

Answers to data response and decision making exercises

1. St Lucia is a small island country of 617 sq km located in the Lesser Antilles chain of islands of the eastern Caribbean Sea. Table 9.1 shows a range of economic, social and environmental information about St Lucia.



Fig. 9.22 Location of St Lucia.

Fig. 9.23 St Lucia.



Fig. 9.24 Mountains from Edmund Forest, St Lucia.



Fig. 9.25 Hotel with pool, St Lucia.

Population	164 000
Population density	270 per sq km (world: 54 per sq km)
Population density world ranking	43/244
Annual population growth rate	0.74%
Population doubling time	95 years
Life expectancy	77.6 years
Literacy rate	90%
Population with access to improved sanitation	91%
Population with access to improved water	96%
Infant mortality rate	11.45 per 1000 people
Land area covered by forest	77%
Main employment provider	Tourism (54%)
Main income provider	Tourism (65%)

Table 9.1: St Lucia – selected economic, social and environmental indicators.

What do each of the following indicators measure?

a) Literacy rate

This is a measure of the proportion of people in a population who are able to read and write. In MEDCs this figure is universally high and often one hundred per cent, whereas in poorer LEDCs with less money to invest in universal education, the proportion is much lower. Low literacy rate is an important factor hindering economic development in a country.

b) Population with access to improved sanitation

Improved sanitation refers to the presence of efficient systems that hygienically remove human waste for processing without allowing it to come into contact with freshwater supplies. In MEDCs, almost everyone has access to improved sanitation whilst in many LEDCs, a lack of such systems is a major cause of disease such as cholera and associated high death rates.

c) Infant mortality rate

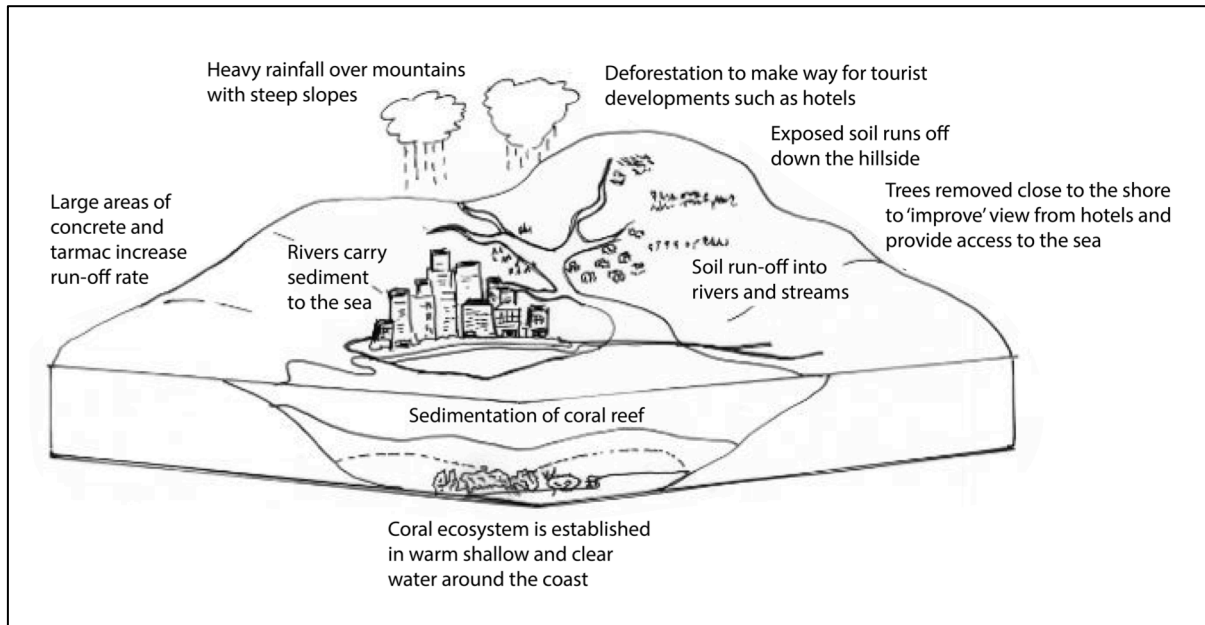
This measures the proportion of children dying at birth or before their first birthday per one thousand live births. It is a very accurate measure of the level of development of a country. In poorer countries where it is high, it is an indication of the lack of funds to invest in medical care. In richer countries with advanced medical facilities, the figure is very much lower.

2. A recent report by the United Nations Environment Programme (UNEP) identified deforestation particularly in the drier northern part of St Lucia as a major cause of land degradation. Loss of biodiversity, soil erosion and the sedimentation of rivers and coastal coral ecosystems and a reduction in the quality of both drinking and recreational water quality were all recognised as consequences of tree removal.

a) From the information in Table 9.1, suggest one reason for the removal of forest cover in St Lucia.

Over half the jobs that people do in St Lucia and nearly two thirds of the country's income comes from tourism. Tourists are people who visit St Lucia for recreation and leisure. Commonly this will involve staying at purpose-built hotels and resorts on the island. Building new resorts and leisure facilities such as shopping centres along the coast and in the mountains to attract more tourists will be a major cause of deforestation on the island.

- b) Draw a labelled diagram in the box below to show how sedimentation of rivers and coral ecosystems around the coast is likely to be caused.



- c) Why would it be likely that sedimentation of drinking water sources would lead to consumers in St Lucia having to pay more for their supplies?

The settling and build-up of silt and rock particles in sources of drinking water such as rivers and reservoirs will mean that extracted water will be more expensive for supply companies to purify. This cost would inevitably be passed on to consumers in increased unit prices.

3. Over thirty species of bird are resident in St Lucia. Of these, five are endemic species that can be found only on the island. One of these is the St Lucia parrot. Its habitat is tropical forest and with an estimated population of just 350–500 individuals, the bird is classified as ‘vulnerable to endangered’. Loss of habitat through deforestation followed by illegal collecting for the pet trade, are the two main causes of the bird’s decline from at least 1000 at the beginning of the 1950s. When the estimated number of parrots dropped to just 150 in the late 1970s, the Durrell Wildlife Conservation Trust supported by the St Lucian government began a captive breeding programme. The first pair of captive bred parrots was returned to the wild in 1989.



Fig. 9.26 St Lucia parrot.

- a) Captive breeding and release programmes are sometimes criticised as a means of protecting and restoring biodiversity in the wild. Using examples you have studied, explain why this is.

Despite examples of successful captive breeding and release schemes like the Arabian oryx and California condor, many ecologists are still critical of this approach. Some disapprove because they believe they tend to draw funds away from preserving habitat and protecting wildlife in the wild. They question the value of captive breeding if there is no habitat left

for the species to be released back into. Other schemes are looked on unfavourably because interbreeding from the narrow gene pools of small captive populations can mean animals are less able to survive in the wild. Ecologists can be unsympathetic because they believe captive-bred species on release are more vulnerable to predators, human activities and wild disease not encountered in captivity.

- b) The Durrell Wildlife Conservation Trust together with the St Lucia Forestry Department are now planning new surveys to obtain a more accurate count of parrot numbers. They do not have the resources to survey the entire remaining forest. How would you advise them to go about estimating parrot numbers on the island using a random sampling method? One approach is to divide the remaining forest into one kilometre squares and give each map square a number. Ten of these numbers could then be selected randomly by computer. Researchers would then visit only these ten squares of forest and count the birds they see in each over a set period of time. A mean figure could be calculated and then multiplied by the total number of squares of forest, providing an extrapolated total.

- c) One of the rarest endemic plants on St Lucia is *Bernardia laurentii* a small shrub found only on the rocky summit of the volcanic cone Petit Piton. It is not found anywhere else in the world and is classified as being under the threat of extinction.



Fig. 9.27 *Bernardia laurentii* plant.



Fig. 9.28 Petit Piton in St Lucia.

Explain how an ecologist might go about estimating numbers of the shrub using a quadrat or line transect. Suggest two things that might affect the reliability of your results.

A quadrat is a method of sampling the number, variety and distribution of the shrub within a small area of the summit habitat. The most common sampling area used is a square metre within a frame divided up into as many as fifty smaller squares. The results from the sample area quadrat are then extrapolated to arrive at an estimate for total numbers and density of the shrubs in the habitat as a whole. A line transect involves laying a measuring tape or rope with marked points across the mountain top habitat. Continuous sampling involving the identification and recording of all the shrubs touching the line along its entire length or systematic sampling where only the presence or absence of the shrub at previously agreed intervals along it is recorded. Extrapolating from samples assumes that the entire habitat has precisely the same ecological conditions as say, the sample quadrat locations or the line chosen along which to conduct a sample transect. The reality is that variables such as soil fertility, climate and exposure will change significantly in even a small area. The reliability of such extrapolated results will therefore be very limited. Other factors affecting the validity of the results will be the sample size (i.e. how many sample quadrats or transects are carried out) and the frequency of the sampling. The larger the sample size of quadrats and transects, and the more frequently they are carried out during the course of a year, the more reliable the extrapolated estimates of the number and spread of the shrub will be on Petit Piton.

4. Rainforest Adventures is a company offering fun and educational excursions for tourists and visitors to St Lucia. It aims to '*promote environmental consciousness and conservation awareness while striving to provide world class eco tourism*'. It offers activities such as riding forest canopy zip wires, leisure hiking along forest ecosystem nature trails, waterfall climbing, birdwatching and abseiling.



9.29 Hiking at Des Cartiers Rainforest Trail, St Lucia.

Explain what ecotourism is and why it might be considered a sustainable way of exploiting the forest of St Lucia that will ensure its long-term existence.

Ecotourism encourages visitors to enjoy natural areas in ways that ensure both the environment and local communities are conserved and enhanced. It is sustainable because the natural resources of people and nature that it relies upon are never exhausted. With forest eco-tourism activities, such as bird watching or hiking, the government of St Lucia would earn significant income (eco-tourism is often highly priced because of small group numbers and personal visitor itineraries) whilst ensuring the forests are protected for future generations.

5. Around the coast of St Lucia there are 90 sq km of unique coral reefs that grow on volcanic rocks. They are particularly extensive off the south and southwest coasts close to Soufrière Bay.



Fig. 9.30 Coral reef in St Lucia.



Fig. 9.31 Location of Soufrière Bay.

Sedimentation caused by eroded soil from the land that ends up in the ocean, where it reduces water quality, 'smothers' the coral and deprives it of light is a major threat to the coral ecosystem of St Lucia. The main natural cause of sedimentation of coral reefs is hurricanes and tropical storms, which impact the island regularly. The most serious human cause is the

development of the coastline for hotels, villas and apartments. Suggest how both hurricanes and human coastal development can cause sedimentation of coral reefs in and around Soufrière Bay.

A hurricane is a very large low pressure weather system which forms over tropical or sub-tropical water. Very strong winds of over 119 kilometres an hour spin around the system accompanied by torrential rain, thunder and lightning. Very strong waves generated by the winds can cause serious damage to coral reefs, often breaking coral branches, but it is the rain which has most serious effect. Exposed inland soils are easily eroded by the powerful rain and are washed into the sea, smothering corals with sediment and other debris, as well as fertilisers and pesticides which run off from farmland. Human activity by indiscriminately clearing forest from coastal slopes for tourist developments often makes this situation worse. Because of its location within the tropics, St Lucia receives heavy rain as a component of its natural climate throughout the year. With or without occasional hurricanes, exposed soils and sediments will rapidly dissolve into surface run-off and end up being deposited around the coastline in the shallow seas where the coral reef ecosystems have established themselves.

6. During the 1980s and early 1990s, pressure built up on the coral reefs around Soufrière Bay as both the resident population and the number of tourists visiting the south and southwest of the island increased rapidly. By 1990, there were over 150 commercial fishermen working the bay and two large holiday resorts, together with four smaller hotels and a number of guesthouses and restaurants right on the seashore, had been built. In addition, growing numbers of day charter boats and water taxis provided day excursions to the bay for people staying in hotels in the more developed north of the island.

This pressure created a number of environmental problems including:

- pollution of coastal waters by sewage, chemical fertilisers and solid domestic waste, especially plastics
- serious depletion of near shore fish stocks
- yacht anchor damage to reefs
- sedimentation of the reefs caused by soil erosion run-off from the land
- unregulated tourist activities such as diving causing damage to the coral reefs

These problems led to growing conflicts between different interest groups or stakeholders using the resources of the bay, particularly the following:

- disagreements between fishermen and dive operators who were trying to work the same areas
- disputes between yacht owners and fishermen when boats were anchored in fishing areas
- hostility between local residents and hotel and resort operators over which beaches tourists would be given exclusive access to
- arguments between fishermen and hoteliers and resort owners over which beaches would be used for commercial fishing activities such as processing and packing and which would have only recreational and tourism activities such as swimming and sunbathing

To solve these environmental problems and conflicts, in 1995 the government of St Lucia authorised the setting-up of the Soufrière Marine Management Association (SMMA) in order to conserve the natural marine environment and ensure its sustainable development in the future.

- a) What do you understand by the term 'sustainable development'?

This is the aim of improving the quality of life of the world's population through exploiting natural resources in ways which do not lead to their exhaustion or detrimental effects on the environment. In St Lucia, the government will want to earn income from its marine environment through tourism and fishing, but in a carefully regulated way. If the environment is degraded then tourists will stop coming and fish stocks will disappear and incomes will fall.

- b) Why is plastic waste a serious marine pollutant?

Plastic can take up to one thousand years to degrade and half of all plastics float. Plastic tends to degrade by breaking down into very small fragments which float on the surface or cover beaches when washed ashore. Living organisms like turtles can become entangled in plastic, or mistake it for food such as jellyfish. The largest concentration of marine plastic pollution is the Great Pacific Garbage Patch which has an area twice the size of Texas.

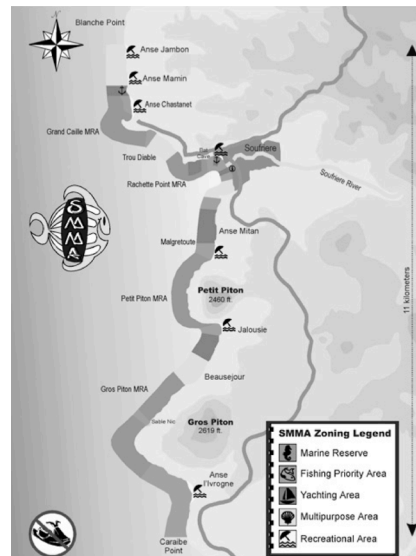
- c) Suggest how yacht anchors might damage coral reefs, particularly in stormy weather.

When storms occur, the winds generated will frequently be strong enough to move yachts and cause them to drag their anchors as they do so. If the yacht has anchored over a coral reef, the dragged anchor will often catch on the branches or polyps of the coral breaking them off as it is pulled along. In addition, dragged anchors also churn up sand and sediment which resettles and smothers the coral, blocking out light and reducing photosynthesis.

- d) One of the first things that the SMMA did was to draw up a code of conduct for people diving onto the coral reefs to adhere to. Suggest three things that they might have included.

To protect the coral it will be important for the SMMA to limit the number of people allowed to dive each day through insisting that they buy a permit from a central office. It could also make sure that diving only happens from the boats of licensed operators to reduce the number of vessels on the ocean at any one time. The code of conduct should also include instructions never to touch, otherwise damage or collect the coral. Oil from human skin, and especially from sunscreen worn by divers, can break down the fragile mucous membranes of the coral plants making them susceptible to disease and making it very difficult to feed properly. Collecting and selling coral is now illegal in many countries around the world such as St Lucia.

7. The map below shows what the SMMA did to ensure the sustainable development of the marine ecosystem of Soufrière Bay in the future.



9.32 SMMA marine zones.

- a) Explain in your own words the action that the SMMA has taken.
- The western coastal waters are divided up into distinctly separate areas and each zone has been allocated a different function. The most ecologically important area for marine life has been designated as a marine reserve where no other activity can occur. Areas with important fishing stocks have been given a fishing priority whilst those close to hotels have recreational uses such as swimming from beaches. An area has also been set aside for yacht owners so that they know exactly where to drop anchor without damaging wildlife.
- b) Why might this not necessarily end conflict between different users of the bay?
- Whilst it may be easy to mark out zones on a map it will be very challenging to control who uses each area across large areas of ocean. This will require constant patrolling by SMMA boats. For example, shoals of fish will not stay in one place, but will move with sources of food, which could mean fishermen operating in a recreational zone. Some yacht owners may seek out the most sheltered areas of coast to anchor, which may be above a marine reserve.
8. St Lucia is a relatively poor country by world standards. Gross national income per person (at purchasing power parity) stands at US\$10 290 compared with US\$38 530 per person in France. Each year the government of St Lucia earns US\$2 billion. In comparison the government of France earns US\$2544 billion a year. St Lucia is ranked by the World Bank as the 96th wealthiest country in the world (out of 186) and France is ranked 25th.
- a) Imagine a foreign developer approached the government to seek permission to build a huge resort that would accommodate at least 20 000 foreign tourists every year along a section of the coast designated as a marine reserve. Why might the government be persuaded to allow such a development?

A proposal such as this will be very difficult for a government seeking to become an MEDC to turn down. It will create many jobs for local people such as in services like catering. Thousands of extra tourists will spend millions of dollars locally, further boosting prosperity. The government will collect more tax from both the newly employed and the resort owners, some of which it can spend on improving the quality of the people who voted it into power.

- b) If you were an environmental manager, how might you convince them to hold to the SMMA sustainable development plan and not allow the development?

It would be important to show the government that although approving the resort proposal might bring in increased wealth in the short term, it would in fact be a negative long-term economic decision. Inevitably the marine reserve, one of the most important visitor attractions on the island and directly below the resort, would be degraded quickly. Visitors would then stop coming and income would fall. Protecting the reserve and encouraging several smaller-scale developments elsewhere would maintain and increase incomes steadily into the future. In this way, the government could be confident of developing economically in a sustainable way.