquifer sizes/depths and distribution;
climate/precipitation/aridity/drought;
global warming / climate change;
available technology;

*Award **[1 max]** for definition of sustainable use*:
using water at a rate which allows natural replenishment/regeneration;
using water in a way that minimizes damage to the environment;

*Award up to **[3 max]** for evaluation of relative importance*:
the relative importance of different factors will depend on the context of the area;
in semi-arid/desert areas there is a smaller stock of water resources in the first place;
conflicts over water can be made worse when there are political tensions between different user groups;
or in societies with a short-term attitude toward resource use;
in countries near to carrying capacity, population numbers will be more significant than in countries where water supplies are abundant;
in countries where water is abundant it may be perceived as an unlimited resource and therefore wasted;
in societies where there is good awareness of sustainability issues individuals may take steps to ensure their own level of water use is sustainable *e.g.* recycling rain water;
in countries with oil resources technological solutions to water shortages such as desalinization are a more affordable option;
in LEDCs expensive high tech solutions are less of an option;

*Award up to **[2 max]** for use of appropriate illustrative case study/examples.*
*e.g.* Aral Sea – short-term gain in cotton industry at expense of sustainable water use;
*e.g.* Colorado river – drastically reduced flow due to high consumption/wasteful abstraction of groundwater resources; ***[9 max]***
*Do not accept vague or general examples e.g. dry in Africa.*

*Expression of ideas*: ***[2 max]***

*Total*: ***[20]***

**4.** (a) *Award **[1 max]** for definition of soil degradation*:
an (umbrella) term for a range of processes which lead to a reduction in the productivity of a soil / *OWTTE*;
soil degradation is the loss of fertility/quality of a soil;

overgrazing can lead to compaction so soil is more likely to be eroded;
overcultivation can lead to nutrient depletion/loss of soil structure;
deforestation/overgrazing can lead to loss of vegetation so soil is more easily dried out/baked by the sun/eroded;
overgrazing, overcultivation and deforestation can lead to desertification;
salinization can be caused by excessive irrigation;
overpopulation forces people to farm marginal areas;
removal of hedgerows/woodlands / windbreaks can expose soil to erosion; ***[5 max]***

*Do not credit responses which go into detail on one or two human activities as an outline of a range of activities is required.*

(b) free-living/symbiotic bacteria fix atmospheric nitrogen converting into a usable form for plant roots;
mycorrhizal fungi on tree roots take up soil phosphate and pass to the tree, increasing growth;
decomposers break down litter releasing nutrients into the soil;
soil organisms help to mix the soil improving its structure;
will occupy niches as prey and predators within food chains;
their burrows will help to aerate the soil;
can feed off roots reducing crop productivity/damaging plants;
as they decompose/their feces will contribute to organic matter within the soil; ***[5 max]***

(c) *Award **[4 max]** for evaluation of view.*
*strengths of view that participation is important*:
participation has an important role to help educate people about environmental issues;
participation means that people who may be causing the problems are less likely to do so if they are involved in decisions about their own environments;
sometimes poorer/less powerful/marginal groups in society have the best knowledge about what is right for an environment *e.g.* indigenous groups, and if they participate their knowledge can be shared;
people who believe in democracy argue that everyone has a right to have a say in how communal resources/environments are managed;
ecosystems need to be managed holistically so people from all walks of life who have useful skills can contribute;

*weaknesses of view that participation is important*:
sometimes leadership needs to be taken by political groups to ensure change happens;
too many people being consulted can slow down progress when the need for action is urgent;
many groups in society may not care about the environment or see it as important;

*Award **[1]** for an example of successful community project*:
*e.g.* tree planting in Nepal;

*Award **[3 max]** for any relevant points discussing the project*:
villagers provided with seedlings / individual responsibility for protecting forests given to local community groups;
forests provide fuel wood resources for villagers;
soil also conserved as forests protect from erosion;
communities benefit directly from standing forest reserve and are therefore more likely to participate in protecting trees as they grow; ***[8 max]***

*Accept responses which use Skåne Biosphere Reserve as an example of community involvement.*

*Do not accept "communities reaching international agreements e.g. Kyoto/Montreal protocols" as a valid example of involvement of communities unless the discussion explains how communities are involved at a local level. All solutions to environmental problems will involve groups of people so the expectation here is that responses will be an example of the involvement of LOCAL people in a "community project."*

*Expression of ideas*: ***[2 max]***

*Total*: ***[20]***

**5.** (a) *Award **[1]** for any factor together with a brief link to how it reduces population growth rates.*
economic development can lead to a reduction in birth rates;
increased actual/perceived cost of having children leads people to limit their families;
education of women/improving status of women can lead to reduction in total fertility rates;
improving health/diet/sanitation leads to lower infant mortality and reduced birth rates;
war can increase death rates and (temporarily) limit birth rates;
disease/AIDS can increase death rates/reduce birth rates as young people are most affected;
famine/food shortages can increase death rates/limit birth rates;
natural hazards can increase death rates/limit birth rates;
political strategies can help to encourage/force people to have fewer children;
contraception will reduce numbers of pregnancies;
decline in influence of religion that disallows usage of contraception;
changing cultural values in traditional societies that used to view status of man as linked to how many children/how many boys they have; ***[4 max]***

(b) some areas will become warmer so more agriculturally productive;
increased carbon dioxide may lead to increased productivity;
some areas may experience a more pleasant climate;
which can lead to an increase in tourist revenues;
reducing need for heating;
melting of ice will increase land that is available for development/improve transport routes;
melting of ice may make natural resources *e.g.* oil more accessible/fresh water more available from glacier melting;
some areas will experience increased rainfall;
technologies to reduce carbon emissions can be seen as a growth industry that can generate income/employment;
some could argue (though perhaps not very ethically) that global warming will act as a natural check on population growth/help to reduce overpopulation;
effects of global warming can help to unite the world to take environmental issues more seriously/work together to address common problems; ***[6 max]***

(c) *Candidates can approach this question in a number of ways, and responses will depend on the choice of environmental problems.*
*Note: Although the assumption is that the environmental problems are from the Environmental Systems and Societies course, a candidate who chooses to respond to any environmental problem e.g. a natural hazard such as the tsunami or flooding, should still be credited.*

*Award **[1]** for two contrasting environmental problems. Contrast may be one of cause or scale*:
*e.g.* ozone depletion and loss of biodiversity;

*Discussion:*
technocentric responses played a key role in solving ozone depletion;
alternatives to gas-blown plastics/propellants/methyl bromide enabled products to be produced without releasing so many ozone-depleting substances;
so technology enabled societies to continue lifestyles they had become accustomed to;
however, without the Montreal Protocol international agreement to set limits, there would have been little likelihood of governments taking the necessary steps to produce these alternatives;
so a political solution was important as well as a technological one;

technological solutions have played some role in the response to the loss of biodiversity;
web-based monitoring systems have helped to monitor species numbers;
satellite tracking of migrating organisms, *e.g*. whales / sea birds;
ICT systems have been important in enforcing agreements such as CITES;
and sophisticated technological solutions like seedbanks enable us to preserve DNA so that valuable genetic diversity is not lost;
however some might argue that technologies *e.g*. GM crops are actually responsible for the loss of species diversity;
and many of the causes of species loss *e.g*. habitat degradation are occurring in societies with little access to technology and it cannot play a role in solving these problems;

technology is a tool which cannot on its own solve any problem, there has to be political will to make changes and then technology can help to provide solutions; ***[8 max]***

*Expression of ideas*: ***[2 max]***

*Total*: ***[20]***