Cluster 1: Development, Economy and Environment

1 Mangroves are a group of trees and shrubs that live in the coastal intertidal zone and have been acknowledged to help countries progress towards sustainable development.

Resource 1 depicts the 17 Sustainable Development Goals (SDGs). Resource 2 shows the global distribution of mangroves in 2000. Resource 3 shows tree cover loss in mangroves from 2000 – 2012 across various regions. Resource 4 is an article explaining the benefits of mangroves and the challenges of mangrove restoration in Indonesia.

(a) Using Resource 1, explain how the Sustainable Development Goals (SDGs) help countries to progress towards sustainable development. [5]

Answer Guide:

• Definition of sustainable development:

- Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs.
- Brief explanation of the Sustainable Development Goals (SDGs):
 - Main objective: Help countries to progress towards sustainable development in 17 different interlinked areas
 - What the goals are about: Economic growth and providing social needs while tackling environmental protection and climate change

• Explain link between SDGs and SD:

- Interdependence of the 3 dimensions of sustainable development:
 - Sustainable development can only be achieved through interdependence in meeting goals in three dimensions – economic, social, and environmental dimensions. Meanwhile, the 17 SDGs are crafted such that the goals together will help countries pursue goals across all 3 interdependent dimensions of sustainable development.
- Intergenerational aspect:
 - By achieving outcomes in all 17 SDGs, this would ensure that there are sufficient resources on Earth to maintain life for both the present and the future, which is the purpose behind the concept of sustainable development.
- How it helps countries progress towards sustainable development:
 - Provides quantitative targets and indicators for each goal that countries should work towards
- Use of examples:
 - Any appropriate use of examples from Resource 1 with explanation will be credited
- (b) With reference to Resource 2, describe the global distribution of mangroves in 2000. [4]

Answer Guide:

- Mangroves can be found in the coastal areas of most continents, with the exception of Antarctica.
- Mangroves can be found mostly within the Tropics of Cancer and Capricorn.
 - Also, most mangroves are located closer to the Equator rather than Tropics of Cancer/ Capricorn.
- Mangroves are most concentrated in Southeast Asia.
- Mangroves are least concentrated in the Middle East, Africa, and the western coast of South America.
 - o In fact, no mangroves can be found along the western coasts of South

America and Australia that are located within the Tropics of Cancer and Capricorn.

[4]

[5]

- There are more mangroves concentrated in the Eastern hemisphere as compared to the Western hemisphere of the world map.
- (c) Using Resource 3, compare the change in tree cover loss in mangroves in Asia and Africa from 2000 to 2012.

Answer Guide:

Asia Basis of Comparison		Africa		
Generally experienced tree cover loss from 2000-2012.		Generally experienced tree cover loss from 2000-2012.		
Asia experienced anything between 7,500 hectares to 21,000 hectares of tree cover loss per year from 2000 – 2012.	Nature of change	Africa experienced anything between 100 hectares to 1,000 hectares of tree cover loss per year from 2000 – 2012		
Large extent of loss across the years.		Very small/ minimal extent of loss across the years		
Asia experienced a larger increase in extent of loss per year from 2000 – 2012, from 7,500 hectares to 13,000 hectares.	Extent of change	Africa experienced a smaller increase in extent of loss per year from 2000 – 2012, from 100 hectares to 1,000 hectares.		
Large variations / fluctuations from year to year, from 2000 – 2012. Tree cover loss in mangroves in Asia saw a pattern of increases and decreased from 2000 – 2012. E.g. Increasing from 2001 to 2003 continually, fell	Variability of change	Little variations/ fluctuations from year to year, from 2000 – 2012. Tree cover loss in mangroves in Africa was rather consistent throughout the years, ranging only from 100 hectares to 1,000		
an increase again afterwards.		hectares.		

(d) With reference to Resource 4, identify the ecosystem services that mangroves provide.

Answer Guide:

Identification of ecosystem service	Description of ecosystem service	Reference to Resource 4
--	-------------------------------------	-------------------------

	Mangroves can help with moderation of extreme weather events / flood control.	"Mangroves can also withstand large waves and act as a barrier against tsunamis, protecting residents in coastal areas."
Regulating services	Mangroves can help with climate regulation.	"Mangroves can absorb up to five times more carbon emission than a tree in an upland area. Various studies have shown that mangroves and the soil beneath them can store up to 89 tonnes of carbon per hectare."
Provisioning services	Mangroves provide products for basic human needs – e.g. wood from mangroves, etc.	"They can also be processed for consumption or sale"
Cultural services	Mangroves provide non- material benefits such as spaces for recreation and tourism.	"not to mention the potential for ecotourism."

(e) Explain how human activities might reduce the ability of the environment to provide ecosystem services.

[6]

Answer Guide:

In general, human activities have an impact on the availability and quality of ecosystem services provided by the environment.

Human activity	Impact of human activity on the environment	→ Impact on the ability of the environment to provide ecosystem service		
Deforestation / Clearing of land	Destruction of habitats. This happens when land is cleared in order to make space for urban dwellings, commercial production of crops and breeding of livestock	Associated loss of plant and animal species which provide provisioning services to humans (e.g. food, medicines). Associated loss of environments that provide cultural services – e.g. in the forms of tourism and spiritual services.		
Use of	Pollution of natural	Negatively impacts habitats		
agrochemicals	environments, as the original	for biodiversity and the health		
and disposal of	quality of the environment is	of plant and animal species,		
industrial waste	reduced / water body	which results in loss of		
(usually into	becomes contaminated.	provisioning services to		
water bodies)		humans as well.		
Introduction of	Invading species can out-	Negatively impacts supporting		

invasive species	compete and species as	displace they	native are	services – e.g. by disrupting pollination or altering energy
	transferred	to	new	and nutrient flows.
	environments	through	travel	
	and transport			

With reference to Resource 4, explain the challenges of relying on mangrove restoration to achieve sustainable development in Indonesia. (f)

Answer Guide:

Nature of challenge	Description of challenge	Explanation of challenge of relying on mangrove restoration to achieve SD	Evidence from Resource 4
Economic challenges	Lack of funding	Mangrove restoration projects can help to achieve sustainable development, as they provide benefits to economic and social benefits to humans while protecting the environment. However, the lack of funding for mangrove restoration in Indonesia in the first place is a barrier to rely on it as a strategy to pursue sustainable development, because if there is no funding, mangrove restoration will not be able to	"Despite the level of ambition, though, funding is a real challenge. Due to rising COVID-19 cases which led to budget constraints, the target for 2021 was lowered to 33,000 ha in 32 provinces. "
	Desire for economic growth	happen.There is still a demand for land currently taken up by mangrove forests in Indonesia for economic activities.Due to the demand for this land, mangrove restoration projects cannot occur in the first place, meaning that relying on it to achieve sustainable development is not helpful.	"Conversion of land for shrimp farms, excessive logging, and the establishment of infrastructure in coastal areas such as reclamation, roads and ports."
Social challenges	Lack of education of ecosystem services	Lack of knowledge of other benefits that mangroves can provide means that there will not be consensus and buy-in among the people to protect and even restore mangroves. This would present a barrier to mangrove restorations, putting a damper on relying on this to achieve sustainable development.	"For instance, when mangrove areas have been converted to ponds, the authorities cannot simply replant them. They will need to engage the fishermen, who do not necessarily understand the function of

[6]

mangroves	in	the
replanting		
process."		

Cluster 1: Development, Economy and Environment

- 2 Resource 5 is a comparison of materials in a typical solar photovoltaic (PV) cell by mass and by value. Resource 6 shows drought forecast maps of the Lower Mekong Basin (LMB) for November and December 2019. Resource 7 is a map of the mainstream dams on the Mekong River. Resource 8 is a photograph of a dam construction site along the Mekong River in China.
 - (a) Using an example for each, explain what is meant by renewable and non-renewable resources. [4]

Possible responses:

- Renewable energy sources are naturally replenished within a human timespan. Sunlight is a renewable resource because it does not run out. Scientists believe that the Sun will not burn out within the next 5 billion years.
- Non-renewable resources are considered finite and thus can be depleted once used. Coal is a non-renewable resource because it is finite, and once used, is not replaced. Because of its non-renewable nature, there are coal mines that have been depleted and abandoned.
- (b) With reference to Resource 5, compare the distribution of silver, aluminium and glass in a typical solar photovoltaic (PV) cell by mass and by value.
 [6]

Possible response:

- In terms of mass,
 - Silver makes up the lowest proportion (less than 1%).
 - Glass makes up the highest proportion in terms of mass at 75%.
 - Aluminium, at 9%, is smaller in proportion in terms of mass compared to glass but higher in proportion to silver.
- In terms of monetary value,
 - Silver has the greatest contribution to a cell's monetary value at 47%.
 - Glass has the least contribution to a cell's monetary value at 8%.
 - Aluminium, at 26%, contributes less than silver but more than glass to the monetary value of a cell

[6]

(c) Explain why there may be environmental trade-offs in the usage of solar panels.

Possible response:

- Production of PV panels and siting of solar facilities causes negative impacts on local ecosystems:
 - Siting facilities disturbs local ecosystems.
 - PV panels require some rare materials, like silver, whose extraction is energy intensive and polluting.
- Generation of e-waste:
 - Solar panels are also complex pieces of technology that become big, bulky sheets of electronic waste at the end of their lives.
 - Challenges in recycling Recovering the most valuable materials from solar panels, including silver and silicon, requires bespoke recycling solutions. As solar panels are made of materials such as aluminium, glass and silicon, which can be potentially recycled, but are often difficult to separate, the recycling process is costly.
- Exacerbating pressure on landfills and potential for pollution:
 - If solar panels are not recycled, they are likely to enter landfills, which implies that valuable resources go to waste.

- In addition, because solar panels contain toxic materials like lead that can leach out as they break down, landfilling also creates new environmental hazards.
- (d) With reference to Resource 6, identify the changes in drought forecast in the Lower Mekong Basin (LMB) between November and December 2019. [3]

Possible responses:

- Overall, Lower Mekong Basin is predicted to have more areas/ larger areal extent with greater drought severity (exceptional drought) in December 2019 compared to November 2019.
- The **areas with exceptional drought** were largely concentrated in Thailand within the lower Mekong Basin Boundary in November 2019. However, it was predicted to extend beyond the Lower Mekong Basin Boundary and into Lao PDR and Cambodia as well in December 2019.
- (e) Describe the distribution of dams along the Mekong River as shown in Resource 7. [5]

Possible responses:

- The greatest number of completed dams are concentrated in China (5).
- However, the highest number of planned dams are in Lao PDR (7).
- There are 2 dams under construction, and they are both in Lao PDR.
- In China, the dams are located within close proximity to each other compared to Lao PDR and Cambodia.
- (f) With reference to Resources 6, 7 and 8, explain why there may be conflict over water supply in the Mekong River.

Possible responses:

- Drought conditions in the LMB (as shown in Resource 6)
 - Due to greater extent of drought conditions in the LMB, riparian states might experience greater competition over limited water supplies, thereby resulting in conflict between riparian states.

[6]

- Pursuit for socio-economic development & the development of dams (as shown in Resource 7)
 - Presence of dams in several countries along the Mekong River suggests the desire to tap on the benefits of dams such as for irrigation or hydropower.
 - However, as water is stored in the dams of reservoirs, this leaves less water for downstream states, potentially resulting in severe changes in amount of fresh water available for downstream riparian states.
- Environmental trade-offs related to dam construction (as shown in Resource 8)
 - Resource 8 shows sediments in the river as a result of deforestation. This could trigger impacts on the quality of water supply downstream which can trigger conflict between China and downstream countries