Environmental systems and societies

Standard Level

Paper 1 – Mock Examination

Mock Exam 2

Calculator required

Time allowed: **1 hour**

Maximum mark: **35 marks**

Candidate information

Candidate name: .....

Session number: .....

Date: .....

Instructions to candidates

- Write your session number in the box above.
- Do not open this examination paper until you are told to do so.
- Answer **all** questions. Refer to the resource booklet that accompanies this question paper.
- Answers must be written within the answer boxes provided.
- A calculator is required for this paper.
- The maximum mark for this examination paper is **[35 marks]**.

Case study: Sabah, Borneo (Malaysia). The resource booklet contains Figures 1–11. Some questions require more than one figure, and the final question requires the booklet as a whole. This is an original practice paper written by IB Demystified for revision purposes. It is not a past paper and is not endorsed by, affiliated with or produced by the International Baccalaureate Organization.

Answer **all** questions. Answers must be written within the answer boxes provided.

1. Using **Figure 2**, identify the ecosystem that has replaced lowland rainforest across much of eastern Sabah. [**1**]

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2. (a) Using **Figure 4**, calculate the difference between the biocapacity per person and the ecological footprint per person in 1980. [**1**]

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(b) **Figure 4** shows that Malaysia's ecological footprint per person now exceeds its biocapacity per person. Suggest **two** ways in which Malaysia could reduce this ecological deficit. [**2**]

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3. (a) Using the data in **Figure 5**, calculate the percentage of amphibian species that are endemic to Borneo. [**1**]

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(b) Explain why Borneo supports a high level of biodiversity. [**3**]

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4. (a) With reference to **Figure 6(a)**, suggest **one** advantage of using the proposed southern route (Route B) compared with the route that was built (Route A). [**1**]

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(b) With reference to **Figure 6(a)**, suggest a possible reason why Route B was rejected in favour of Route A. [**1**]

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(c) With reference to **Figure 6(b)**, identify **one** conflict between the oil palm industry and sustainability. [**1**]

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(d) With reference to **one** specific event in **Figure 6(b)**, outline a strategy that could be used to reduce future incidents of pollution. [**1**]

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5. With reference to **Figures 7(a)** and **7(b)**, outline **two** reasons for the change in the use of biomass, biogas and solar between 1990 and 2023. [**2**]

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6. Using **Figure 8**, identify which product makes up the greatest proportion of Sabah's exports by value. [**1**]

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7. (a) With reference to **Figure 9(a)**, outline the relationship between mean monthly rainfall and mean monthly discharge of the Kinabatangan River. [**1**]

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(b) Identify **one** transfer and **one** transformation in the hydrological cycle shown in **Figures 9(b)** and **9(c)**. [**2**]

Transfer: . . . . . .

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Transformation: . . . . . .

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(c) With reference to **Figures 9(b)** and **9(c)**, describe a feedback loop that could be triggered by deforestation of the floodplain forest. [**2**]

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(d) Outline how the floodplain forest may provide a **named** example of natural income. [**1**]

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(e) Describe **two** ways in which climate change could affect the floodplain forest ecosystem. [**2**]

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8. (a) Outline **one** impact that a reduction in the bearded pig population may have on the food web in **Figure 10(b)**. [**1**]

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(b) With reference to **Figures 10(c)** and **10(d)**, explain how the repeated use of anticoagulant rodenticides could contribute to the evolution of resistance in the rat population. [**2**]

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9. With reference to **Figure 11**, evaluate the potential effectiveness of completing the riverside corridor along the lower section of the Kinabatangan for wildlife conservation. **[3]**

10. With reference to the information in the resource booklet, discuss to what extent Sabah has been effective at meeting its legal commitments to protect the environment. [**6**]

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

Answers written on this
page will not be marked.

End of examination

Total: **35 marks**

Environmental systems and societies

Standard Level

Paper 1 – resource booklet

Mock Exam 2

Calculator required

Time allowed: **1 hour**

Maximum mark: **35 marks**

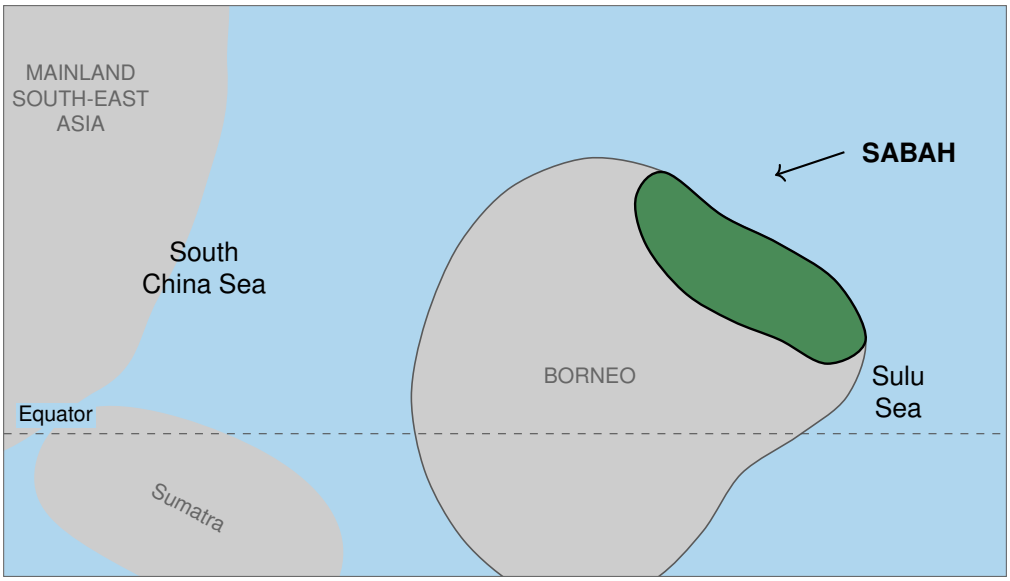
Instructions to candidates

- Do not open this booklet until you are told to do so.
- This booklet contains all the resources needed to answer paper 1.
- Case study: **Sabah, Borneo (Malaysia)**.

Contents

Figures 1–3	Location, ecosystems and fact file on Sabah
Figures 4–5	Ecological footprint, biocapacity and species diversity
Figure 6	Highway routes and the oil palm timeline
Figures 7–8	Energy choices, electricity generation and exports
Figure 9	Rainfall and discharge, the hydrological cycle, tree adaptations
Figure 10	Lower Kinabatangan, food web and rodenticide use
Figure 11	Proposed riverside corridor

Figure 1: Map showing the location of Sabah



Not drawn to scale

Figure 3: Fact file on Sabah

- Sabah is a state of Malaysia occupying the north-eastern corner of the island of Borneo. It covers approximately 73 600 km^2 and has a population of about 3.9 million.
- Borneo lies on the equator and has a hot, wet climate with rainfall throughout the year. Mount Kinabalu, at 4095 m, is the highest mountain between the Himalayas and New Guinea.
- Kinabalu Park is a UNESCO World Heritage site. Sabah also contains the Danum Valley and Maliau Basin conservation areas, which protect some of the last unlogged lowland rainforest in Borneo.
- In 2007 Malaysia, Indonesia and Brunei signed the Heart of Borneo declaration, a commitment to conserve and sustainably manage a shared area of forest across the centre of the island.
- In 2018 the Sabah state government made a legal commitment to place **30 % of its land area** under Totally Protected Area status by 2025, and banned the conversion of any further forest reserve to plantation.
- State law requires plantations to leave an undeveloped riverside reserve at least 20 m wide along both banks of major rivers.
- Around half of Sabah's lowland forest has been converted to oil palm plantation since 1970. Oil palm is now the state's largest source of export income and employment.
- Nature-based tourism (diving, orangutan viewing and river cruises) attracted about 1.4 million visitors a year before 2020, and is a growing source of income for river communities.

Figure 2: Ecosystems of Sabah

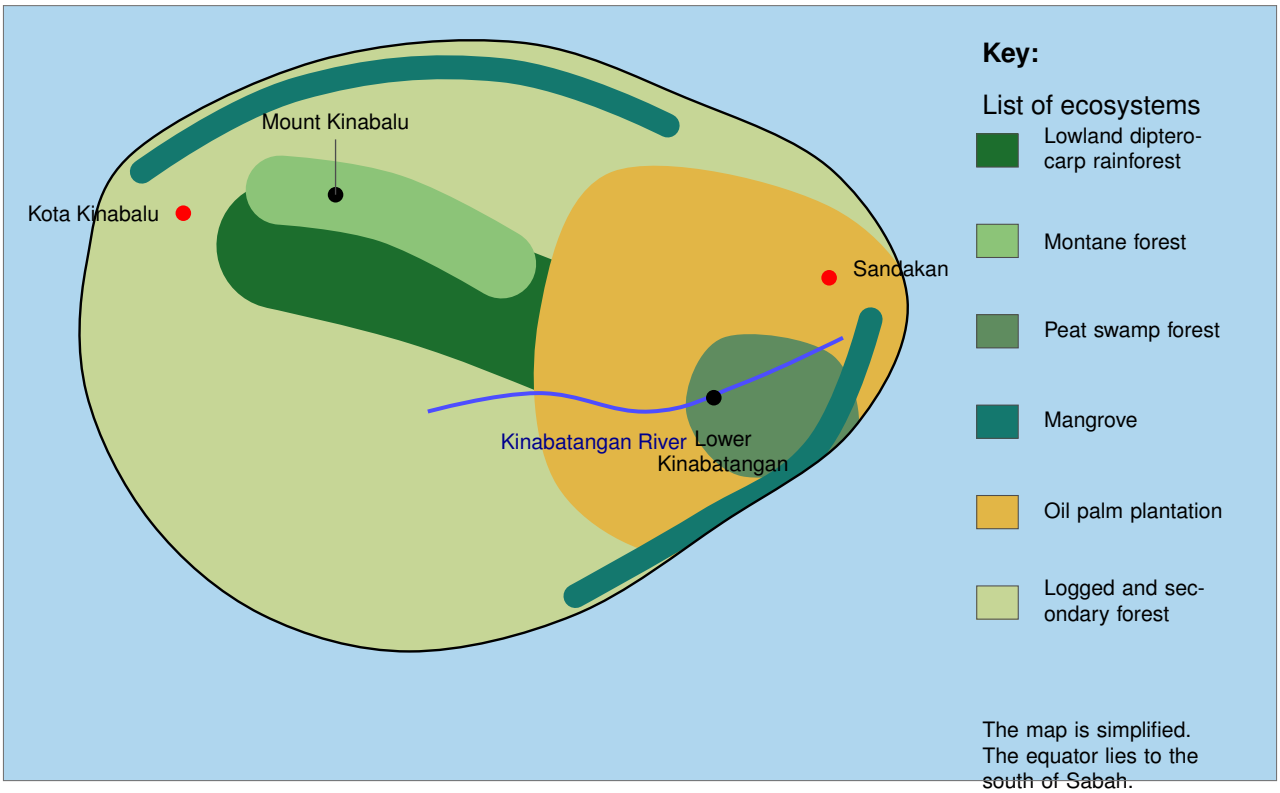
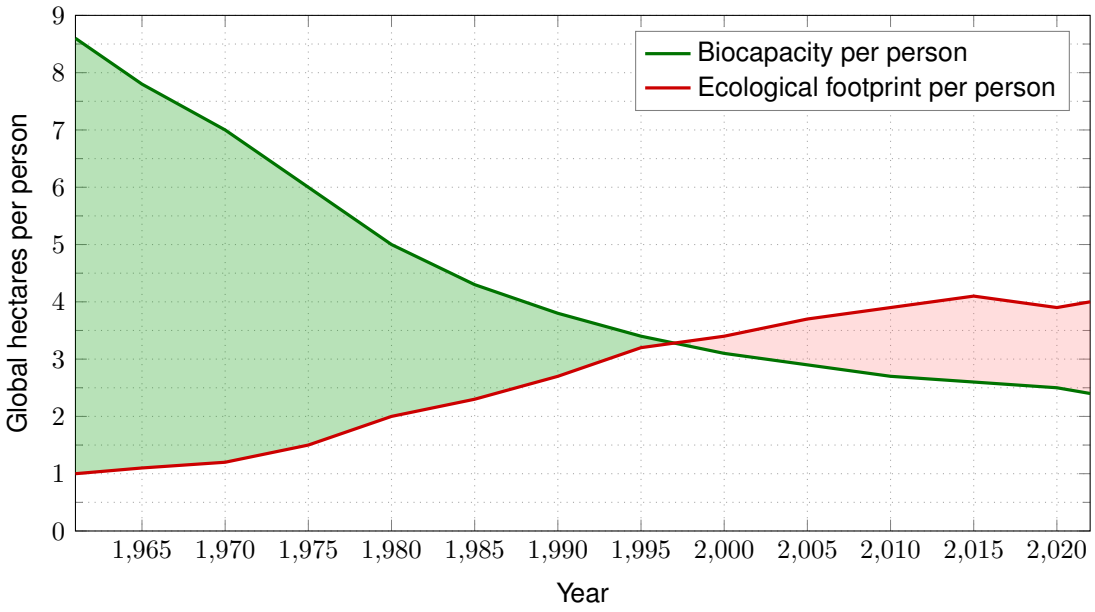


Figure 4: Ecological footprint (per person) and biocapacity (per person) for Malaysia, 1961–2022



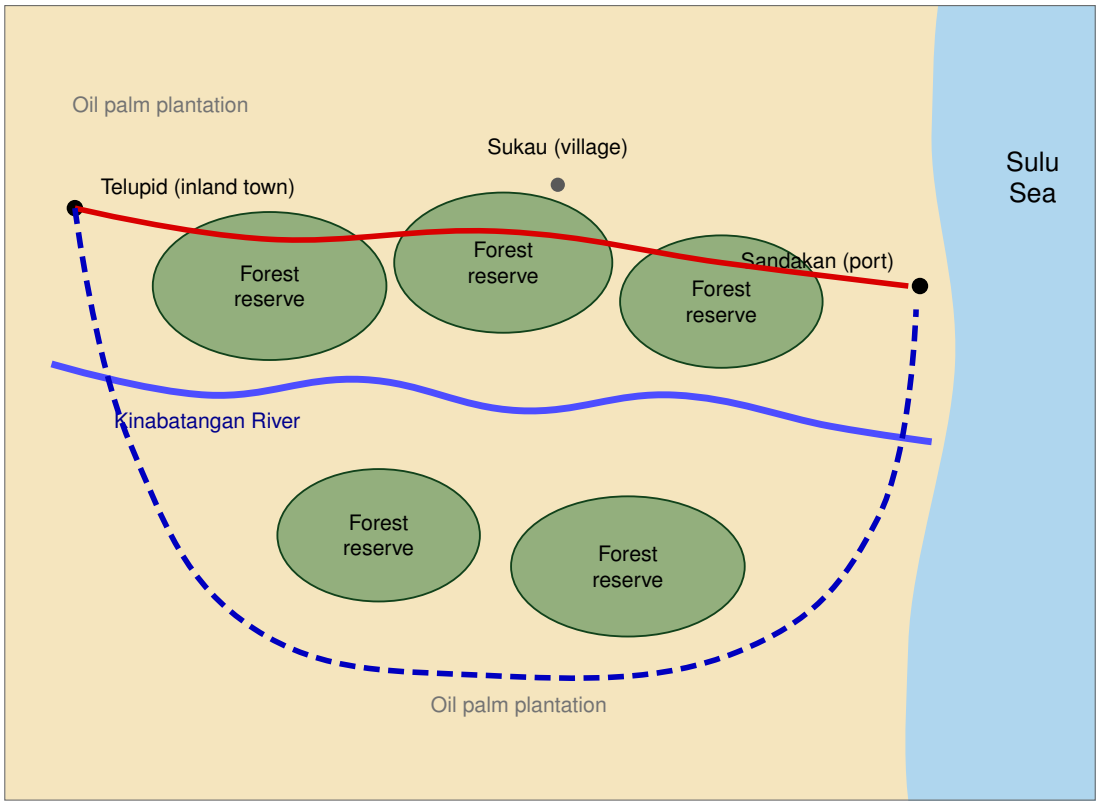
Biocapacity is the amount of biologically productive land and water available, measured in global hectares per person.

Figure 5: Species diversity among different taxonomic groups on the island of Borneo

Taxonomic group	Total species	Endemic species*
Vascular plants	15 000	6 000
Mammals	288	91
Birds	420	37
Reptiles	254	69
Amphibians	166	90
Freshwater fish	394	149

* Endemic species refers to those species only found in a given region – here, the island of Borneo.

Figure 6(a): Two proposed routes for a new highway across the Lower Kinabatangan



Key:

Route A: the 95 km northern route that was built (opened 2019)

Route B: the 140 km southern route that was proposed and then rejected

Forest reserve

River

The forest reserves shown are the fragmented lots of the Lower Kinabatangan Wildlife Sanctuary. Land outside the reserves is almost entirely oil palm plantation, owned by a small number of large companies. Route B would require three new river crossings.

Figure 6(b): Timeline for oil palm in the Lower Kinabatangan

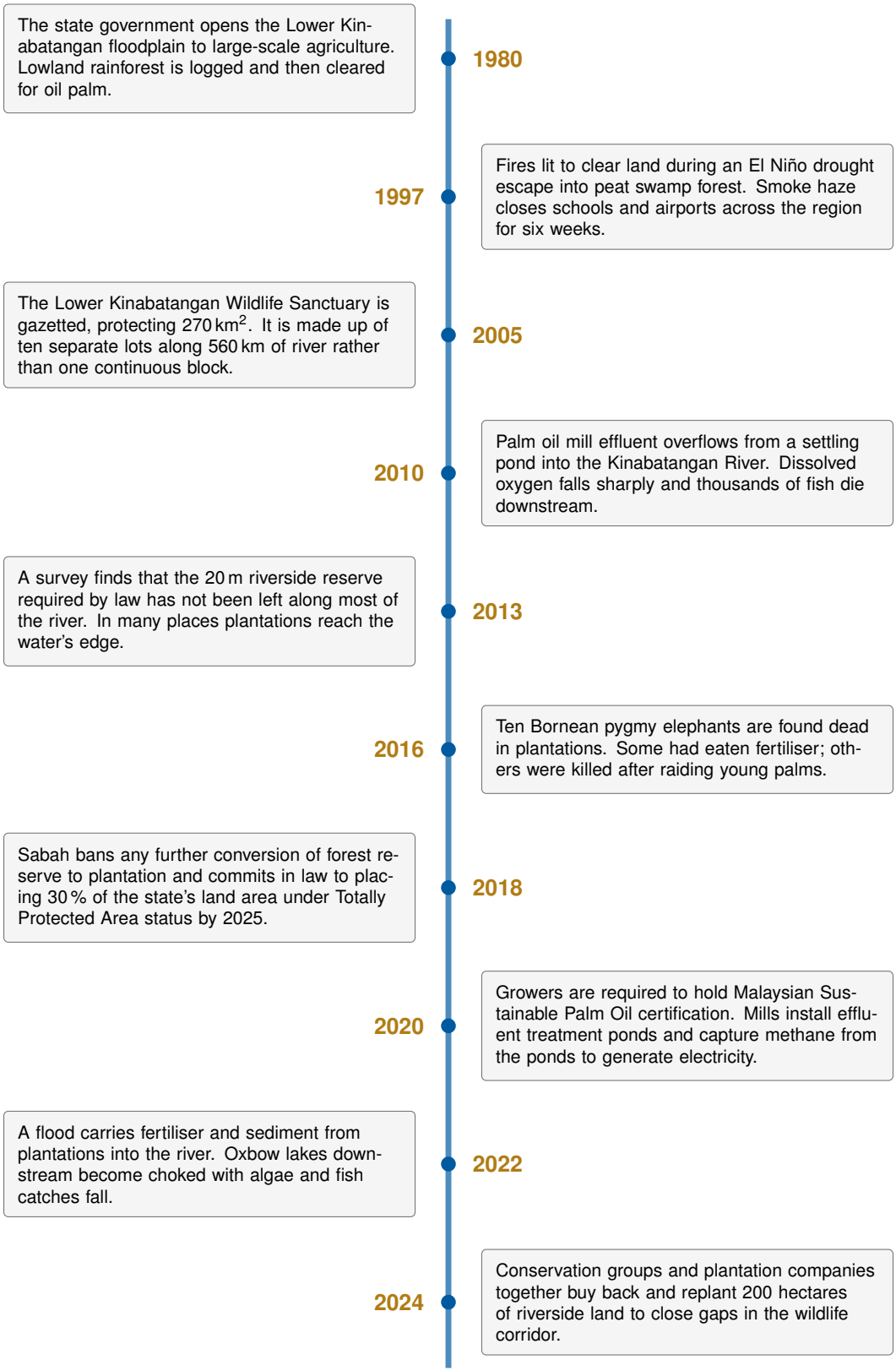
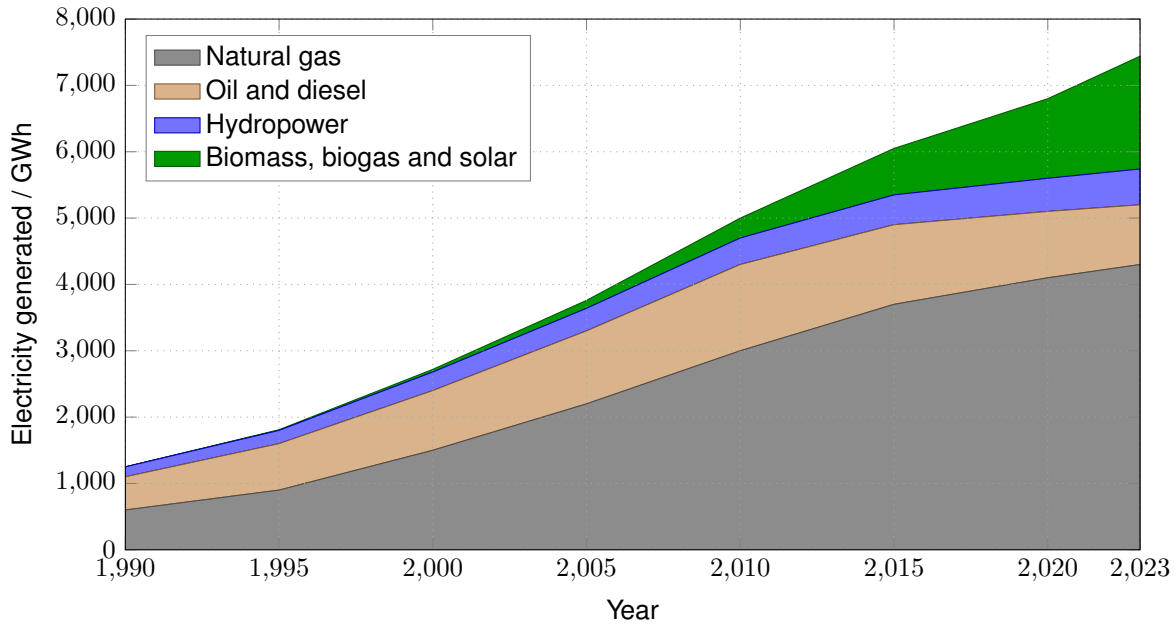


Figure 7(a): Fact file on Sabah's energy choices

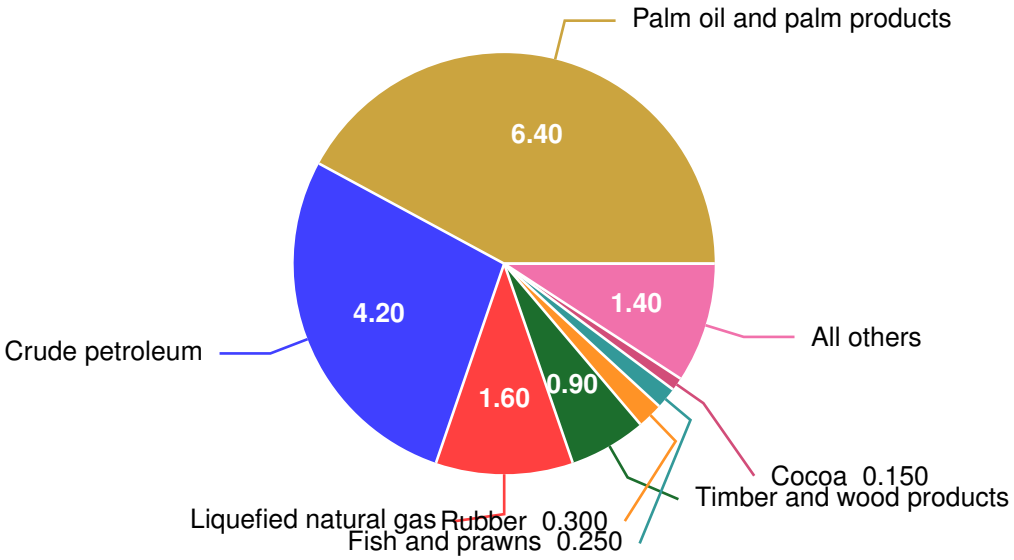
- Most of Sabah's electricity is generated from natural gas piped from offshore fields, and from diesel generators in towns that are not connected to the main grid.
- Sabah's rivers are short and steep, so large hydropower schemes are limited; existing dams produce less during the drier months.
- A proposed 300 MW coal-fired power station was cancelled in 2011 after opposition from local communities and conservation groups.
- The oil palm industry produces very large quantities of waste: empty fruit bunches, fibre and shell can be burned as biomass fuel, and the effluent from mills releases methane that can be captured and burned.
- Since 2011 the national government has paid a guaranteed price (a feed-in tariff) for electricity generated from biomass, biogas and solar, and since 2020 mills have been required to capture methane from effluent ponds.
- About 8 % of rural households in the interior still have no mains electricity supply.

Figure 7(b): Sabah's electricity generation by source (1990–2023)



The graph is stacked: the thickness of each band shows the contribution of that source, and the top of the shaded area shows total generation.

Figure 8: Sabah's main exports by value (billions of USD) for 2022



*Each wedge represents billions of US dollars. Total exports in 2022 were 15.20 billion US dollars.

Figure 9(a): Mean monthly rainfall and mean monthly discharge of the Kinabatangan River

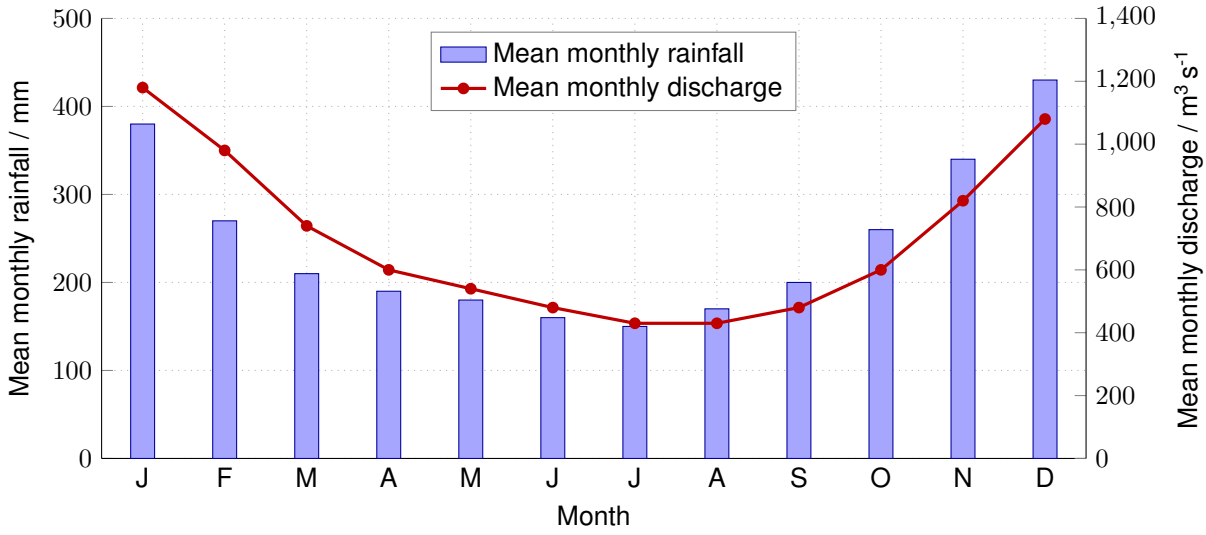


Figure 9(b): Relationship of the Kinabatangan rainforest with the hydrological cycle

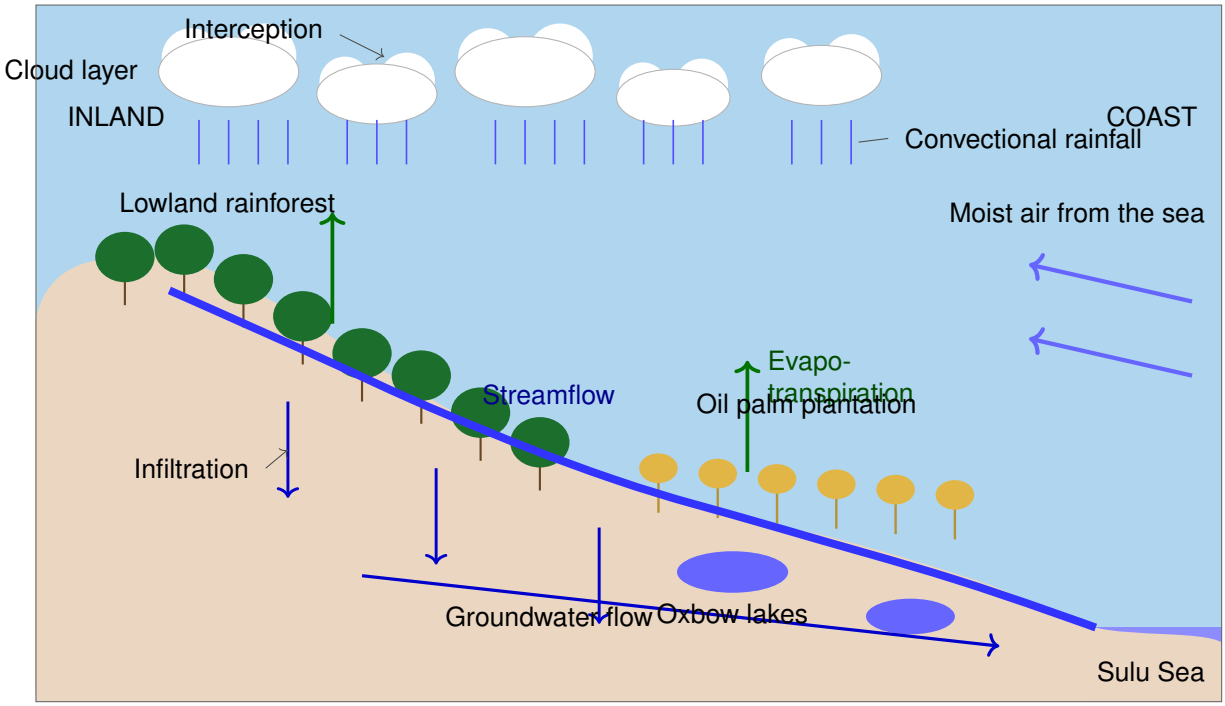


Figure 9(c): Adaptations of lowland rainforest and floodplain trees in Borneo

Trees growing on the Kinabatangan floodplain and the surrounding lowlands are adapted to very heavy rainfall, thin and easily leached soils, and seasonal flooding. These adaptations include:

- **Buttress roots**: broad, flattened roots flare out from the base of tall dipterocarp trees. They support trees over 60 m tall in shallow soil and hold soil in place during floods.
- **Drip tips**: leaves taper to a fine point so that rainwater runs off rapidly, preventing algae and fungi from growing on the leaf surface.
- **Shallow root mats and mycorrhizal fungi**: a dense mat of fine roots close to the surface, with fungi attached, absorbs nutrients from decomposing litter before heavy rain washes them away.
- **Stilt and prop roots**: trees growing on frequently flooded ground are held above the water on arching roots, so the trunk is not waterlogged.
- **Pneumatophores**: in the peat swamp and mangrove, roots grow vertically up out of the waterlogged soil, allowing gas exchange where the soil contains almost no oxygen.

Figure 10(a): Fact file on the Lower Kinabatangan Wildlife Sanctuary

- The sanctuary was gazetted in 2005 and protects 270 km^2 of floodplain forest along the lower 560 km of the Kinabatangan River.
- It is not a single block. It consists of ten separate lots strung along the river, and conservationists often describe it as a "string of beads". Oil palm plantation surrounds the lots on all sides.
- It supports ten primate species, including the Bornean orangutan and the proboscis monkey, and about 300 Bornean pygmy elephants – one of the largest remaining populations.
- Elephants moving between forest patches must cross plantations. Crop raiding leads to conflict with growers, and elephants are sometimes injured or killed.
- Nature tourism lodges at Sukau employ local people as boatmen and guides, and river cruises are the main source of income for several villages.
- State law requires a riverside reserve at least 20 m wide on both banks, but a 2013 survey found this had not been left along most of the river.

Figure 10(b): Simplified food web for the Lower Kinabatangan floodplain forest

Arrows show the direction of energy flow. The width of the shaded triangle represents the decrease in biomass at each trophic level.

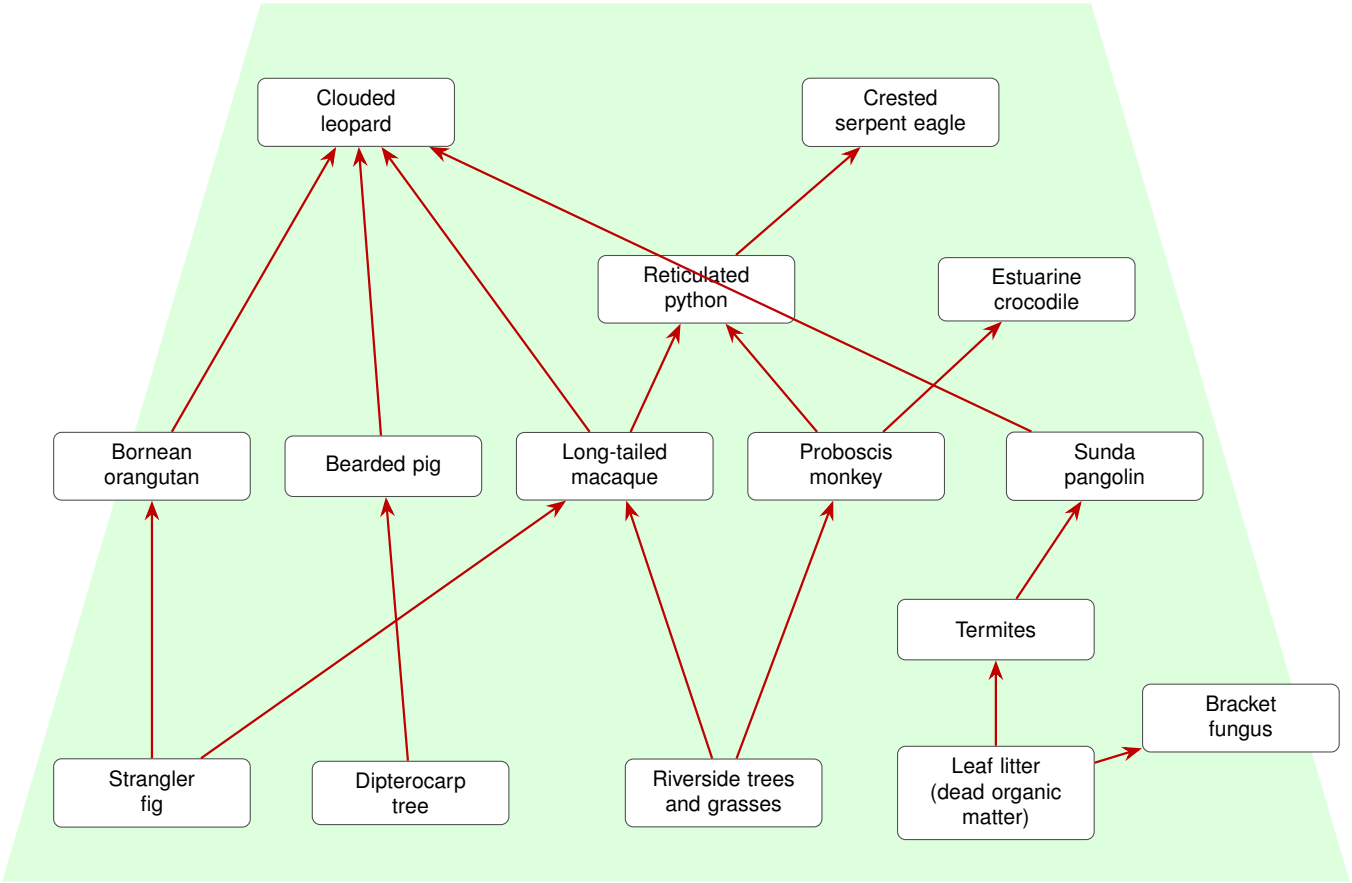
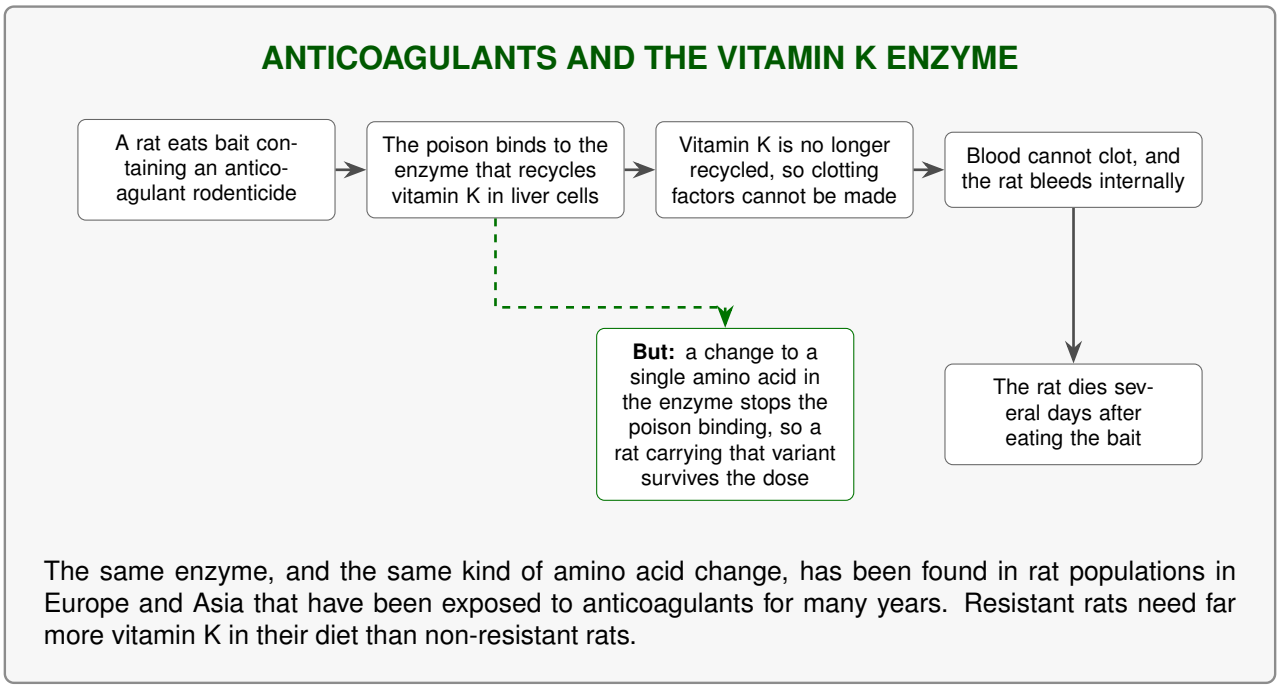


Figure 10(c): Fact file on rat control in oil palm plantations

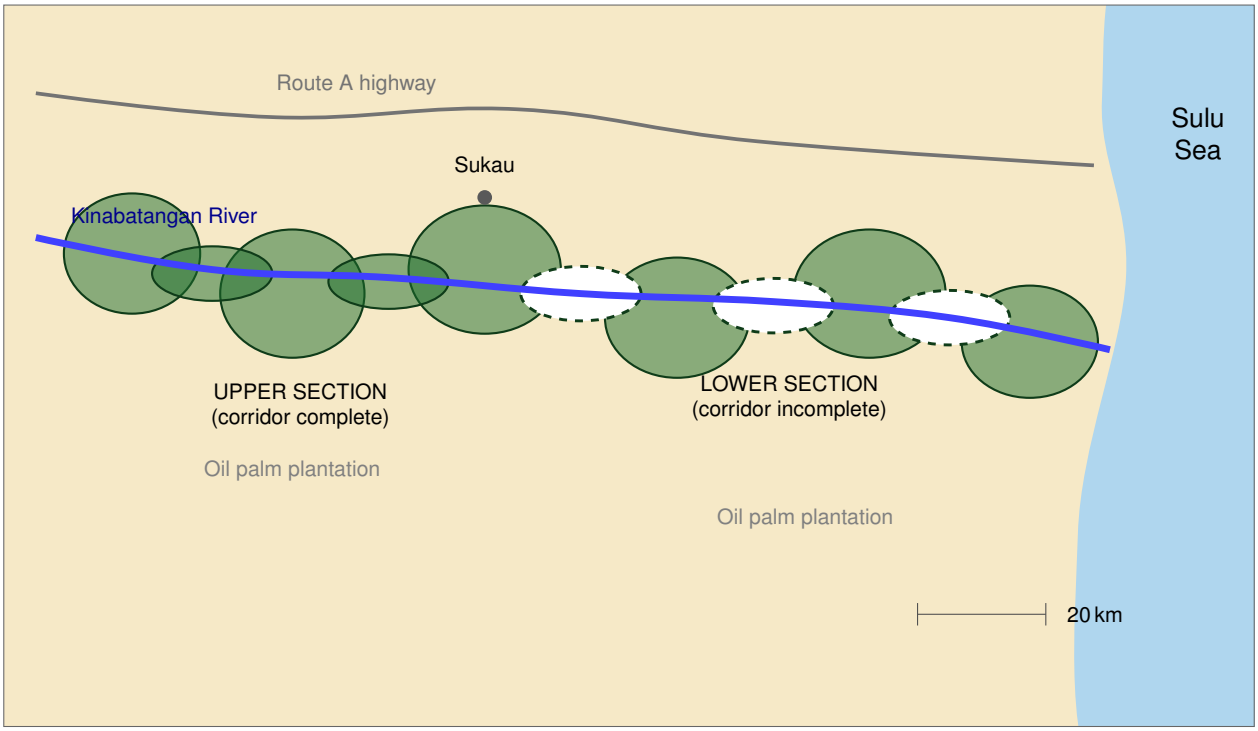
- Rats feed on ripening oil palm fruit and can destroy 5–10 % of a plantation's crop each year, so growers treat them as their most serious pest.
- Most plantations control rats using anticoagulant rodenticides placed in bait stations between the palm rows. These have been applied repeatedly across the Kinabatangan floodplain since the 1980s.
- Anticoagulants stop the animal's blood from clotting. Rats die of internal bleeding several days after eating the bait, which means a poisoned rat is still moving and easily caught during that time.
- The poison remains in the body of a dead or dying rat, so predators that eat them – barn owls, snakes, civets and monitor lizards – can also be poisoned. This is known as secondary poisoning.
- Populations of rats resistant to the older, first-generation anticoagulants have now been reported in several oil palm growing regions, and growers have had to move to stronger compounds.
- Some plantations now put up barn owl nest boxes instead, using the owls as a form of biological control. A single barn owl family can take more than 1000 rats in a year.

Figure 10(d): Mechanism by which an anticoagulant rodenticide kills a rat



The same enzyme, and the same kind of amino acid change, has been found in rat populations in Europe and Asia that have been exposed to anticoagulants for many years. Resistant rats need far more vitamin K in their diet than non-resistant rats.

Figure 11: Proposal for a riverside corridor along the Lower Kinabatangan



Key:

- Existing sanctuary lots and completed corridor
- Land still required to complete the corridor
- Highway
- Kinabatangan River

The land still required lies in the lower section of the river, where the riverside strips are owned by three large plantation companies. Buying it back is estimated to cost more than 20 million US dollars.

Note on sources

This resource booklet was written and drawn by IB Demystified as original practice material. It is not a past paper, and it is not endorsed by, affiliated with or produced by the International Baccalaureate Organization.

The Sabah case study is realistic but deliberately simplified for teaching. All figures have been drawn for this paper. Values have been rounded so that they can be read quickly under exam conditions, and some events in the timeline in Figure 6(b) have been simplified or combined. The species shown in the food web in Figure 10(b) do occur in the Lower Kinabatangan, but the feeding relationships shown are a simplified selection rather than a complete web. The highway routes in Figure 6(a) are illustrative. None of the values in this booklet should be quoted as a research source.

End of resource booklet
