Diploma Programme
Programme du diplôme
Programa del Diploma

Environmental systems and societies

Standard level

Specimen paper 1 and 2

For first examinations in 2017

Contents

Examination code

				–				

Diploma Programme
Programme du diplôme
Programa del Diploma

Environmental systems and societies
Standard level
Paper 1

Specimen paper

Candidate session number

1 hour

Instructions to candidates

- Write your session number in the boxes above.
- Do not open this examination paper until instructed to do so.
- Answer all questions. Refer to the resource booklet which accompanies this question paper.
- Write your answers in the boxes provided.
- A calculator is required for this paper.
- The maximum mark for this examination paper is **[35 marks]**.

1. (a) Identify **two** biomes in Mongolia. **[1]**

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(b) Outline **two** factors that have contributed to the high biodiversity in Mongolia. **[2]**

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2. (a) With reference to **Figure 3a**, **3b**, and **3c** outline **two** ways in which the climate may limit productivity in Mongolia. **[2]**

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(b) With reference to **Figure 3c** and your own knowledge, explain **one** reason why Mongolia is susceptible to soil erosion. **[2]**

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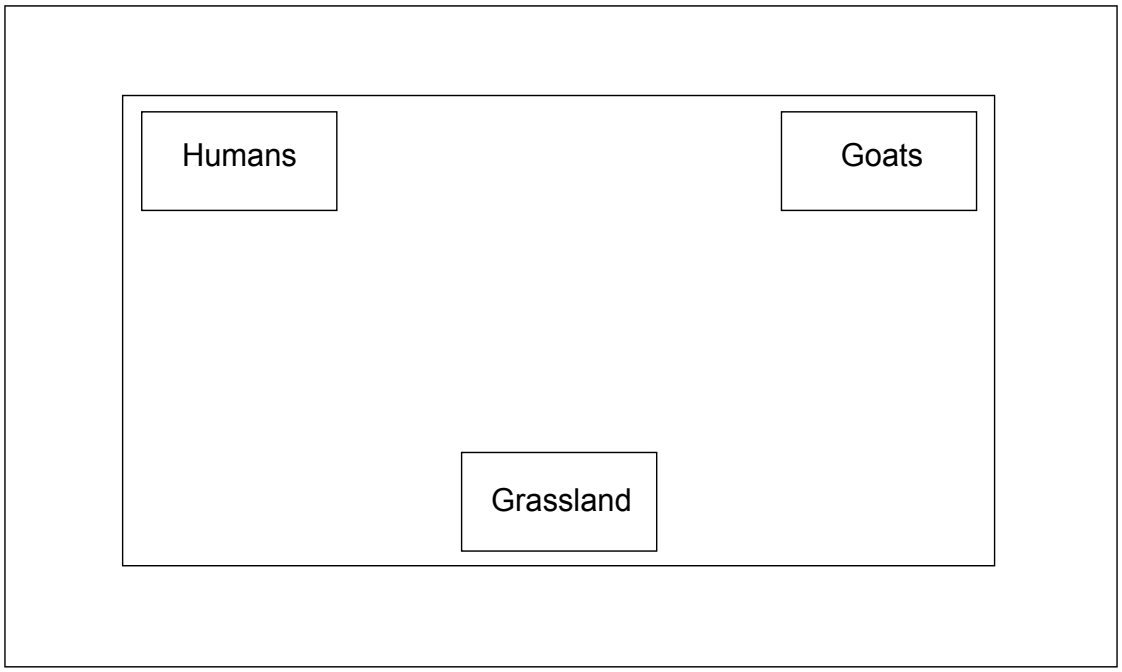
3. Using the diagram below, draw labeled arrows to create a flow diagram that shows:

(a) one input and one output of the system. **[1]**

(b) two flows between the given storages. **[1]**

Farming System



4. To what extent does the data in **Figure 6a** and **6b** provide evidence for climate change in Mongolia? **[4]**

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5. (a) With reference to **Figure 7b**, state **one** impact on the natural capital of this ecosystem of nomads settling in one place. **[1]**

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(b) Identify **two** reasons for the changing number of livestock when former nomads become settled in one place. **[2]**

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6. **Figure 8a** shows a variation in the community over the distance between A and D.

(a) With reference to **Figure 8a**, state why site D is included in the study. **[1]**

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(b) Outline **two** ways in which the abiotic conditions of Tracks A and C differ. **[1]**

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(c) (i) State the process through which communities change over time. **[1]**

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(This question continues on the following page)

(Question 6 continued)

(ii) Explain how this process can cause changes in the biotic and abiotic conditions by reference to Tracks A and C. **[3]**

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7. (a) With reference to **Figure 4** and **Figure 10** outline **two** possible reasons why the Snow leopard has received special attention from conservationists. **[2]**

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(b) The Snow Leopard Trust demonstrates features of several different value systems. Identify **one** feature of its activity that would be typical of anthropocentric and **one** of technocentric value systems in the table below. **[2]**

Activity which is typical of anthropocentric value systems	**Activity which is typical of technocentric value systems**
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8. With reference to **Figure 11** and other information from the resource booklet, suggest why Mongolia's biocapacity has changed over time. **[3]**

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9. With reference to the information presented in the resource booklet, analyse the global ecological value of Mongolia. **[6]**

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Diploma Programme
Programme du diplôme
Programa del Diploma

Environmental systems and societies
Standard level
Paper 1

Specimen paper

1 hour

RESOURCE BOOKLET

Instructions to candidates

- Do not open this booklet until instructed to do so.
- This booklet contains **all** the resources to answer paper 1

Figure 1a: World map showing location of Mongolia

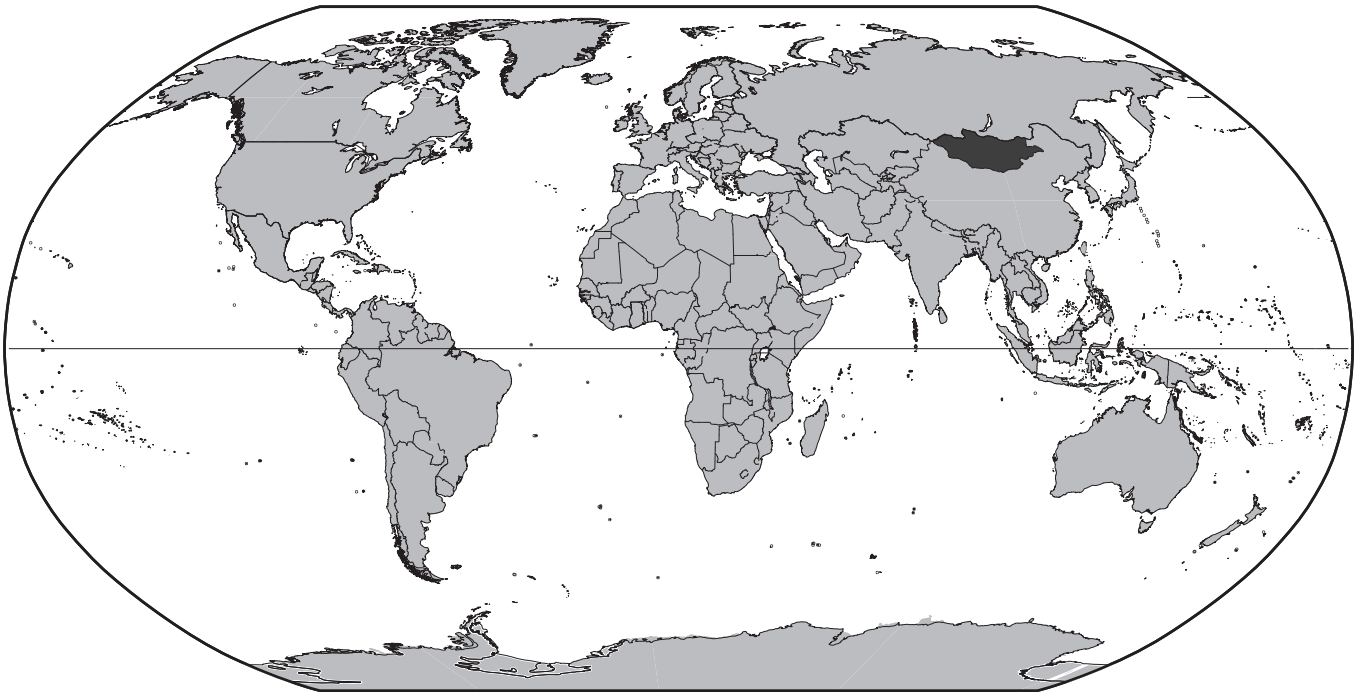
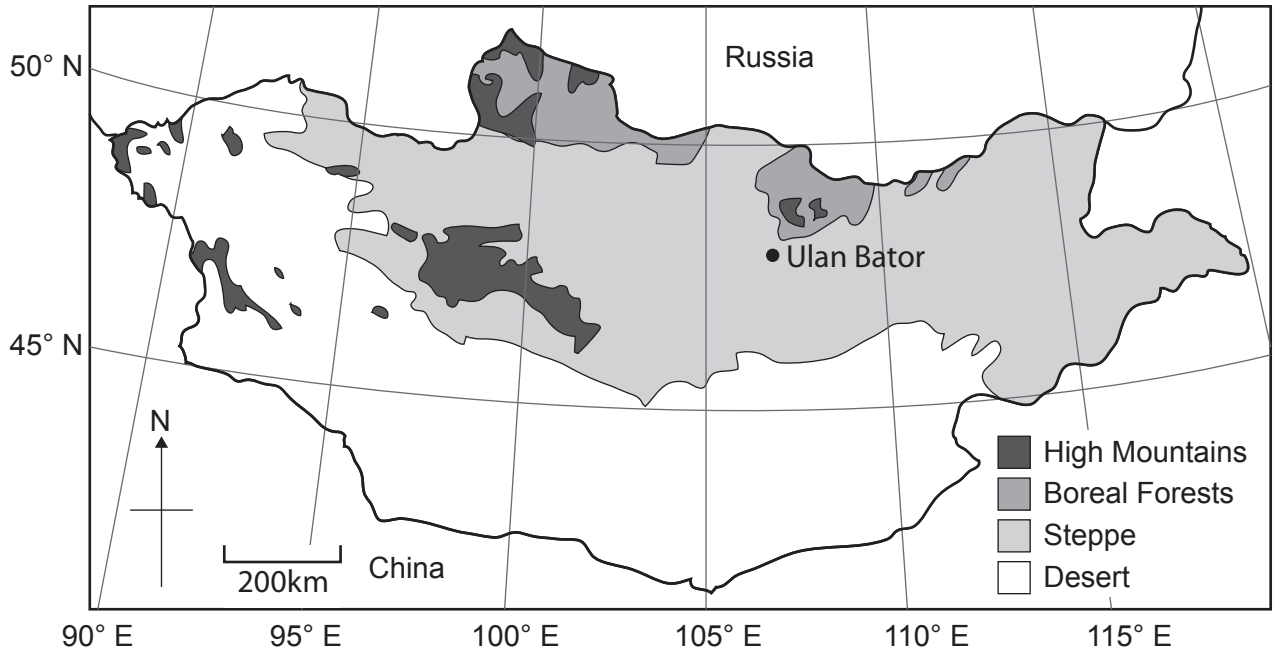


Figure 1b: Detailed map showing Mongolia



[Source: www.cia.gov]

Figure 1c: Map showing the range of the snow leopard

[Source: www.tendua.org]

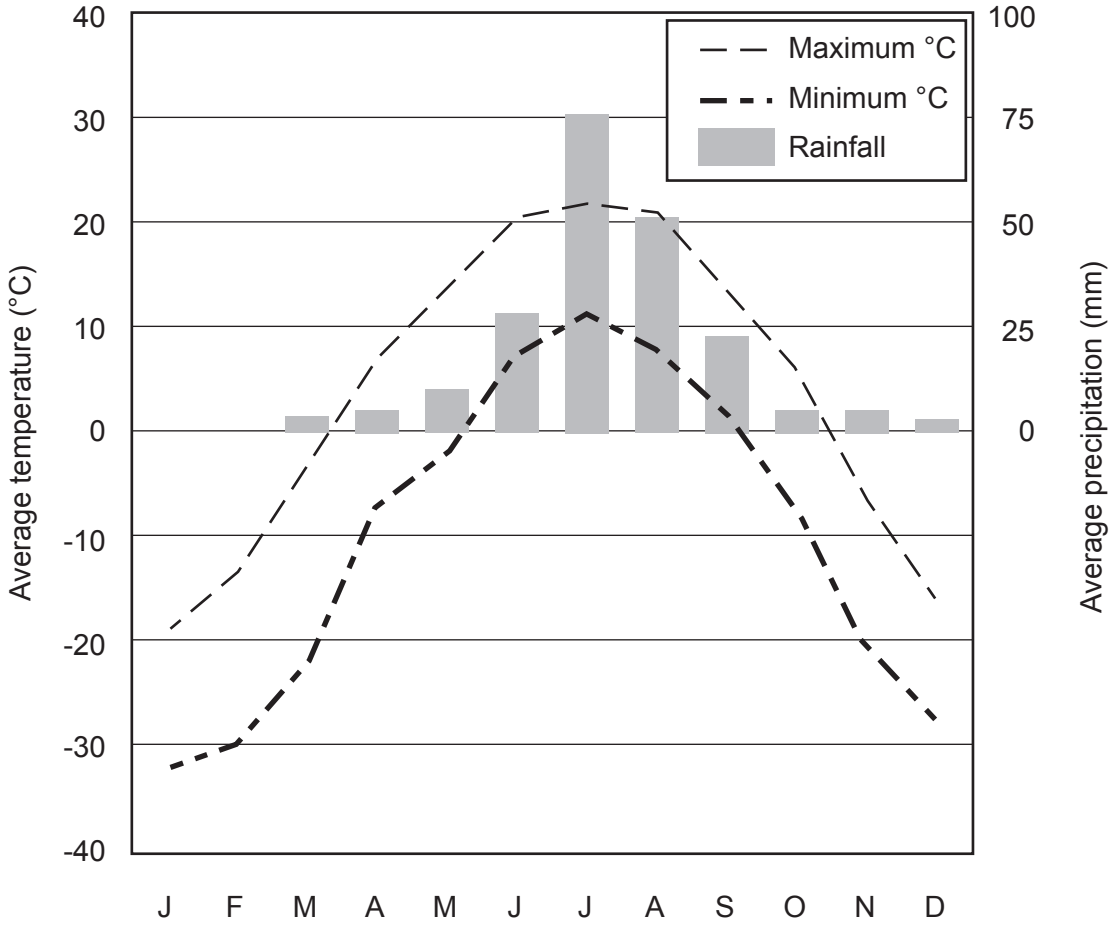
Figure 2: Fact file on Mongolia

- Mongolia covers 1.5 million sq km. Only 1% of this is used for settlements and farming
- It is a land of natural contrasts made up of large areas of flat, unforested grassland (steppe), mountains in the west, and the Gobi Desert in the south
- 80 % of the country lies 1000m above sea level
- The population is 2.7 million, 40 % of whom live in the capital city, Ulan Bator
- The rest of the population is spread over large, often inaccessible areas. Many are nomadic herders living in yurts
- Mongolia is one of the poorest countries in Asia
- In the Human Development Index Mongolia is ranked 108 out of 187 countries
- 13 % of land area is protected.

[Source: extract – fact file from Mongolia, Geofile 658, Nelson Thornes 2012, reproduced by permission of the publishers, Oxford University Press]

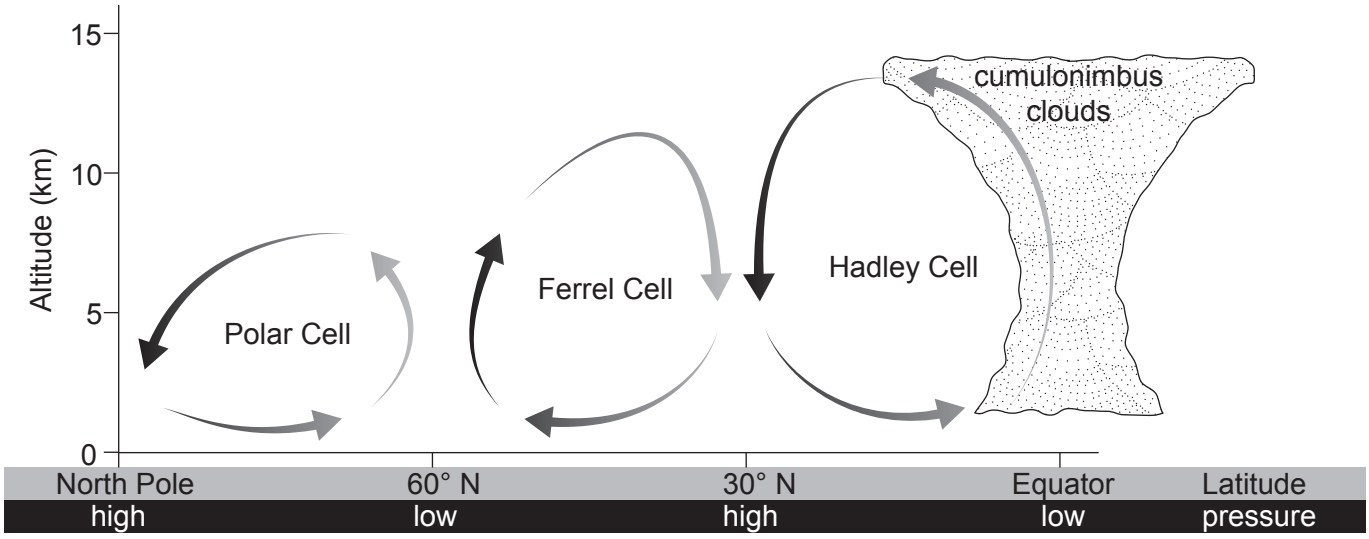
Figure 3a: Climate graph of Ulan Bator, Mongolia

Mongolia's harsh climate has always presented its people with problems:



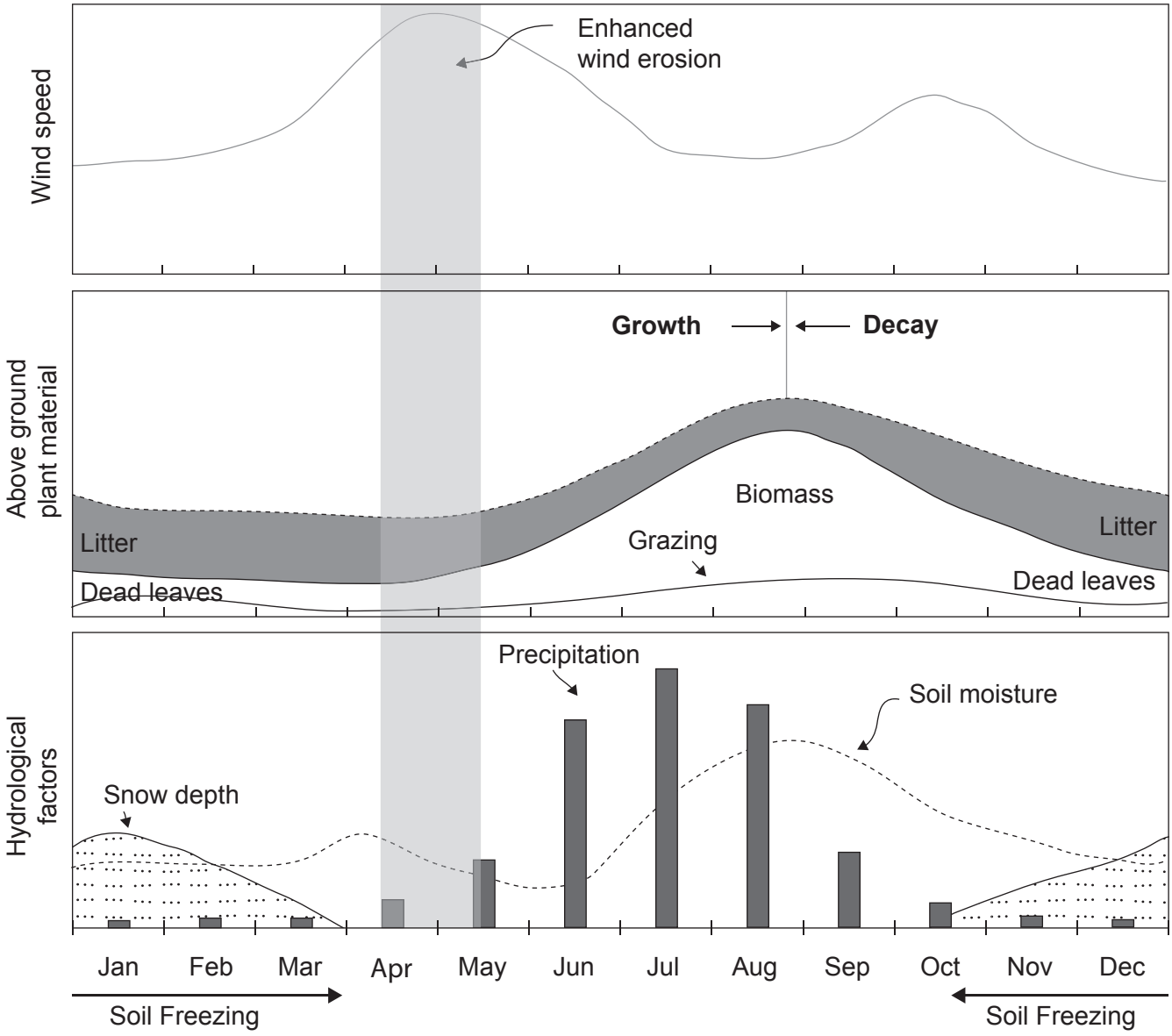
[Source: wikimedia.org]

Figure 3b: Tricellular model



[Source: www.geogonline.org.uk]

Figure 3c: Graphs to show the relationship between climate, biomass and soil erosion



[source: www.origin-ars.els-cdn.com]

Figure 4a: Fact file on Mongolian species

- 139 mammal species, 450 species of birds (including 331 migratory and 119 resident birds), 76 species of fish, 22 reptile species, and 6 species of amphibians
- More than 3,000 species of higher plants, 927 lichens, 437 mosses, 875 fungi. Many other species, however, remain to be classified
- 150 endemic plant species and a number of endemic animal species such as the Saiga antelope.

[Source: www.en.wikipedia.org]

Figure 4b: Photos showing Mongolian flora and fauna

Sheep's fescue *Festuca ovina*

[Source: http://stevensonintermountainseed.com]

Bactrian camel *Camelus bactrianus*

[Source: www.letus.org]

Przewalski's horse *Equus ferus przewalskii*

[Source: http://nature.ca]

Saiga antelope (endemic) Tatarica mongolica

[Source: http://beniceartfriends.com]

Snow leopard *Uncia uncia*

[Source: © WWF]

Feather grass *Stipa pennata*

[Source: http://en.wikipedia.org © Sten Porse]

Figure 5a: Nomadic herders fact file

About 30 % of Mongolians live as nomadic herders on sparsely populated grasslands. The herders' cattle, sheep and goats represent their wealth. They use them to pay for everything from food to medicine and schooling for their children.

These grasslands develop rich fertile soils that have supported nomadic pastoralists for centuries, but they are also highly vulnerable to degradation due to wind erosion and over grazing. Changes in climate can cause further degradation of these soil systems.

Harsh conditions can make life very hard. In a recent survey over 97% of the herders interviewed believed climate change to be a problem in their area.

The environmental conditions they described were:

- frequent drought followed by Dzud (severe winter) events with heavy snowfall
- drying up of rivers and springs and reduction in drinking water
- reduction of feeding value of pasture land and hay making yield
- increased sand movement and desertification
- decrease in animal body weight leading to decrease in the production of meat, milk, wool and cashmere.

Figure 5b: Photos showing nomadic herder life

Inside a yurt

[Source: Donna Caplinger]

A yurt

[Source: http://upload.wikimedia.org]

Frozen livestock killed by severe cold

[Source: http://news.bbc.co.uk]

Mongolian herder gathering cashmere wool from goat

[Source: www.globalenvision.org]

Snow leopard doll made from wool felt by Mongolian women

[Source: © Snow Leopard Trust]

Goat herder child

[Source: from the case study "food security in the face of climate risks – Mongolian herders' experiences" presented by Batkhishig Baival and Bayarmaa Baljinnyam at the Mary Robinson Foundation organised Hunger-Nutrition-Justice 2013 Conference in Dublin 15–16 April 2013]

Figure 6a and b: Climate data for Mongolia

Figure 6a: Annual average air temperature in Mongolia, 1940–2008

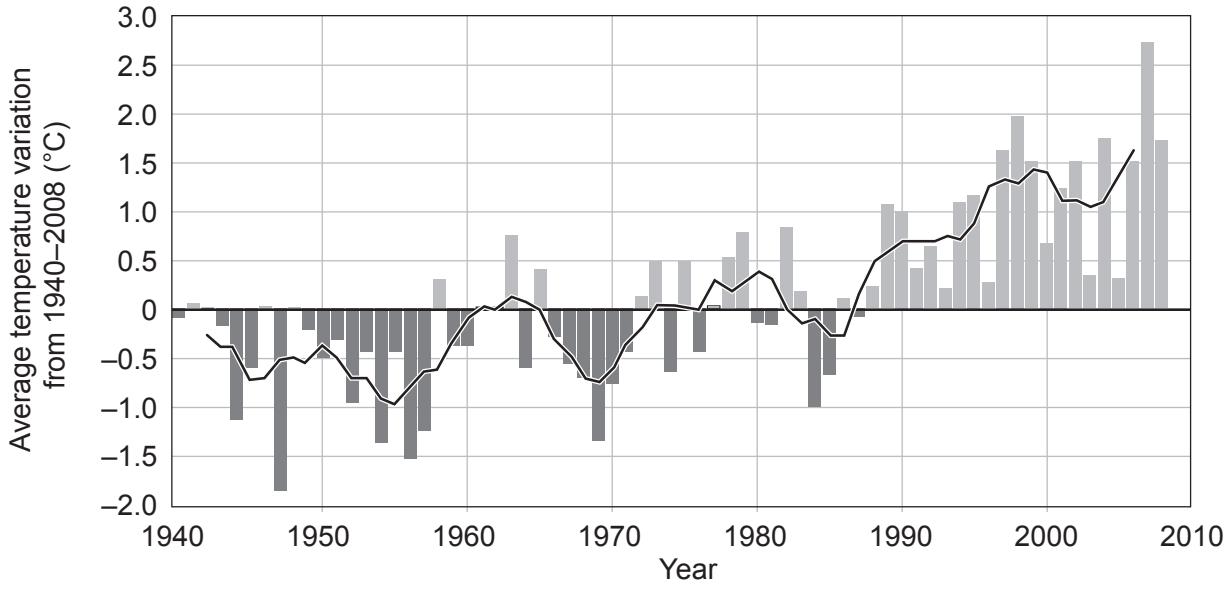
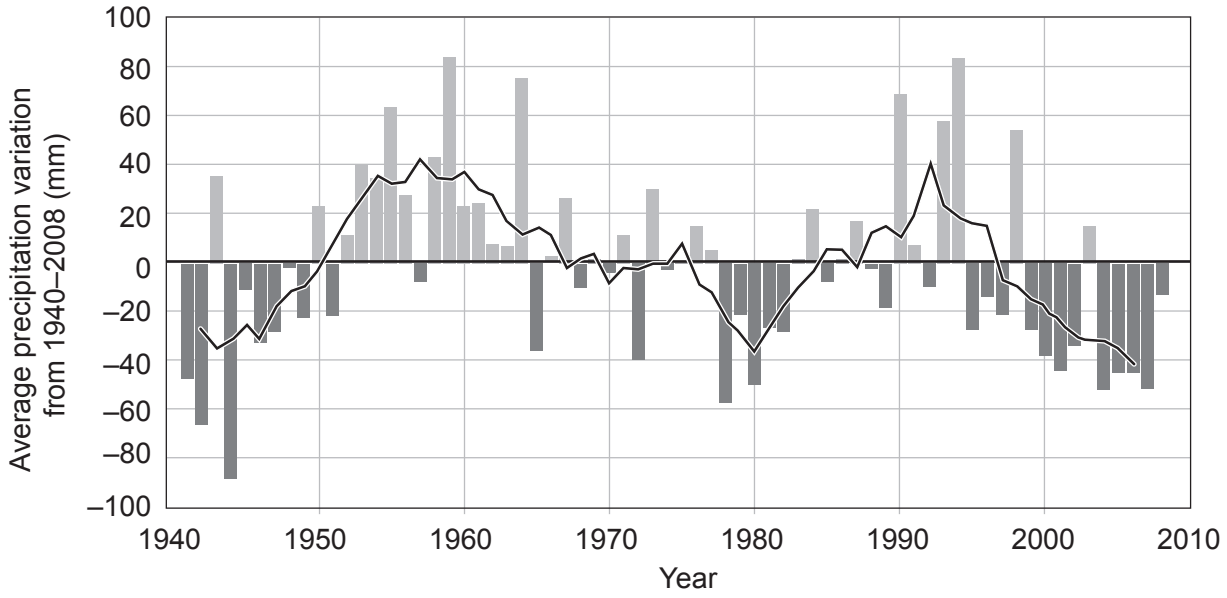


Figure 6b: Total annual precipitation in Mongolia, 1940–2008



[Source: Mongolian met office]

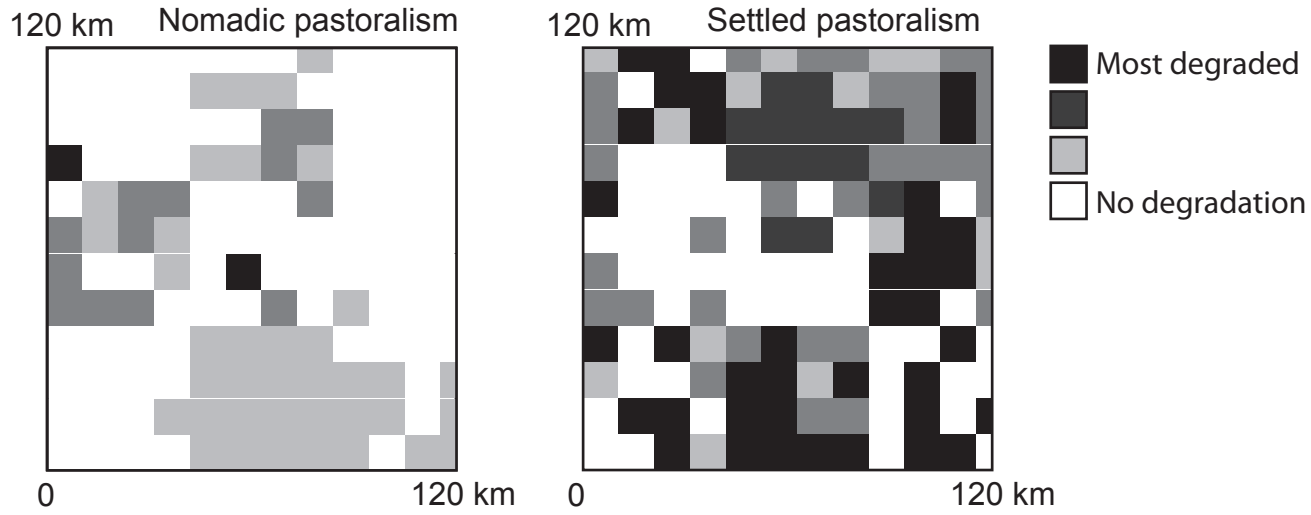
Figure 7a: Changes in pastoralism in Mongolia

Nomadic pastoralism is when livestock (groups of animals) are moved to find fresh grazing pastures. The movement can be anywhere at any given time with no set path or pattern.

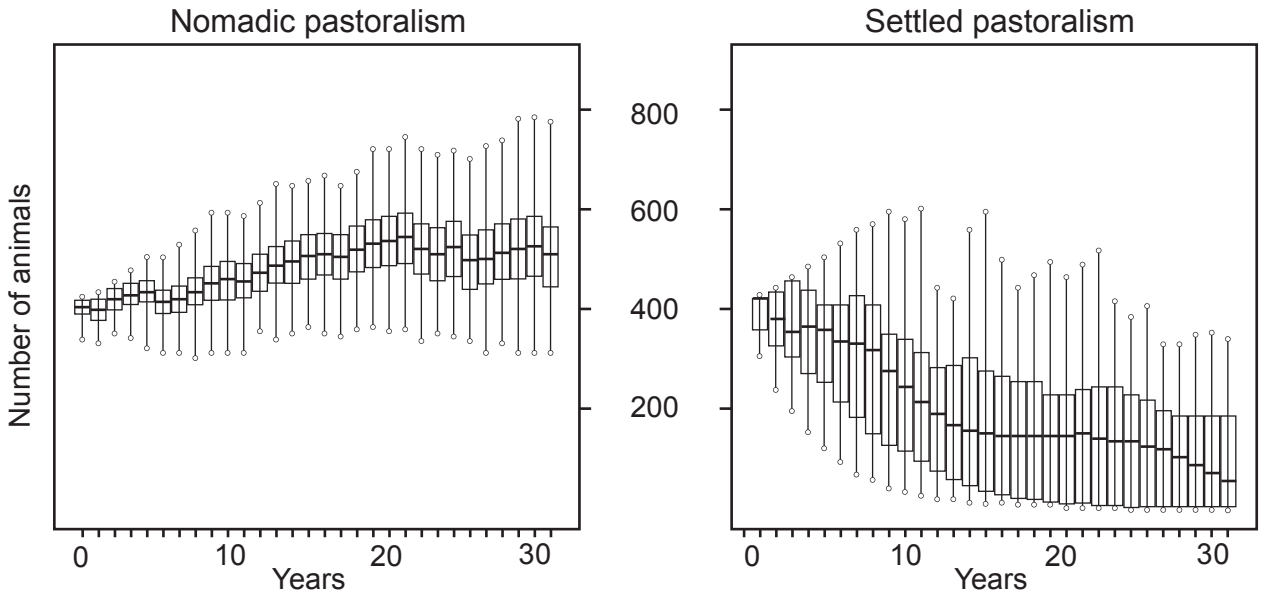
Settled pastoralism is when the animals are kept in the same place for the whole year, or at least most of it. A permanent place to keep the animals is needed, such as a barn.

There has been a recent trend for nomadic pastoralists to settle near Ulan Bator. This is because of the higher price of meat in these areas and the harsh conditions on the steppe. The Government has encouraged nomads to settle as this is seen as being more developed.

Figures 7b: A study comparing the degradation of land under nomadic pastoralism and settled pastoralism using computer modeling

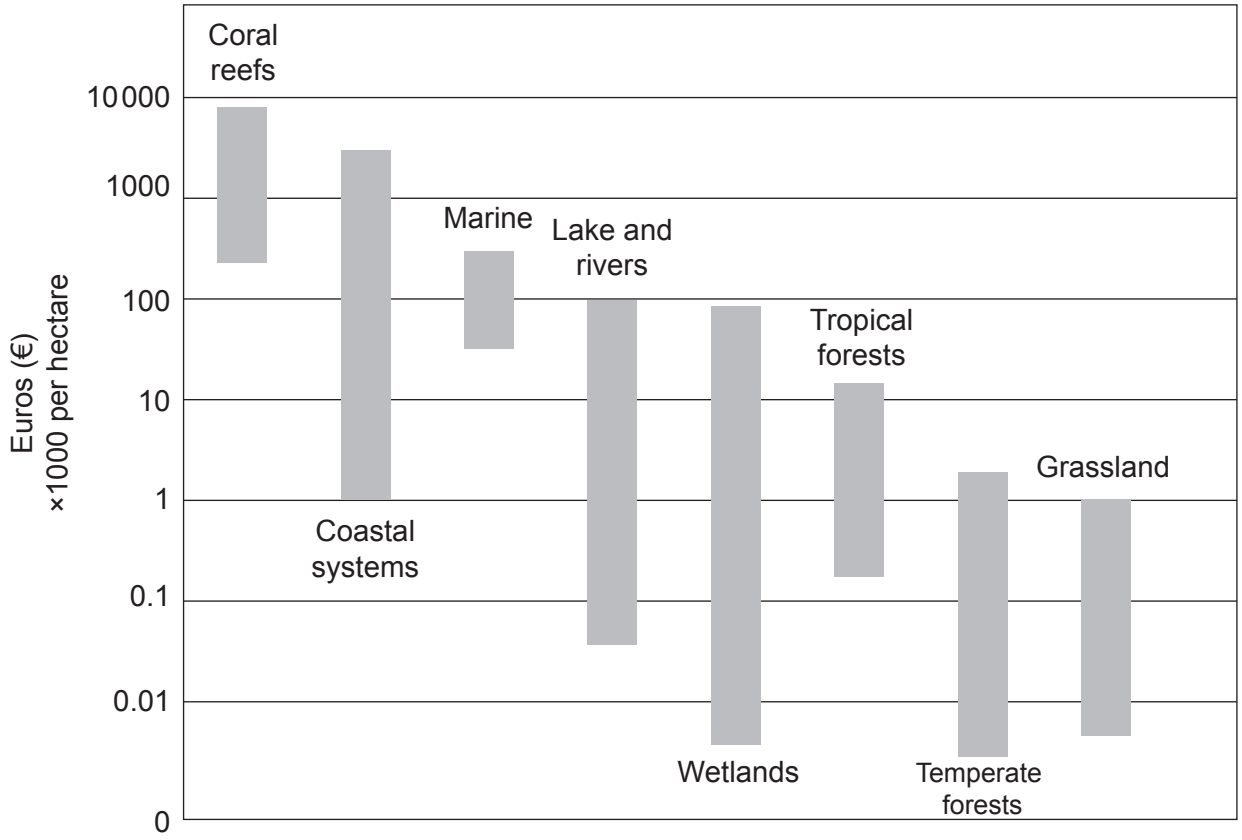


Figures 7c: Changes in the number of animals owned by households



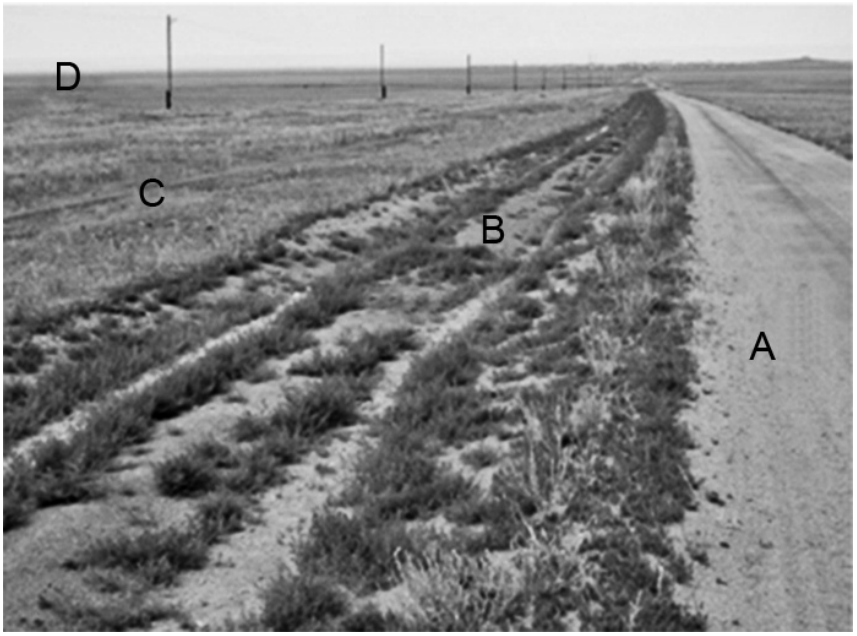
[source: http://www.chikyu.ac.jp]

Figure 7d: Costs of ecosystem restoration



[Source: www.circleofblue.org]

Figure 8a: Roads in the Mongolian Steppe



[Source: www.suiri.tsukuba.ac.jp]

Roads in the steppe are often no more than sandy tracks. Drivers overtaking or passing other vehicles can go off the track and cause damage to the vegetation. Over time tracks become recolonized with vegetation.

An ecological study was undertaken to compare three tracks in the steppe. Two abandoned tracks were selected (Track B and Track C), which were in parallel next to the current track (Track A), to investigate the recovery of vegetation.

Each investigated track extended over 500m and was 2–3m in width. An additional site (D) was also investigated.

Figure 8b: Variation of soil hardness

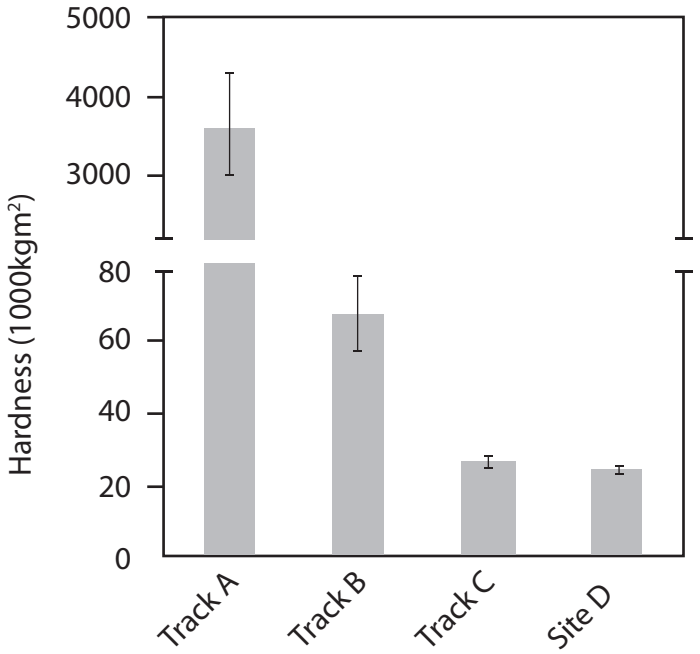
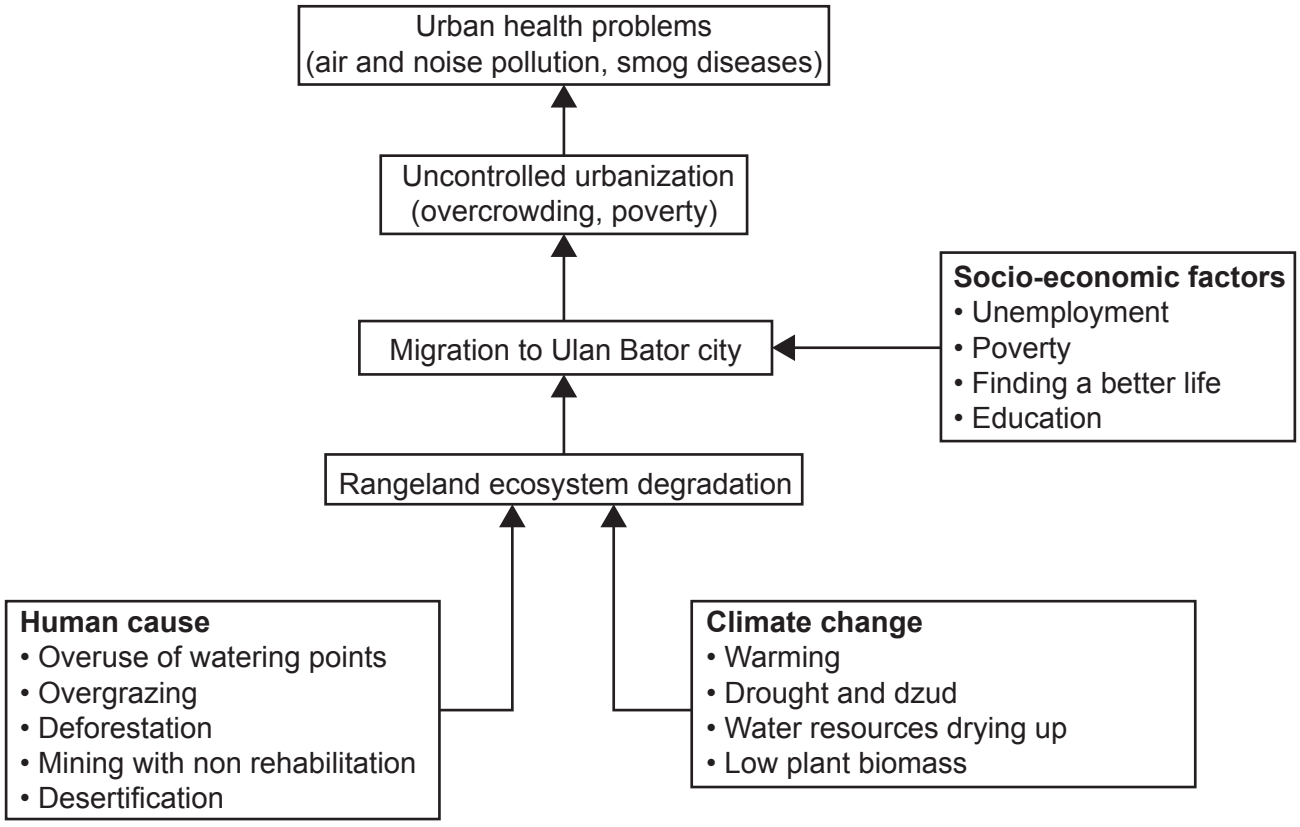


Figure 9: Environmental unsustainability in Mongolia



[Source: Davaanyam Surenjav "Dry rangelands degradation, migration, uncontrolled urbanization and urban health in mongolia" 2008]

Figure 10: Snow Leopard Trust

Snow leopard population:
- 500–1,000 (2nd largest population in the world).

Threats to snow leopards:
- poaching for trade in hides or bones
- revenge killing for livestock loss
- mining in snow leopard habitat.

Mission and conservation philosophy
The Snow Leopard Trust started working in Mongolia in 1992. It builds community partnerships by using science to determine priorities for protecting the endangered snow leopard:
- understanding snow leopard behavior and habitat
- listening to the community to identify needs
- seeking resources for sustaining long-term programs.

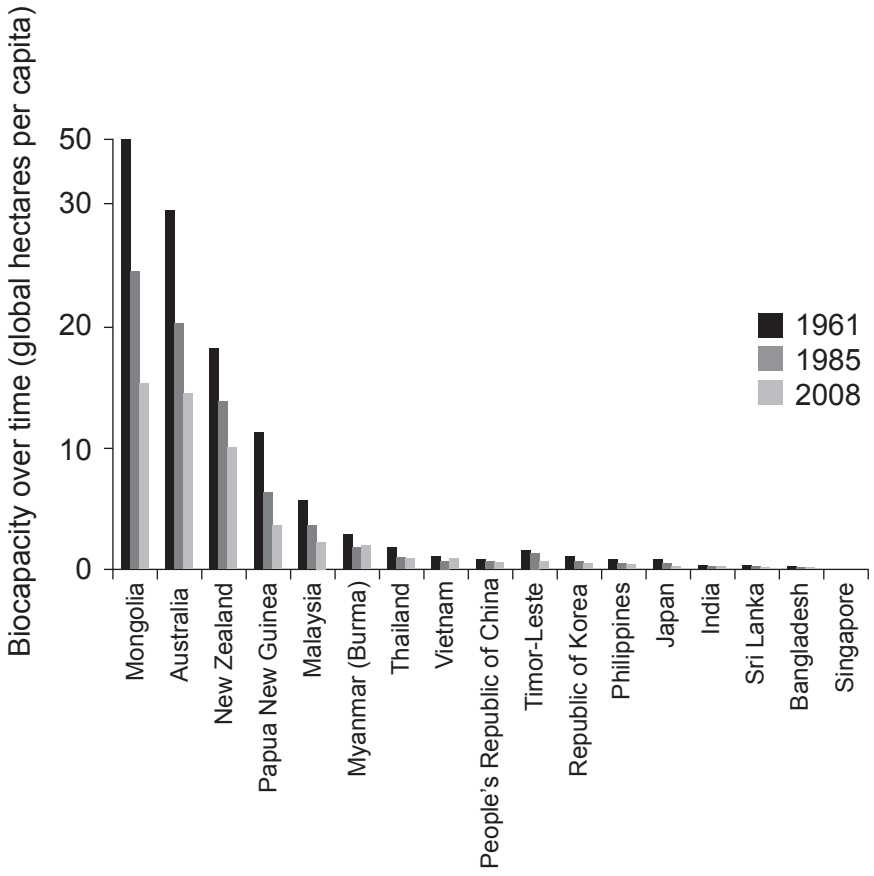
Conservation methods:
- snow leopard businesses (local women sell handmade snow leopard dolls to increase incomes)
- livestock Insurance (financial compensation given to herders who lose an animal to snow leopard predation)
- research center set up to study ecosystem
- cameras, satellite tracking, GPS tracking collars
- genetic research.

Landscape Focus Area: one landscape area (approximately 4000 km^2) where conservation and research efforts are focused.

[Source: © Snow Leopard Trust]

Figure 11: Biocapacity for different countries

Biocapacity can be defined as the amount of biologically productive land, measured in global hectares per capita.



[Source: http://assets.panda.org]

Diploma Programme
Programme du diplôme
Programa del Diploma

Markscheme

Specimen paper

Environmental systems and societies

Standard level

Paper 1

8 pages

General marking Instructions

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

2. Make sure that the question you are about to mark is highlighted in the mark panel on the right-hand side of the screen.

3. 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.**

4. Sometimes, careful consideration is required to decide whether or not to award a mark. In these cases use RM™ Assessor annotations to support 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.

5. Personal codes/notations are unacceptable.

6. Where an answer to a part question is worth no marks but the candidate has attempted the part question, enter a zero in the mark panel on the right-hand side of the screen. Where an answer to a part question is worth no marks because the candidate has not attempted the part question, enter an "NR" in the mark panel on the right-hand side of the screen.

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. RM™ Assessor will only award the highest mark or marks in line with the rubric.

8. Ensure that you have viewed **every** page including any additional sheets. Please ensure that you stamp "seen" on any page that contains no other annotation.

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.

Subject details: Environmental systems and societies SLP1 markscheme

Mark allocation

Candidates are required to answer **ALL** questions. Total = **[35]**.

1. Environmental systems and societies uses marking points to determine the achievement of candidates

i. A markscheme often has more marking points than the total allows. This is intentional

ii. Each marking point has a separate line and the end is shown by means of a semi-colon (;)

iii. 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**

iv. The order of marking points does not have to be as in the markscheme, unless stated otherwise.

2. Each marking point has a separate line and the end is shown by means of a semi-colon (;).

3. An alternative answer or wording is indicated in the markscheme by a slash (/). Either wording can be accepted.

4. Words in brackets ( ) in the markscheme are not necessary to gain the mark.

5. Words that are underlined are essential for the mark.

6. The order of marking points does not have to be as in the markscheme, unless stated otherwise.

7. If the candidate's answer has the same "meaning" or can be clearly interpreted as being of equivalent significance, detail and validity 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 **OWTTE** (or words to that effect).

8. Remember that many candidates are writing in a second language. Effective communication is more important than grammatical accuracy.

9. Occasionally, a part of a question may require an answer that is required for subsequent marking points. If an error is made in the first marking point then it should be penalized. However, if the incorrect answer is used correctly in subsequent marking points then **follow through** marks should be awarded. When marking, indicate this by adding **ECF** (error carried forward) on the script.

10. Do **not** penalize candidates for errors in units or significant figures, **unless** it is specifically referred to in the markscheme.

1. (a) desert / mountain / steppe / boreal forest; **[1 max]**

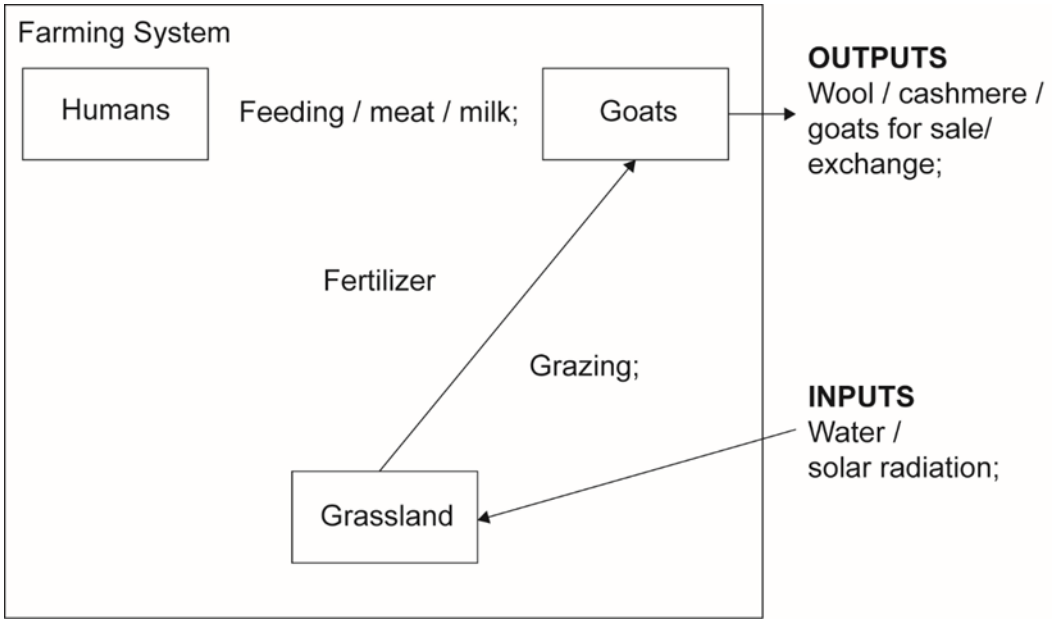
*Award **[1]** for any two.*

(b) species diversity *eg* 139 mammal species;
genetic diversity *eg* large population of snow leopards;
habitat diversity due to variation in climate/terrain;
habitat diversity leading to more niches/species diversity;
low human impact. *eg* small populations/ subsistence/nomadic lifestyles; **[2 max]**

2. (a) cold temperatures from October to April limit growing season;
limited annual rainfall /less than 250mm pa so insufficient water;
uneven distribution of rainfall throughout the year;
soil frozen/snow cover from October to March; **[2 max]**

(b) wind speeds increase in April and stay high until the end of June, so loose layers of soil can be blown away;
the soil also starts to defrost in April so it is more likely to undergo weathering;
levels of vegetation are low as spring growth has not started;
although snow has melted, soil will be quite dry because precipitation over the preceding months is low;
the dry soil is exposed in April and so erosion is likely at this time of year; **[2 max]**

3. (a) **[1 max]**



(b) **[1 max]**

*Award **[1]** for a valid input correctly labelled (outside box) and a valid output correctly labelled (outside box).*

*Award **[1]** for two correctly labeled flows between storages.*

4. ***Strengths:***
increasing temperature in figure 6a supports Climate change;
data produced by an official source (Meteorological Office);
data collected over 70 years;
the change in rate of increase supports human cause / matches global pattern;
only one year in the past 10 has had higher than normal rainfall;

Weaknesses:
significant change in temperature is only recent/last 20 years;
no discernible trend/cyclical pattern in precipitation;
apparent trend in temperature could be due to natural fluctuations/cycles;
errors in data collection/short survey period/limited survey area increases margin of error; **[4 max]**

*Award **[3 max]** for strengths.*
*Award **[3 max]** for weaknesses.*

5. (a) settled pastoralism is associated with degradation of soil/reduced pasture; **[1]**

(b) degraded pasture support fewer animals;
price of meat is higher so smaller herds yield same profits;
insufficient space for large herds;
farmers supplementing income from other sources/alternative employment;
livestock have to be accommodated in barns; **[2 max]**

6. (a) base line study/control/to compare with the others/to see what Steppe looks like when not degraded; **[1]**

(b) A is more compacted/harder than C;
A will have less aeration than C;
A is drier/holds less water than C;
A is more exposed to wind than C;
A is likely to have lower organic content/lower fertility than C; **[1 max]**

*Award **[1]** for any two differences.*

6. (c) (i) succession; **[1]**

(ii) increases of levels of vegetation;
cause an increase in soil aeration;
decaying vegetation improves the soil fertility;
the soil and vegetation provide habitats for other organisms;
leading to increased biodiversity; **[3 max]**

7. (a) iconic species/easily recognized/ beautiful/likely to attract media attention;
could be a keystone species;
species faces a variety of different threats;
threats may be increasing (*eg* Due to Climate change/population pressure);
Mongolia has the second largest population and it still has only 500–1000 individuals left; **[2 max]**

(b)

Value system	**Features**
anthropocentric	trust believes humans must sustainably manage the ecosystem; their approach is practical (pragmatic) *eg* Increasing snow leopard enterprises / livestock insurance;
technocentric	they believe that technological developments can provide solutions to environmental problems *eg* GPS tracking to monitor leopards; trust's approach is optimistic about the role humans can play in improving the situation; scientific research is encouraged in order to form policies and understand leopard depletion;

[2 max]

8. since 1961 Mongolia's biocapacity has dropped from 50 Global hectares per capita to 24 in 1985 and only 15 by 2008;
by 2008 it had dropped to less than a third of its 1961 value;
soil erosion has reduced biocapacity;
this is partly caused by climate change;
but is also caused by overgrazing as livestock become concentrated close to urban areas; **[3 max]**

9. *Answers may include:*

- it has high habitat diversity including several biomes / *eg* from desert to tundra (Fig 1b or 2);
- low human population that has limited human impact on the systems (Fig 2);
- human population live subsistence lifestyles that have relatively low impact globally (Fig 5);
- a significant percentage of area is protected (Fig 2);
- it has endemic/unique species / that cannot be protected elsewhere (Fig 4);
- it has the second largest population of Snow Leopard in the world (Fig 13);
- it has the highest biocapacity in Asia (Fig 10);
  ...but it is a fragile system due to its climatic extremes (Fig 3);
- and is under threat from climate change/overgrazing/wind erosion/urbanization/mineral extraction (Fig 5/6/7);
  ...but would be relatively cheap to restore (Fig 7d);
  ...and might be relatively easy to conserve/protect due to subsistence culture;

[6 max]

Examination code

				–				

Diploma Programme
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Environmental systems and societies
Standard level
Paper 2

Specimen paper

Candidate session number

2 hours

Instructions to candidates

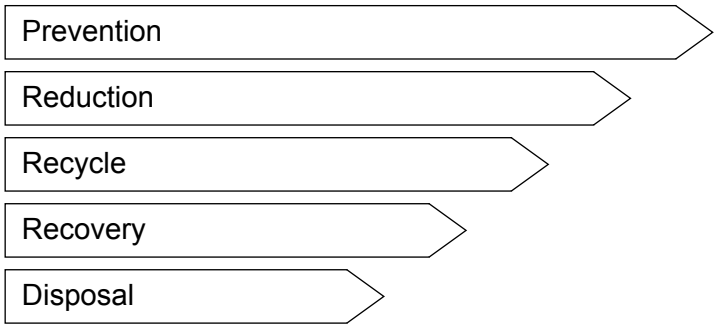
- Write your session number in the boxes above.
- Do not open this examination paper until instructed to do so.
- Section A: answer all questions.
- Section B: answer **two** questions.
- Write your answers in the boxes provided.
- A calculator is required for this paper.
- The maximum mark for this examination paper is **[65 marks]**.

Section A

1. The United Nations Environment Programme (UNEP) have suggested the following hierarchy (order of preference) for waste management strategies.

Figure 1

Waste management hierarchy



[Source: UNEP, 2011. Green Economy Report]

(a) Outline **two** reasons why the UNEP prefers reduction over recycling as a waste management strategy. **[2]**

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. . . . . .
. . . . . .
. . . . . .

(b) Describe **two** ways in which government policy makers can promote the more preferred methods of waste management. **[2]**

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(Question 1 continued)

(c) State **one** advantage and **one** disadvantage of a named method of "disposal" in the management of urban waste. **[2]**

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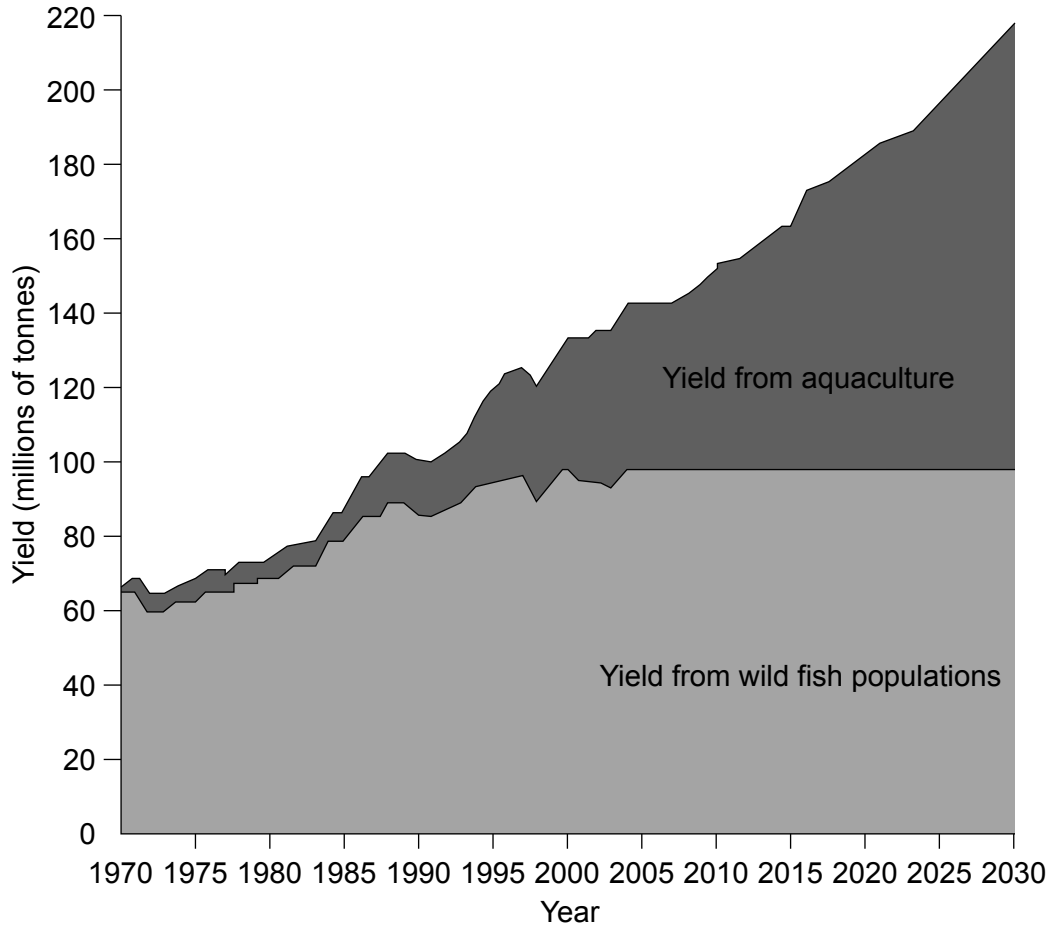
2. **Figure 2** shows actual and projected global yields from harvesting wild fish populations and fish from aquaculture 1970–2030.

Figure 2



[Source: www.futuretimeline.net]

(This question continues on the following page)

(Question 2 continued)

(a) Calculate the increase in fish yield between 1970–2010 from wild populations, and from aquaculture.

(i) Increase in yield from wild populations. **[1]**

. . . . . .
. . . . . .

(ii) Increase in yield from aquaculture. **[1]**

. . . . . .
. . . . . .

(b) Outline **two** possible reasons for the different rates of increase in fish yield from aquaculture and wild populations over the period 1970–2010. **[2]**

. . . . . .
. . . . . .
. . . . . .
. . . . . .

(c) Outline **two** possible environmental impacts of the predicted growth in aquaculture. **[2]**

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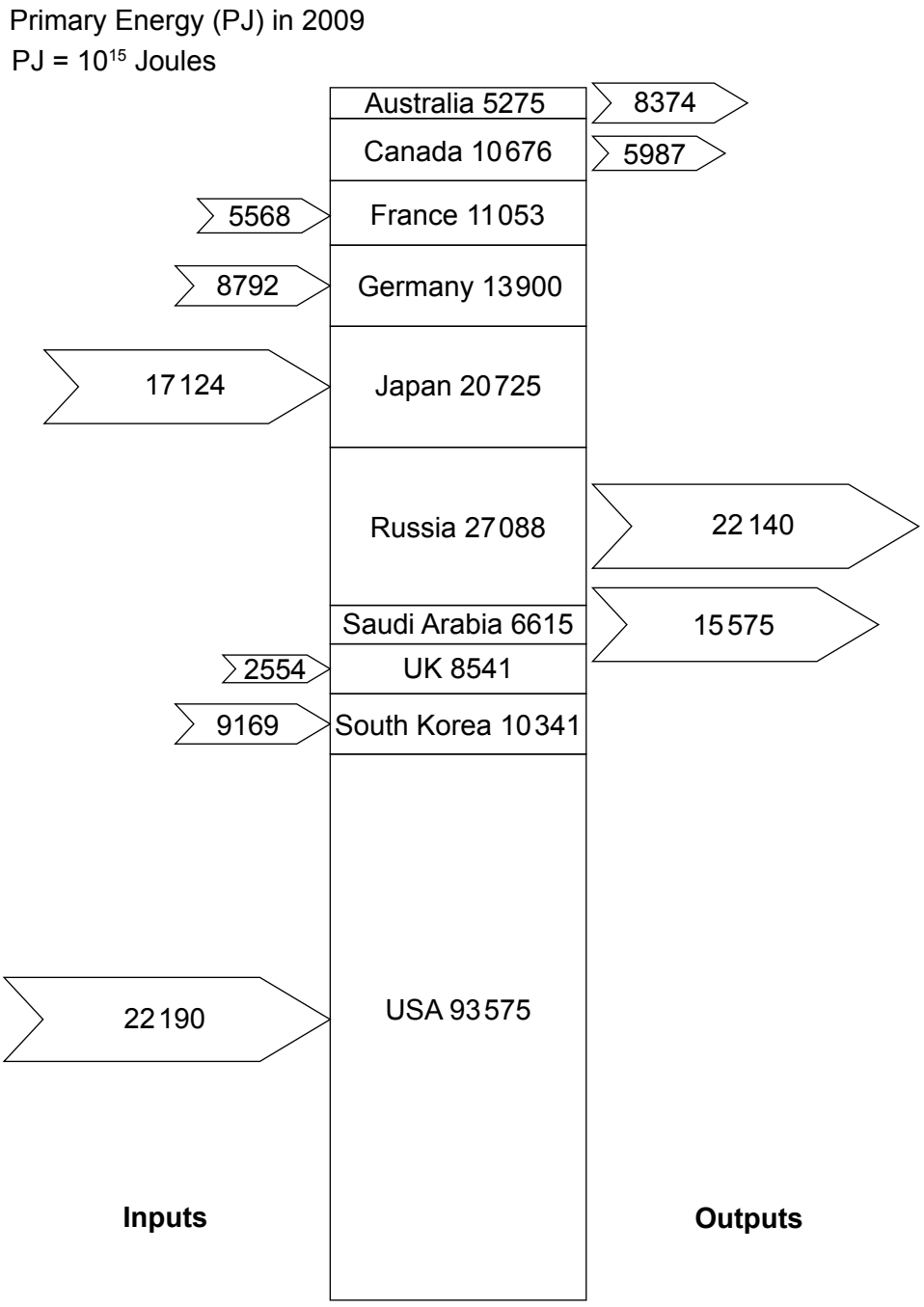
3. **Figure 3** shows the net import or export of primary energy for a variety of countries in the year 2009.

Figure 3



[Source: www.world-nuclear.org]

(This question continues on the following page)

(Question 3 continued)

(a) Outline how the data might be relevant to the energy security of a particular country. **[1]**

. . . . . .
. . . . . .

(b) From **Figure 3**, identify **one** country likely to have relatively high energy security, and **one** likely to have relatively low energy security. **[1]**

High energy security:

. . . . . .

Low energy security:

. . . . . .

(c) State **one** other factor, besides the net import or export of energy, that influences the energy security of a country. **[1]**

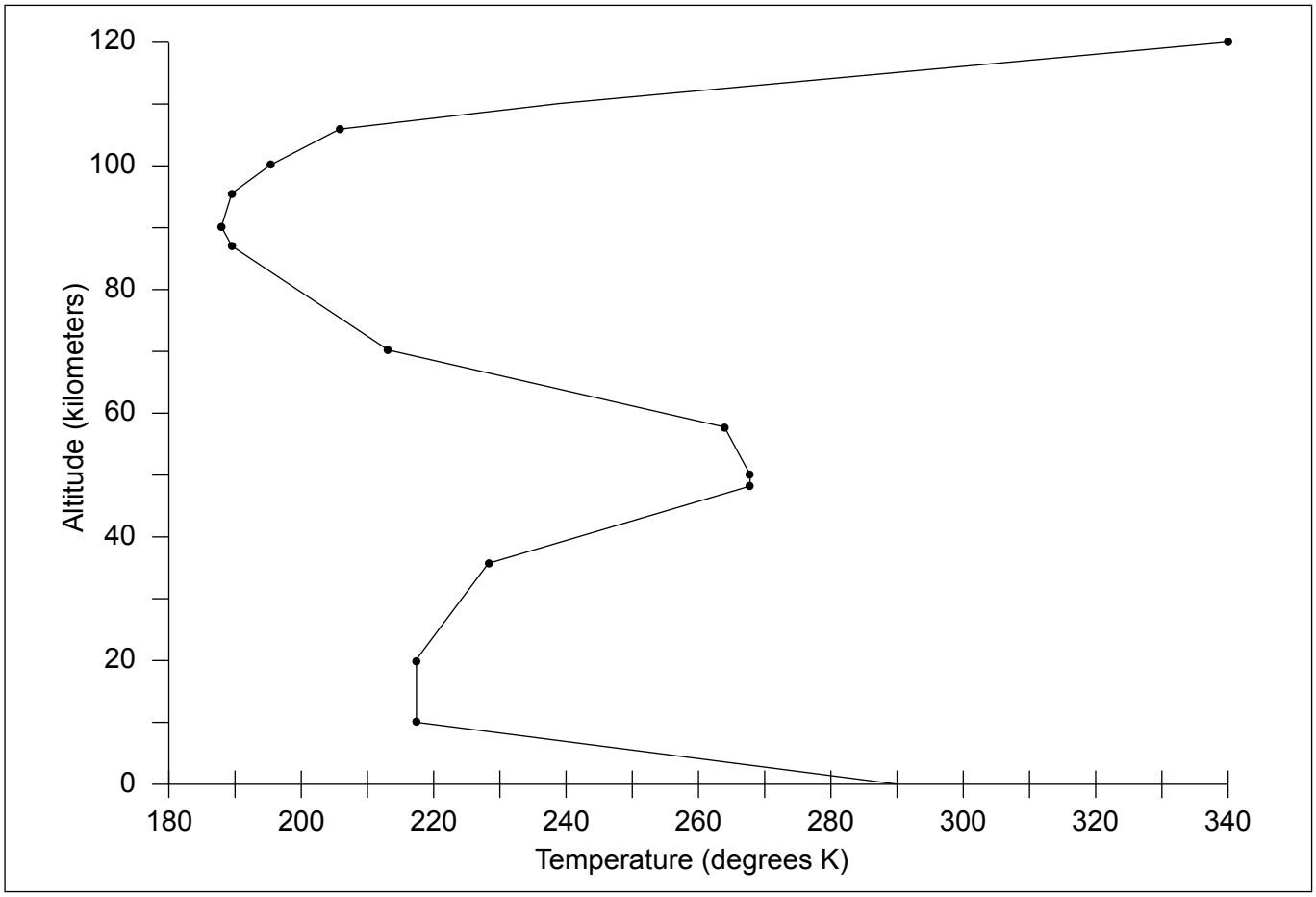
. . . . . .
. . . . . .

Please **do not** write on this page.

Answers written on this page
will not be marked.

4. **Figure 4** illustrates the change in temperature with altitude within the earth's atmosphere.

Figure 4



[Source: www.nature.com]

(a) Draw **two** lines on **Figure 4** to show the upper and lower boundaries of the stratosphere. **[2]**

(b) Outline how human activities may influence the concentration of ozone:

(i) in the troposphere. **[1]**

. . . . . .
. . . . . .

(ii) in the stratosphere. **[1]**

. . . . . .
. . . . . .

5. **Figure 5** shows three systems that have reached a tipping point resulting in a shift of their equilibrium from A to B:

Figure 5

	System		
	Great Barrier Reef, Australia	**Chobe National Park, Botswana**	**River Bure, England**
Equilibrium A:	Coral reef ecosystem	Woodland	Clear water; submerged macrophytes; abundant fish.
Equilibrium B:	Bleached, and possibly dead coral	Grassland	High densities of phytoplankton; few fish.
Influence leading to tipping point:	Climate change / increased global temperature	Increased elephant populations	
Time scale of Change:	Days	Years	Months
Ecological impacts:		Loss of woodland leads to changes in populations of other large herbivores and loss of habitat diversity.	Low dissolved oxygen; loss of species diversity.
Social impacts:		Changes in population of visible herbivores impacts values for ecotourism.	Reduced tourism and recreational fishing.

[Source: www.resalliance.org]

(a) Outline what is meant by a tipping point. **[1]**

. . . . . .
. . . . . .

(b) Suggest **one** social and one ecological impact that might arise from the equilibrium shift in the Great Barrier Reef system. **[2]**

. . . . . .
. . . . . .
. . . . . .
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(This question continues on the following page)

(Question 5 continued)

(c) Identify **one** influence that might be causing the River Bure system to reach a tipping point. **[1]**

. . . . . .
. . . . . .

(d) Describe how the process of succession in Chobe National Park is influenced by the elephant populations. **[2]**

. . . . . .
. . . . . .
. . . . . .
. . . . . .

Section B

Answer **two** questions. Write your answers in the boxes provided.

6. (a) Outline the role of ocean circulation in the distribution of heat around the world. **[4]**

(b) Explain how climate affects the productivity of ecosystems around the world. **[7]**

(c) To what extent have human societies contributed both to the problem and the solution of water scarcity around the world? Justify your response with the help of named examples. **[9]**

7. (a) Outline the role of environmental indicators in assessing sustainability. **[4]**

(b) Explain how conservation strategies may help increase the resilience of protected areas. **[7]**

(c) With reference to named examples, discuss the challenges facing human societies in managing the sustainability of tropical biomes. **[9]**

8. (a) Outline how the reasons for food wastage may differ between human societies. **[4]**

(b) Explain how the choice of food production system may influence the ecological footprint of a named human society. **[7]**

(c) Discuss how different environmental value systems influence responses to the human population growth rate. **[9]**

9. (a) Outline **two** advantages and **two** disadvantages of using a named indirect method of monitoring pollution in the environment. **[4]**

(b) Explain how the pyramid structure of food chains can influence the impact of non-biodegradable toxins on an ecosystem. **[7]**

(c) Climate change may be addressed at the level of preventing the causes of impact (mitigation) and limiting the extent of impact (adaptation). Evaluate the relative advantages of mitigation and adaptation with the help of named examples. **[9]**

Diploma Programme
Programme du diplôme
Programa del Diploma

Markscheme

Specimen paper

Environmental systems and societies

Standard level

Paper 2

22 pages

Examiners should be aware that in some cases, candidates may take a different approach, which if appropriate should be rewarded. If in doubt, check with your team leader.

In the case of an "identify" question read all answers and mark positively up to the maximum marks. Disregard incorrect answers. In all other cases where a question asks for a certain number of facts *eg* "describe two kinds", mark the **first two** correct answers. This could include two descriptions, one description and one identification, or two identifications.

It should be recognized that, given time constraints, answers for part (c) questions are likely to include a much narrower range of issues and concepts than identified in the markband. There is no "correct" answer. Examiners must be prepared to award full marks to answers which synthesize and evaluate even if they do not examine all the stimulus material.

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

2. Make sure that the question you are about to mark is highlighted in the mark panel on the right-hand side of the screen.

3. Sometimes, careful consideration is required to decide whether or not to award a mark. In these cases use RM™ Assessor annotations to support 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. Where an answer to a part question is worth no marks but the candidate has attempted the part question, enter a zero in the mark panel on the right-hand side of the screen. Where an answer to a part question is worth no marks because the candidate has not attempted the part question, enter an "NR" in the mark panel on the right-hand side of the screen.

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

7. Ensure that you have viewed **every** page including any additional sheets. Please ensure that you stamp "seen" on any page that contains no other annotation.

8. 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.

Subject details: Environmental systems and societies SLP2 Markscheme

Mark allocation

Candidates are required to answer:
- **ALL** questions in Section A **[25]** and **TWO** questions in Section B **[40]**.
- The maximum total = **[65]**.

1. Environmental systems and societies uses marking points and markbands to determine the achievement of candidates

When using marking points (<u>All of this paper except</u> Section B, part c questions):

i. A markscheme often has more marking points than the total allows. This is intentional
ii. Each marking point has a separate line and the end is shown by means of a semi-colon (;)
iii. Where a mark is awarded, a tick/check (;) **must** be placed in the text at the **<u>precise point</u>** where it becomes clear that the candidate deserves the mark. **<u>One tick to be shown for each mark awarded</u>**
iv. The order of marking points does not have to be as in the markscheme, unless stated otherwise.

When using Markbands (<u>Only</u> for Section B, part c questions):

i. Read the response and determine which band the response fits into
ii. Then re-read the response to determine where the response fits within the band
iii. Annotate the response to indicate your reasoning behind the awarding of the mark **Do not use ticks at this point**
iv. Decide on a mark for the response
v. At the end of the response place the required number of ticks to enable RM Assessor to input the correct number of marks for the response.

2. An alternative answer or wording is indicated in the markscheme by a slash (/). Either wording can be accepted.

3. Words in brackets ( ) in the markscheme are not necessary to gain the mark.

4. Words that are <u>underlined</u> are essential for the mark.

5. If the candidate's answer has the same "meaning" or can be clearly interpreted as being of equivalent significance, detail and validity 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 **OWTTE** (or words to that effect).

6. Remember that many candidates are writing in a second language. Effective communication is more important than grammatical accuracy.

7. Occasionally, a part of a question may require an answer that is required for subsequent marking points. If an error is made in the first marking point then it should be penalized. However, if the incorrect answer is used correctly in subsequent marking points then **follow through** marks should be awarded. When marking, indicate this by adding **ECF** (error carried forward) on the script.

8. Do **not** penalize candidates for errors in units or significant figures, **unless** it is specifically referred to in the markscheme.

Section A

1. (a) Outline **two** reasons why the UNEP prefers reduction over recycling as a waste management strategy. **[1]**

recycling can be expensive / reduction is cheaper;
recycling requires significant energy input / reduction reduces energy needed for production;
reduction reduces initial use of resources/raw materials / recycling only reduces later/further use;
recycling may require community support / reduction can be achieved centrally through production/manufacture;

*Award **[1]** for each correct reason outlined, up to **[2 max]**.*

(b) Describe **two** ways in which government policy makers can promote the more preferred methods of waste management. **[2]**

government policy to set waste reduction/recycling targets;
legislation to implement waste reduction policy;
economic tools/financial incentives/financial penalties (*eg* green taxes) to encourage businesses/factories to reduce waste generated;
encourage reuse/recycling at domestic level through provision of recycling banks/pick up services;
financial incentives/subsidies to encourage set up/development of recycling companies to use collected materials;
increase cost of disposal *eg* landfill tax (to make it less attractive/last option);

*Award **[1]** for each correct way* in which government *policy makers can promote the more preferred methods of waste management described, up to **[2 max]**.*
Accept other reasonable responses.

(c) State **one** advantage and **one** disadvantage of a named method of "disposal" in the management of urban waste. **[2]**

Waste disposal route	**Incineration**	**Landfill**	**Disposal at sea**
Advantages	can be used to generate energy/electricity produced can be fed into the grid/ reduces volume of waste to be landfilled/ash can be used as a building material;	relatively cheap/ easy disposal route/methane produced can be used to generate energy/can be used to create land;	relatively cheap/easy disposal route;
Disadvantages	high building cost/ atmospheric pollution/release of dioxins/production of ash which needs disposal;	limited suitable landfill sites/ production of toxic/explosive landfill gas/production of leachates which may contaminate groundwater or watercourses/ unpleasant odours/increases vermin/ potential of future subsidence of land;	detrimental effect on marine life/waste smoothers organisms on the sea bed/degradation of waste reduces oxygen levels/wildlife can become tangled/poisoned with the waste;

*Award **[1 max]** for a correct advantage stated and **[1 max]** for a correct disadvantage stated.*

2. (a) (i) Increase in yield from wild populations. **[1]**

96 – 64 = 32 million tonnes;

Accept answers between 30–34 million tonnes.

(ii) Increase in yield from aquaculture. **[1]**

fish farmed in 2010 = 148 – 96 = 52
fish farmed in 1970 = 66 – 64 = 2
52 – 2 = 48 million tonnes;

Accept answers between 46–52 million tonnes.
Allow alternative valid calculation.

(b) Outline **two** possible reasons for the different rates of increase in fish yield from aquaculture and wild populations over the period 1970–2010. **[2]**

wild yield may be limited due to overfishing/unsustainable harvesting/depleted wild stocks;
…or due to stricter regulations on fishing activity;
…or due to economic competition from fish farming;
farming yield has increased due to increasing demand from growing population;
…and/or decreasing provision from wild catch;
…or due to technological development making farming more efficient;

*Award **[1]** for each correct reason identified and [1] for a development of the reason identified, up to **[2 max]**.*
Accept other reasonable responses.

(c) Outline **two** possible environmental impacts of the predicted growth in aquaculture. **[2]**

Pesticide / kill pests/insects / control malaria ***OWTTE***;
(pesticide with OWTTE might be fine)

eutrophication from fish waste;
genetic degradation of wild populations from escapees;
depletion of wild stocks to provide fish feed;
depletion of water bodies to supply farms;
habitat loss/disturbance in construction of farms;
pollution from pesticides/pharmaceuticals used in farming;
organic pollution from fish feed;

*Award **[1]** for each correct impact identified and **[1]** for a development of the reason identified, up to **[2 max]**.*
Accept other reasonable responses.

3. (a) Outline how the data might be relevant to the energy security of a particular country. **[1]**

countries with net import of energy are likely to have lower independence/security / those with no net import are likely to be more independent/secure;

(b) From Figure 3, identify **one** country likely to have relatively high energy security, and **one** likely to have relatively low energy security. **[1]**

higher security *eg* Australia/Canada/Russia/Saudi Arabia and lower security *eg* any other;

(c) State **one** other factor, besides the net import or export of energy, that influences the energy security of a country. **[1]**

reliability of supply / affordability of supply / suitability of supply to infrastructure;

4. (a) Draw **two** lines on **Figure 4** to show the upper and lower boundaries of the stratosphere. **[2]**

Award **[1]** for lower boundary at 10 km;
Award **[1]** for upper boundary 50 km;

Allow 2 km margin of error.

(b) (i) Outline how human activities may influence the concentration of ozone: in the troposphere. **[1]**

burning of fossil fuels have increased O_3 in localised regions of troposphere;

Accept answers between 30–34 million tonnes.

(ii) in the stratosphere. **[1]**

release of ozone depleting gases *eg* CFCs have reduced O_3 in stratosphere;

5. (a) Outline what is meant by a tipping point. **[1]**

a tipping point is a degree of change within a system that will destabilise it, causing it to adopt a new equilibrium (***OWTTE***);

(b) Suggest **one** social and **one** ecological impact that might arise from the equilibrium shift in the Great Barrier Reef system. **[2]**

Social: reduced tourism / reduced storm protection / reduced food availability/fishing;
Ecological: reduced biodiversity / reduced carbon fixation (by coral structures);

*Award **[1]** for a social impact arising from the ecological shift and **[1]** for an ecological impact from an ecological shift, up to **[2 max]**.*

(c) Identify **one** influence that might be causing the River Bure system to reach a tipping point. **[1]**

higher concentrations of phosphate / nitrate / increase in untreated water/sewage / increase in fertilisers;

(d) Describe how the process of succession in Chobe National Park is influenced by the elephant populations. **[2]**

by the elephants feeding on trees;
…they inhibit/prevent the process of succession leading to a woodland climax;
…and maintain a sub-climactic/plagioclimax community of grassland;
…*ie* maintain an alternative stable state to the system;

*Award **[1]** for each correct description given, up to **[2 max]**.*

Section B

6. (a) Outline the role of ocean circulation in the distribution of heat around the world. **[4]**

ocean circulation systems are driven by differences in temperature and salinity that affect water density;
the resulting difference in water density drives the ocean conveyor belt;
which distributes heat around the world;
heating of oceans at the equator generates heat which is transferred to cooler climates in the northern and southern hemispheres;
eg North Atlantic Drift moves warm water from Gulf of Mexico to Western Europe, ameliorating the climate;
cold water may also move to warmer areas, cooling the climate;
eg Labrador Current cools NE USA;

*Award **[1]** for each correct role outlined, up to **[4 max]**.*

(b) Explain how climate affects the productivity of ecosystems around the world. **[7]**

the conversion of energy into biomass (for a given period of time) is measured as productivity;
energy capture during photosynthesis is partially determined by limiting factors of water, light and temperature;
energy available to an ecosystem is ultimately determined by the amount of energy captured and converted by autotrophs/plants;
the tricellular model of atmospheric circulation explains the distribution of precipitation and temperature;
this influences the structure and relative productivity of different terrestrial biomes;
when solar radiation (insolation) and precipitation are not limiting, productivity is very high;
tropical rainforests have the highest (terrestrial) levels of productivity due to this reason;
when solar radiation is abundant but precipitation is low, *eg* deserts, productivity is low;
low temperatures, usually associated with low insolation, limit productivity, *eg* tundra;
climate change is altering the distribution of biomes and thus their productivity;

*Award **[1]** for each correct explanation, up to **[7 max]**.*

(c) To what extent have human societies contributed both to the problem and the solution of water scarcity around the world? Justify your response with the help of named examples. **[9]**

Answers may include:

What is the problem?:
- freshwater resources are a finite, though a technically renewable resource
- Inequitable availability of water arises from economic/social/political factors
- this may be for the majority of a society, *eg* Afghanistan
- costs of extraction/political conflicts/government provision/infrastructure cause inequitable availability of water to certain social groups
- *eg* Bangladesh
- some cities with large populations in slums there is a large disparity in access to clean water, *eg* Delhi
- in some countries there is a marked difference in the distribution of water between rural and urban populations, *eg* The Democratic Republic of Congo
- whereas uneven distribution arises from climatic/topographical/geographical factors
- *eg* rainfall/freshwater basins vary geographically causing uneven distribution
- *eg* South vs North England / South vs North Spain / North vs South China
- some countries may suffer both a physical and economic scarcity of water, *eg* Somalia
- some countries may have an abundance of freshwater resources but an economic scarcity of water, *eg* The Democratic Republic of Congo

How do societies contribute to the problem?:
- over-extraction of water for irrigation in agriculture can amplify water scarcity
- *eg* Yemen for khat production / Ogallala aquifer in Great Plains of USA
- over-extraction of water for hydraulic fracturing (fracking) can result in local water shortages
- fracking procedures can also result in contamination of the water sources, reducing water availability
- deforestation or changes in land-use can result in water not being able to recharge aquifers as water runs off surface too quickly
- this can also be as a result of poor farming practices where land is left ploughed but unplanted over winter
- urbanisation changes water flow and can result in less water infiltration into ground to recharge aquifers
- it can also lead to flash floods as drains are unable to cope with heavy rainfall and thus increased surface runoff
- a lack of infrastructure for sanitation can lead to water contamination
- *eg* India
- poor enforcement of environmental regulations can also lead to contamination from industrial sources or artisanal mining
- *eg* mercury used in artisanal gold mining
- *eg* China's waterways are often heavily polluted from uncontrolled industrial effluent
- *eg* Virginia contamination from leaking storage container limited access to fresh safe water for over 300 000 people
- bore wells drilled into unsuitable geology can result in natural contamination from arsenic
- *eg* Bangladesh

- rapid population growth may result in a trend to physical or economic water scarcity
- *eg* Sub-Saharan Africa
- climate change will change the availability of water around the world
- increased severe weather may result in water contamination through flooding and mixing of sewage
- *eg* Thames Valley, UK / Hurricane Sandy / Katrina in USA
- increased seasonal snow and glacier melt may change water availability in alpine regions
- *eg* Switzerland
- rising sea levels will lead to salt water intrusion of fresh water in Pacific atoll islands
- changing seasonal rainfalls may increase drought in some regions
- *eg* sub-Saharan Africa / Mid-West of USA

How do societies provide solutions?

- In democratic societies, political pressure from population may result in regime change and change in policies
- *eg* Delhi
- in areas of the world with shared freshwater resources there may be potential for conflict over inequitably but can be solved with discussion and agreements
- *eg* Indus Water Agreement between India and Pakistan
- some large countries may try to solve this challenge of regional physical scarcity with large infrastructure projects, *eg* China, Spain
- countries can enhance water availability through the use of technology, *eg* reservoirs, desalination, artificial recharge of aquifers
- some societies may choose to increase water efficiency
- *eg* variable flush toilets / aerated taps and shower heads
- regulation and laws can enforce water metering and cap water use
- *eg* hosepipe bans
- low-technology solutions such as rainwater harvesting schemes

Please see markband on page 22

7. (a) Outline the role of environmental indicators in assessing sustainability. **[4]**

actors such as biodiversity, pollution, population or climate may be used quantitatively as environmental indicators of sustainability;
the Millennium Ecosystem Assessment is an example of the use of environmental indicators on a global scale;
the Vancouver Greenest City 2020 Action Plan / Seoul's "One Less Power Station" is an example of the use of environmental indicators on a local scale;
a community makes an evaluation of which factors upon which it would like to focus and makes a baseline evaluation;
strategies are then developed (short, medium and long term) to improve upon the indicators;
at fixed time points the indicators are re-measured and the strategies evaluated;

*Award **[1]** for each correct role outlined, up to **[4 max]**.*

(b) Explain how conservation strategies may help increase the resilience of protected areas. **[7]**

Defining the problem:
the resilience of a system refers to its tendency to avoid tipping points and maintain stability;
diversity and the size of storages within systems can contribute to their resilience / affect the speed of response to change (time lags);
humans can affect the resilience of systems through changing the size of storages and diversity;

Conservation strategies:
reducing habitat fragmentation through promotion of conservation corridors can increase resilience to environmental change
this allows increases in population sizes of organisms / increases in effective genetic diversity
improving agricultural practices can enhance ecosystems through increased insect diversity and thus food web complexity
improved agricultural practices such as low till agriculture can increase carbon stores in the soil and thus resilience to climate change
mitigation strategies to improve carbon stores in natural ecosystems can also help reduce impact of climate change
slowing climate change allows organisms time to adapt or migrate
strategies to increase biodiversity such as increasing habitat diversity will increase the resilience of a system
restoring habitats (ecorestoration) can enhance the resilience of a system
eg restoration of Florida Everglades through undoing the channelization of the Kissimmee River has improved the resilience of this system to flooding and improved diversity
removal of invasive species helps ecosystems become more resilient through increase biodiversity
eg removal of rats from South Georgia

*Award **[1]** for each correct explanation, up to **[7 max]**.*

(c) With reference to named examples, discuss the challenges facing human societies in managing the sustainability of tropical biomes. **[9]**

Answers may include:

Defining the problem:

- sustainable development is socio-economic progress that does not compromise future generations' needs
- sustainability is the use and management of resources that allows full natural replacement of the resources exploited and full recovery of the ecosystems affected by their extraction and use.
- tropical biomes contain some of the most globally biodiverse areas
- tropical biomes contain vast resources of renewable natural capital
- unsustainable exploitation results in massive losses in biodiversity and the ability to perform globally important ecological services
- most tropical biomes occur in less economically wealthy or rapidly growing economic areas of the globe
- therefore, there is conflict between exploitation, sustainable development and conservation
- there is conflict between the improvement of people's standard of living, *eg* provision of electricity, health care, education provision, and conservation of habitats
- demand in economical developed countries can also exacerbate unsustainable development in tropical biomes

Challenges and solutions:

- tropical biomes contain vast areas of land for changing land use which provide opportunities for economic development
- *eg* demand for palm oil has led to loss of vast areas of Indonesian rainforest
- these resources can be used sustainably or unsustainably but if used beyond its natural income this use becomes unsustainable
- if tropical areas are to be developed sustainably, strategies must be in place to monitor the rate of use of the resources
- an inability to police environmental legislation can lead to a lack of sustainable development / loss of habitats
- corruption can lead to a lack of sustainable development even when planned for
- community involvement in projects can aid sustainable development
- environmental indicators can be used to assess this sustainability
- environmental Impact Assessments can also play an important role in sustainable development
- international agreements such as REDD+ can assist tropical areas to conserve forests
- FSA certification can also assist in the monitoring and management of tropical forests
- countries which are implementing the monitoring of supply chains to investigate the impact of resource exploitation may be able to assist in development of sustainable practices
- *eg* pressure from Friends of the Earth has led Samsung and Apple to investigate the sourcing of Tin for use in mobile phones
- these companies then place economic pressure (and support) on local governments to exploit the resource in an environmentally sound manner
- countries may take decision to promote eco-tourism as a way of preserving tropical biomes
- *eg* Costa Rica

- societies need to carefully plan energy needs to avoid fossil fuel exploitation and increase portion of renewable energy
- India may be the first country to skip the fossil fuel stage and move straight to wind and hydropower as major energy sources
- Brazil is a major user of biofuels for energy production
- Columbia has promoted a move to sustainable cities with large public transport infrastructure and promotion of foot and bicycle power
- many Latin American countries and moving towards a higher HDI while retaining a low ecological footprint

Please see markband on page 22

8. (a) Outline how the reasons for food wastage may differ between human societies. **[4]**

Rich countries:
supermarkets' drive for fruit and veg that are uniform in shape, size and colour;
supermarkets pre-packaging fruit and veg so that consumer loses control of amounts bought;
food processing places "consume by" date, beyond which food must be disposed of;
consumers buying too much food and then wasting it;

Less-wealthy countries:
poor infrastructure so food cannot be delivered in a timely manner to markets;
lack of refrigeration facilities means food rots before reaching market or consumer;
lack of knowledge of markets with best prices or demand and so food not sold;

*Award **[1]** for each correct reason outlined, up to **[4 max]**.*

(b) Explain how the choice of food production system may influence the ecological footprint of a named human society. **[7]**

Defining the problem:
named Society with an associated style of food production;
EF is the area of land and water required to support a defined human population at a given standard of living. (The measure takes into account of the area required to provide all the resources needed by the population, and the assimilation of all wastes.);

Food production system impacts:
comment on the productivity of the land available to the society;
comment on the type of (food) consumption common in the society *ie* food miles;
comment on type of food production – amount of input required to system *eg* chemical fertilizers / machinery – oil increases footprint;
comment on particular features of food production system, *eg* no-till agriculture increases carbon stores;
comment on amount of meat eaten – increases footprint;
comment on population size and per capita consumption;

*Award **[1]** for each correct explanation, up to **[7 max]**.*

(c) Discuss how different environmental value systems influence responses to the human population growth rate. **[9]**

Answers may include:

Ecocentric / Deep/Soft-Ecologists:
- role of personal (and society's) behavior / Role of education/ Less materialistic society / Spirituality may mean values of environmental protection embedded in society, *eg* Bhutan / Need to put nature's needs at a higher priority / biorights / Need to rethink economic growth as continual need for use of resources
- probably sees human population growth as a negative impact on the Earth
- would thus promote education of women as strategy to reduce human population growth
- would promote self-restraint in family size
- would promote international collaboration to support countries in meeting the Millenium Development Goals and thus reduce population growth

Anthropocentric / Environmental Manager:
- sustainably manage the global system / use of taxes / use of regulation and legislation / debate would be encouraged to reach a consensus to solving population challenges
- probably sees human population growth as a problem that needs tackling
- also promotes international collaboration to reduce population growth
- may impose national legislation to control population growth
- *eg* China's one child policy
- many societies implement policies to encourage or disincentivise pregnancies and children
- *eg* tax breaks for families

Technocentric / Cornucopian:
- technological developments can provide solutions to environmental problems / role of human ingenuity in improving the lot of humanity / scientific research is encouraged / emphasis on how systems can be controlled, manipulated or exchanged to solve problems / A pro-growth agenda is deemed necessary for society's improvement
- population growth may be seen as a way of supporting economic growth
- if population is deemed to need controlling then technological innovations may be promoted including use of contraception
- population growth seen as less of a problem as new technologies may support a growing population
- as Esther Boserup demonstrated in her work on agricultural innovation in primitive societies with growing populations
- promote scientific research to support a growing population
- *eg* growing meat in a petri dish / vertical gardens / farms

Please see markband on page 22

9. (a) Outline **two** advantages and **two** disadvantages of using a named indirect method of monitoring pollution in the environment. **[4]**

eg Biotic index / Biological Oxygen Demand;

Advantages:
they focus on the impacts which are most significant;
they don't require identification of pollutants that are mixed / difficult to trace;
they can be used to monitor recovery after pollutant dissipates;
they indicate appropriate remedial action to restore polluted systems;

Disadvantages:
they do not identify/quantify specific pollutants present;
they may not help in identifying the source/responsibility for pollution;
they may be influenced by factors other than pollution;

*Award **[1 max]** for naming a correct method. Award **[1]** for each correct advantage outlined up to **[2 max]**. Award **[1]** for each correct disadvantage outlined up to **[2 max]**.*

(b) Explain how the pyramid structure of food chains can influence the impact of non-biodegradable toxins on an ecosystem. **[7]**

non-biodegradable toxins are not broken down as they pass along food chains;
many of these toxins are fat-soluble and so accumulate in the fatty tissue of organisms;
so toxins accumulate over time within the biomass of higher trophic levels;
biomass is also lost through respiration at each trophic level;
this increases the concentration of these toxins;
the concentration therefore becomes greatest/most lethal in the top carnivores;
the top carnivores are often the least stable/most prone to decline;
loss of the top carnivores will lead to an imbalance in the lower populations;
this may lead to disruption of the entire food chain/web/ecosystem;
eg DDT in Bald Eagles / Mercury in Sword fish;

*Award **[1]** for each correct explanation, up to **[7 max]**.*

(c) Climate change may be addressed at the level of preventing the causes of impact (mitigation) and limiting the extent of impact (adaptation). Evaluate the relative advantages of mitigation and adaptation with the help of named examples. **[9]**

Answers may include:

Preventing the causes:

- mitigation is a term used to describe the reduction and/or stabilization of greenhouse gas (GHG) emissions and their removal from the atmosphere
- the reduction of GHGs must be the ultimate goal of any strategy to tackle climate change as atmospheric models indicate that a tipping point may be reached as GHG levels rise
- this is the goal of the 350 campaign which refers to 350 ppm of CO_2 in the atmosphere as being the target level
- other NGO activities have helped to educate and facilitate this aim, *eg* the 10:10 campaign
- some of these campaigns suggest that the only fair mechanism will be for a carbon budget of 1 tonne per person
- evaluation: This has not been taken up by governments as yet
- a major goal of societies with plans to reduce their GHG is to improve energy efficiency
- *eg* The UK government has a plan to promote the upgrading of its housing stock to improve energy efficiency
- evaluation: there have been serious problems in the implementation of UK government schemes due to the difficulty of the planned work with Energy Companies
- *eg* Switzerland has a goal to reduce per capita energy consumption
- evaluation: thus far the campaign has been done through education and publicity but the effectiveness of this may only be improved through incentives *eg* a cap and trade scheme
- the reduction of emissions of the GHGs NO_x and CH_4 from agriculture is another method
- *eg* some countries have attempted to introduce taxes on the emissions of these gases, *eg* New Zealand
- evaluation: So far there has been limited success due to a backlash from farming communities and from the perceived need to supply populations with “cheap” meat
- the main goal of most societies is to reduce use of fossil fuels and to replace their use with Nuclear or renewable energy resources
- *eg* Sweden had the goal to become “oil free” by 2020 / Denmark has a goal to become reliant on 100% renewable energy resources by 2050
- ladakh’s goal to replace diesel generators with an off-grid renewable solution
- evaluation: Sweden had a government change and so the “oil free” goal was never enshrined in law
- evaluation: In some societies there is great pressure from energy industries to slow the pace of transfer away from fossil fuels
- evaluation: Move to natural gas which is more efficient than coal or oil and therefore has lower CO_2 emissions, has delayed the move to renewables in some societies
- evaluation: Societies that implement feed-in tariffs, *eg* Germany for solar, have succeeded in rapid take-up of renewable
- there are various international negotiations to facilitate reducing GHGs, the first with set targets was the Kyoto Protocol
- evaluation: This has had mixed success with some countries exceeding their targets while others have withdrawn from the Treaty

- perhaps more success has been reached on regional and local agreements *eg* The European Union's targets for member states
- trading mechanisms in carbon have also had mixed success with the European Union's mechanism criticised for under-pricing carbon
- some more technocentric-inclined societies advocate for geo-engineering solutions to remove GHGs such as carbon dioxide removal (CDR) or carbon capture and storage (CCS) in which carbon dioxide is compressed, transported and stored permanently underground (geological sites used as repositories) or chemically fixed to form a carbonate
- evaluation: These have proved very difficult to implement due to engineering challenges and then the associated costs
- another geo-engineering solution is to enhance carbon dioxide absorption through either fertilization of oceans with N/P/Fe to encourage the biological conversion of CO_2 into biomass or to increase the upwellings through pumps to release more nutrients at the surface and enhance CO_2 removal
- evaluation: These are largely untested techniques / the problem of euthrophication has not led to increased CO_2 removal / increased temperatures of water bodies is already reducing ability of oceans to store carbon
- another strategy is to protect and enhance carbon sinks through land management practices
- the REDD+ is an agreement stemming from climate change talks to enhance carbon stocks through conservation and reduction of deforestation
- evaluation: REDD+ is largely seen as a successful way to enable countries holding large stocks of natural capital in the form of forests to keep these forested or to encourage afforestation
- evaluation: but needs large amount of management and "policing" to avoid corruption and exploitation of "loopholes" *eg* removal of primary forest to be replaced by secondary forest
- the use of biomass as a fuel sources is another mitigation strategy
- some NGOs support the use of biomass as a way of offsetting carbon emissions, *eg* MyClimate
- some societies encourage the use of biomass and cogeneration as a way of reducing carbon emissions, *eg* Switzerland and Sweden
- evaluation: this can have problems when the biomass is using food crops which can exacerbate food shortages and enhance habitat loss, but when using "waste", *eg* cow manure, the process can be very successful
- General Evaluation: Even if mitigation strategies drastically reduce future emissions of GHGs, past emissions will continue to have an effect for quite some time

Limiting the extent of impacts:

- adaptation is the use of strategies that reduce the adverse affects of climate change and maximize any possible positive effects
- some of the main adaptation needs are flood defences against rising sea levels and heavy rainfall
- evaluation: these need to be part of an integrated approach where land-use is monitored and controlled, *eg* if land is ploughed and left un-planted during heavy rainfall, flooding may be exacerbated / if urban areas are covered in impenetrable surfaces then flooding will be worsened in heavy rainfall
- evaluation: These flood defences may need to be continually increased as climate change worsens
- evaluation: There may be a reluctance to invest in flood defences for perceived rare events / because the government has a low tax – libertarian approach
- as climate change is predicted to increase the prevalence of some infectious diseases, vaccination programmes are considered an adaptation strategy

- evaluation: Difficult to predict which vaccinations will be needed / where they will be needed / expensive
- desalinisation plants will help to overcome need for fresh water in already water scarce regions
- evaluation: Unless powered by renewable energy, these will release GHGs / will release highly saline water which can reduce biodiversity locally / expensive
- as climate change progresses some areas will become more favourable for agriculture and increase food production locally
- evaluation: Soil may not be suitable for agriculture / trials will need to be conducted to see which crops are best for new conditions / new agriculture should be evaluated for carbon storage potential versus the loss of carbon stores from changed land use
- general Evaluation: Adaptive capacity varies from place to place and can be dependent on financial and technological resources
- in some cases, more economically developed nations (MEDCs) provide economical and technological support to less economically developed nations (LEDCs) – a mechanism (the Adaptation Fund) for this has been created in the annual climate change conferences stemming from the Kyoto Protocol

Restoring Impacted Systems:

- restoring impacted systems can enhance carbon storage and thus act as a mitigation strategy
- however impacted systems may struggle to recover while climate change continues to increase in intensity

Please see markband on page 22

Section B, part (c) markband

Marks	Level descriptor
0	The response does not reach a standard described by the descriptors below and is not relevant to the question.
1–3	The response contains: • minimal evidence of knowledge and understanding of ESS issues or concepts • fragmented knowledge statements poorly linked to the context of the question • some appropriate use of ESS terminology • no examples where required, or examples with insufficient explanation/relevance • superficial analysis that amounts to no more than a list of facts/ideas • judgments/conclusions that are vague or not supported by evidence/argument.
4–6	The response contains: • some evidence of sound knowledge and understanding of ESS issues and concepts • knowledge statements effectively linked to the context of the question • largely appropriate use of ESS terminology • some use of relevant examples where required, but with limited explanation • clear analysis that shows a degree of balance • some clear judgments/conclusions, supported by limited evidence/arguments.
7–9	The response contains: • substantial evidence of sound knowledge and understanding of ESS issues and concepts • a wide breadth of knowledge statements effectively linked with each other, and to the context of the question • consistently appropriate and precise use of ESS terminology • effective use of pertinent, well-explained examples, where required, showing some originality • thorough, well-balanced, insightful analysis • explicit judgments/conclusions that are well-supported by evidence/arguments and that include some critical reflection.