

Environmental systems and societies
Standard level
Paper 1

Friday 4 May 2018 (afternoon)

1 hour

Resource booklet

Instructions to candidates

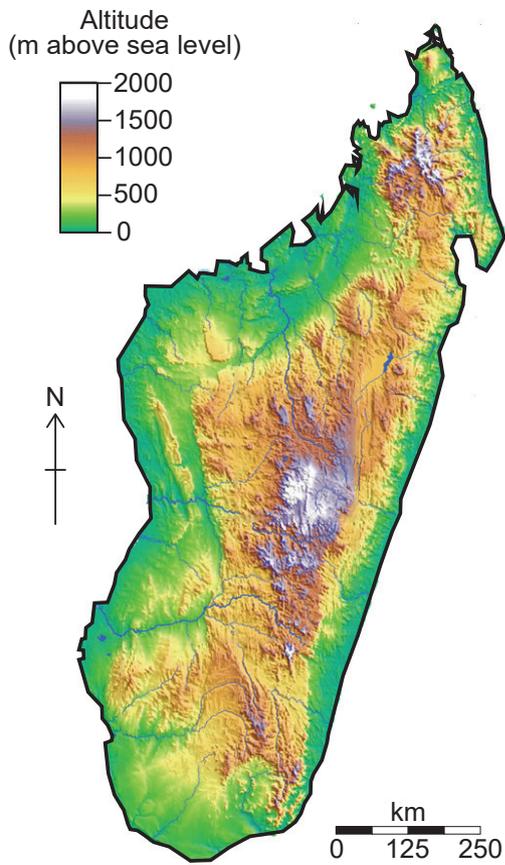
- Do not open this booklet until instructed to do so.
- This booklet contains all the resources to answer paper 1.

Figure 1(a): Map showing the location of Madagascar



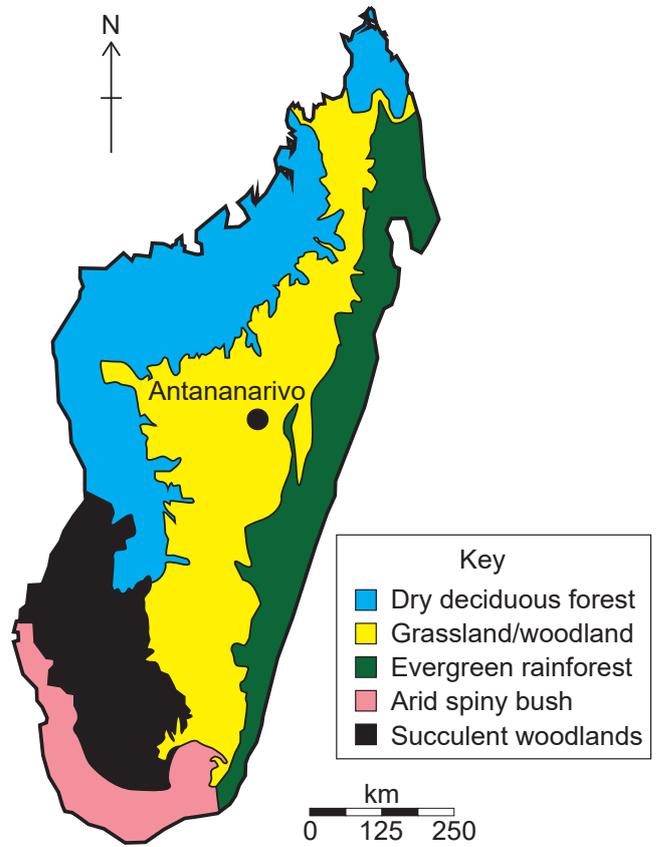
[Source: *The World Factbook 2018*. Washington, DC: Central Intelligence Agency, 2018.
<https://www.cia.gov/library/publications/the-world-factbook/index.html>]

Figure 1(b): Topographic map of Madagascar



[Source: vidiani.com. Licensed under CC BY-SA 3.0 (<https://creativecommons.org/licenses/by-sa/3.0/>)]

Figure 1(c): Map showing different biomes within Madagascar



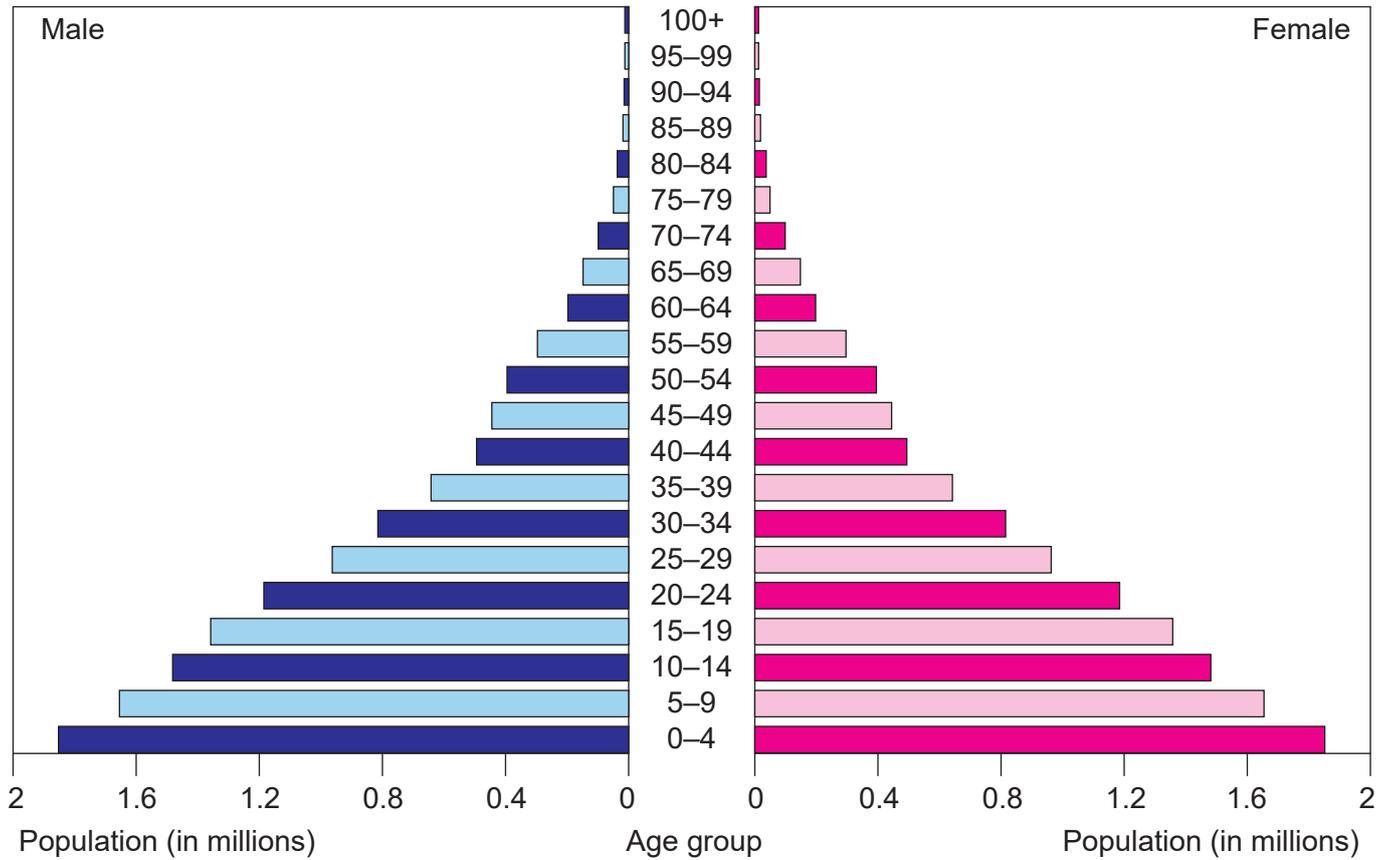
[Source: Adapted from PNAS article, Geogenetic patterns in mouse lemurs (*genus Microcebus*) reveal the ghosts of Madagascar's forests past (<http://www.pnas.org/content/113/29/8049>)]

Figure 2: Fact file on Madagascar

- Madagascar is the fourth largest island in the world. It is located in the Indian Ocean, off the eastern coast of Mozambique, Africa.
- The population is approximately 24 million (July 2016).
- In 2016, the crude birth rate was 32.1/1000 population and crude death rate was 6.7/1000 population.
- The main employment sectors are agriculture, fisheries and forestry.
- Exports include textiles, nickel and produce such as coffee, vanilla, sugar and shellfish.
- Areas of forest are being cleared for:
 - Traditional farming – most of the population relies on traditional subsistence farming
 - Timber – hardwoods such as ebony and rosewood are of high economic value
 - Charcoal production – spiny bush wood is commonly used for charcoal production.
- Soil erosion is a serious problem in Madagascar. In some areas, up to 363 tonnes/ha/year of soil are being lost.

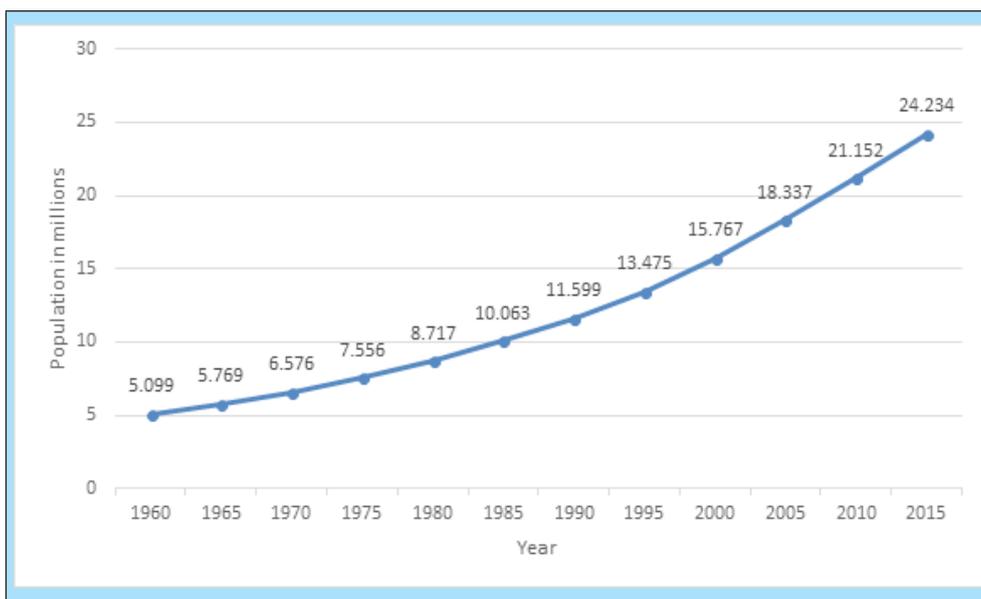
[Sources: *The World Factbook 2018*. Washington, DC: Central Intelligence Agency, 2018 <https://www.cia.gov/library/publications/the-world-factbook/index.html> and Rhett Butler/WildMadagascar.org]

Figure 3(a): Age-gender pyramid for Madagascar in 2016



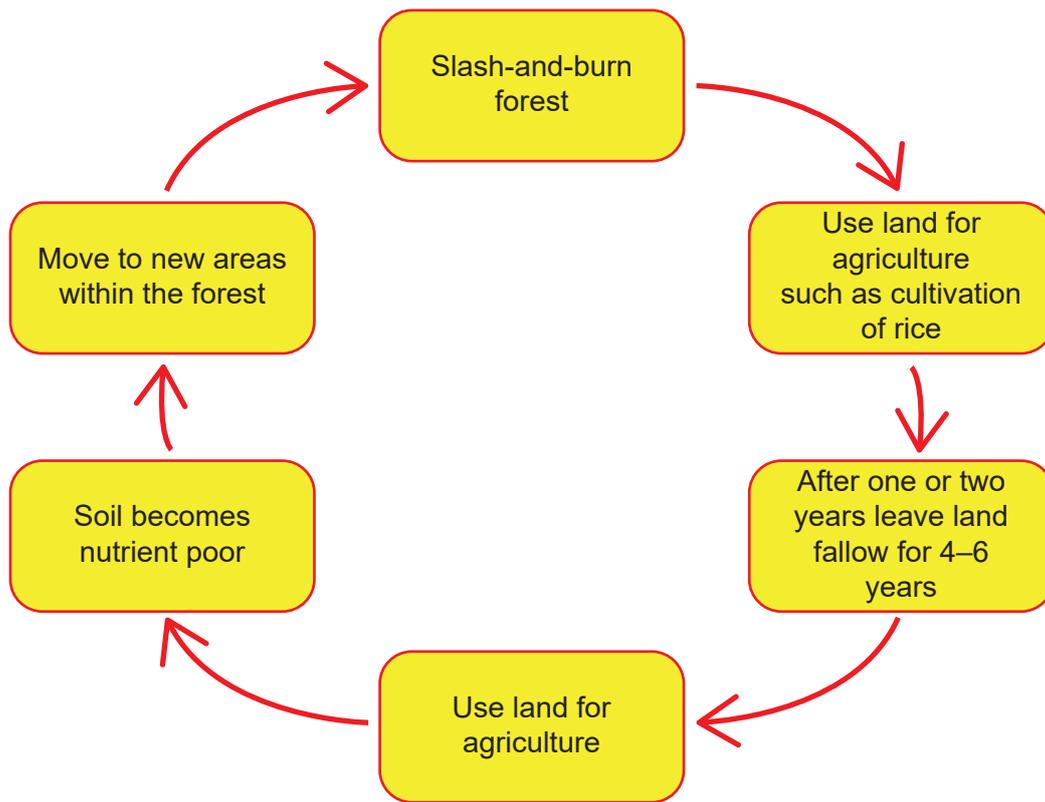
[Source: *The World Factbook 2018*. Washington, DC: Central Intelligence Agency, 2018. <https://www.cia.gov/library/publications/the-world-factbook/index.html>]

Figure 3(b): Population curve for Madagascar (1960–2015)



[Source: Data from World Bank, Bulletin Board on Statistical Capacity (bbbc.worldbank.org)]

Figure 4(a): Tavy – traditional method of slash-and-burn agriculture used in Madagascar



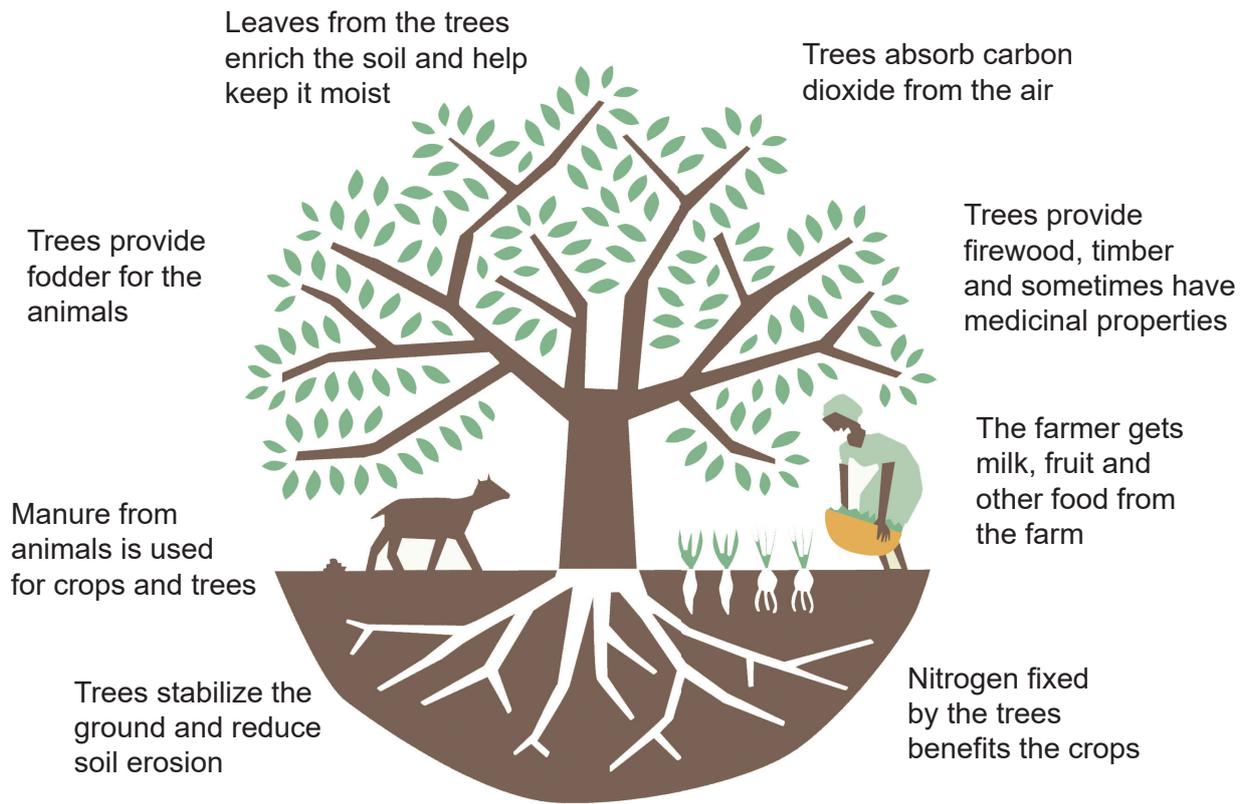
[Source: © International Baccalaureate Organization 2018]

Figure 4(b): Clearance of forest for traditional tavy method of agriculture



[Source: Diorit/Wikimedia commons. Licensed under CC BY-SA 3.0 <https://creativecommons.org/licenses/by-sa/3.0/deed.en>]

Figure 4(c): Agroforestry – an alternative to the traditional tavy method of farming



[Source: Vi Agroforestry. www.viagroforestry.org]

Figure 5(a): Fact file on Madagascan flora and fauna

- Madagascar is home to a diverse range of ecosystems including tropical rainforests, mangroves and coral reefs.
- The island contains 5% of the world’s biodiversity.
- There are over 200 000 known species in Madagascar of which more than 80% are endemic to the island (endemic species are those species not found anywhere else).
- Many species are hunted and collected as pets (for example lemurs, chameleons and tortoises).
- Alien species (for example introduced fish Tilapia) threaten native species (for example endemic cichlid fish species).

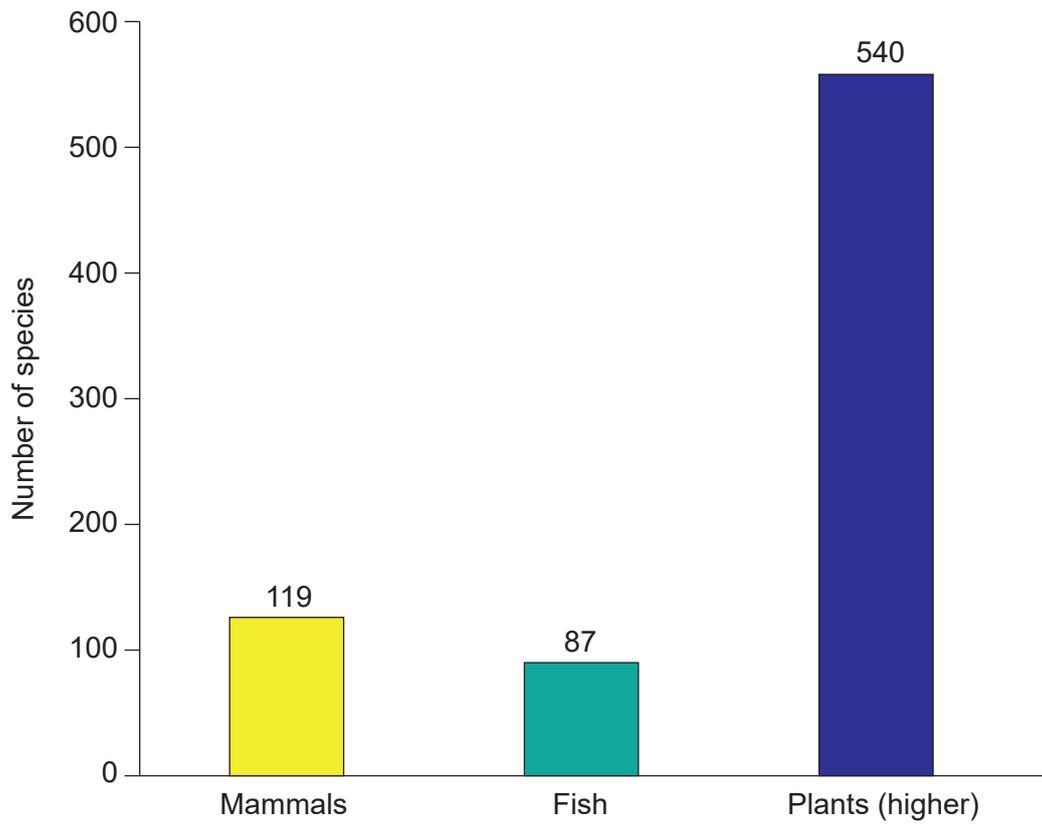
[Source: Rhett A. Butler / Mongabay.com]

Figure 5(b): Proportion of endemic species in Madagascar

	Total number of species	Endemic species (%)
Plants	12 000	90
Orchids	1 000	85
Palms	194	99
Amphibians	244	100
Reptiles	370	92
Bats	38	75
Lemurs	99	100
Fish	154	72

[Source: Madagascar Environmental Threats and Opportunities Assessment 2014 Update, USAID, <http://www.usaidgems.org/Documents/FAA&Regs/FAA118119/Madagascar2014.pdf>]

Figure 5(c): Threatened species in Madagascar



[Source: Graph adapted from <https://en.actualitix.com/>. Data adapted from <https://www.worldbank.org/>. Date accessed 01/03/16. Licensed under CC BY 4.0 <https://creativecommons.org/licenses/by/4.0/>.]

Figure 5(d): Endemic species of flora and fauna in Madagascar



Grandidier's baobab (*Adansonia grandidieri*)

[Source: Olivier Lejade (<https://www.flickr.com/photos/lejade/>). File licensed under CC BY-SA 2.0 (<https://creativecommons.org/licenses/by-sa/2.0/>)]



Madagascar periwinkle (*Catharanthus roseus*)

[Source: Fanghong/Wikimedia <https://commons.wikimedia.org/wiki/File:CatharanthusRoseus4.jpg>, file licensed under CC BY-SA 3.0 (<https://creativecommons.org/licenses/by-sa/3.0/deed.en>)]



Silky sifaka lemurs (*Propithecus candidus*)

[Source: Jeff Gibbs/Wikimedia. https://commons.wikimedia.org/wiki/File:Silky_Sifaka_mom_and_infant_close.JPG. File licensed under CC BY-SA 3.0 (<https://creativecommons.org/licenses/by-sa/3.0/deed.en>)]



Panther chameleon (*Furcifer pardalis*)

[Source: Marc Staub/Wikimedia. File licensed under CC BY-SA 2.0 (<https://creativecommons.org/licenses/by-sa/2.0/>)]



Ploughshare tortoise (*Astrochelys yniphora*)

[Source: Hans Hillewaert/Wikimedia (https://upload.wikimedia.org/wikipedia/commons/c/ce/Astrochelys_yniphora.jpg). File licensed under CC BY-SA 4.0 (<https://creativecommons.org/licenses/by-sa/4.0/>)]



Aye-aye (*Daubentonia madagascariensis*)

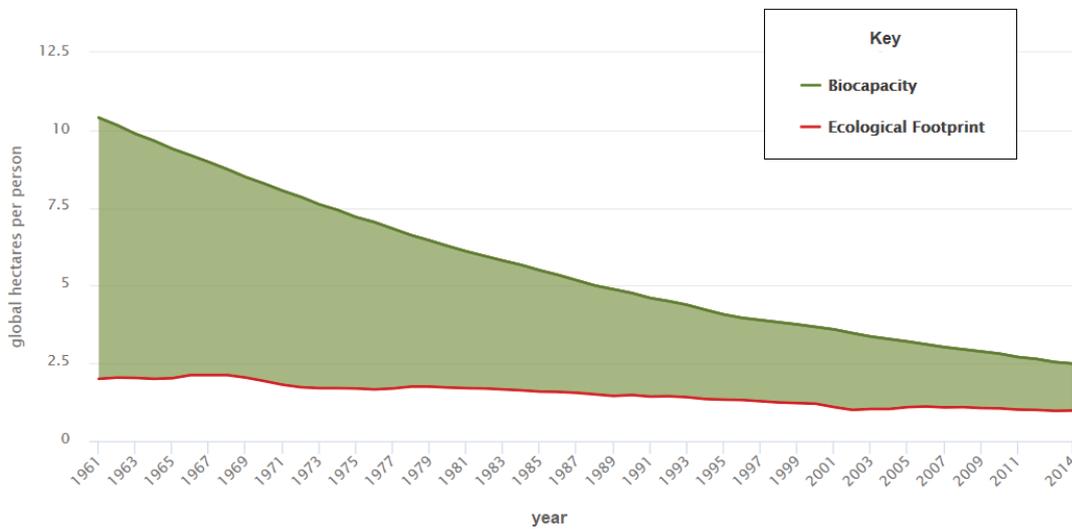
[Source: Frank Vassen/Wikipedia. File licensed under CC BY-2.0 (<https://creativecommons.org/licenses/by/2.0/>)]

Figure 6: Fact file on aye-aye (*Daubentonia madagascariensis*)

- Aye-aye are a species of lemur.
- These nocturnal (active at night) primates live in trees.
- They feed on insects, fruits, nuts and fungi.
- In some areas they are killed because:
 - they are believed to be evil and bring bad luck
 - farmers consider them to be a pest, as they eat crops
 - they are a source of food.
- Aye-aye were considered to be extinct in 1933 but populations were rediscovered in 1957.
- They are classified as endangered on the IUCN Red List.

[Source: © International Baccalaureate Organization 2018]

Figure 7: Ecological footprint and biocapacity* per person in Madagascar



[Source: Global Footprint Network National Footprint Accounts, 2018 Edition
Downloaded 7 July 2018 from <http://data.footprintnetwork.org>]

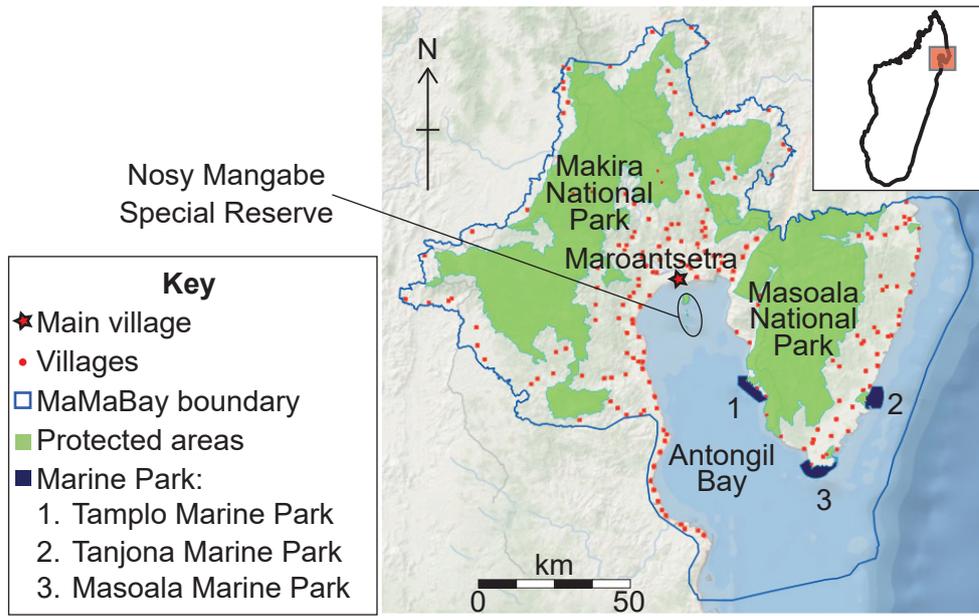
* biocapacity: amount of biologically productive land, measured in total hectares per person

Figure 8(a): Fact file on MaMaBay

- MaMaBay includes Makira and Masoala National Parks and Antongil Bay shown in **Figure 8(b)**.
- Masoala National Park was created in 1997 and Makira National Park in 2012.
- Forest within the Antongil Bay watershed contains about 50 % of the island’s biodiversity.
- Antongil Conservation, an NGO, aims to:
 - preserve diversity of forests
 - develop ecotourism (tourism in which visitors are attracted to see wildlife, has minimal adverse impacts on the environment, and supports conservation efforts and local people)
 - create alternative farming methods and income generation for local people.
- The bay is home to a wide variety of marine life which includes:
 - 11 whale species
 - 19 shark species
 - over 110 fish species
 - 3 turtle species.
- It is an important breeding ground for humpback whales.
- The coastal and marine ecosystem is under threat from high levels of fishing including illegal fishing, depletion of mangrove forest and sediment from river inputs.
- The island of Nosy Mangabe within Antongil Bay provides a sanctuary for the threatened aye-aye.

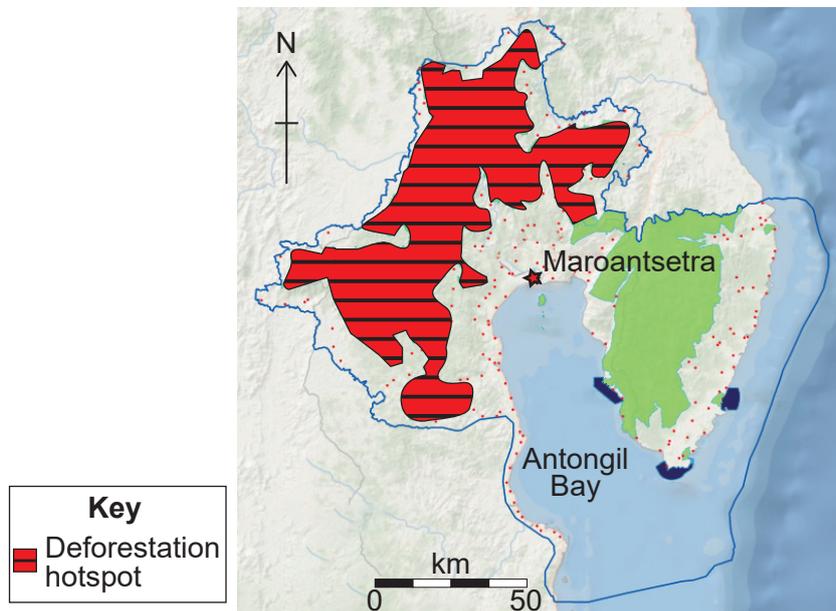
[Source: © International Baccalaureate Organization 2018]

Figure 8(b): MaMaBay including Antongil Bay, north-east Madagascar



[Source: Image produced by Wildlife Conservation Society]

Figure 8(c): Deforestation hotspots within MaMaBay in 2009



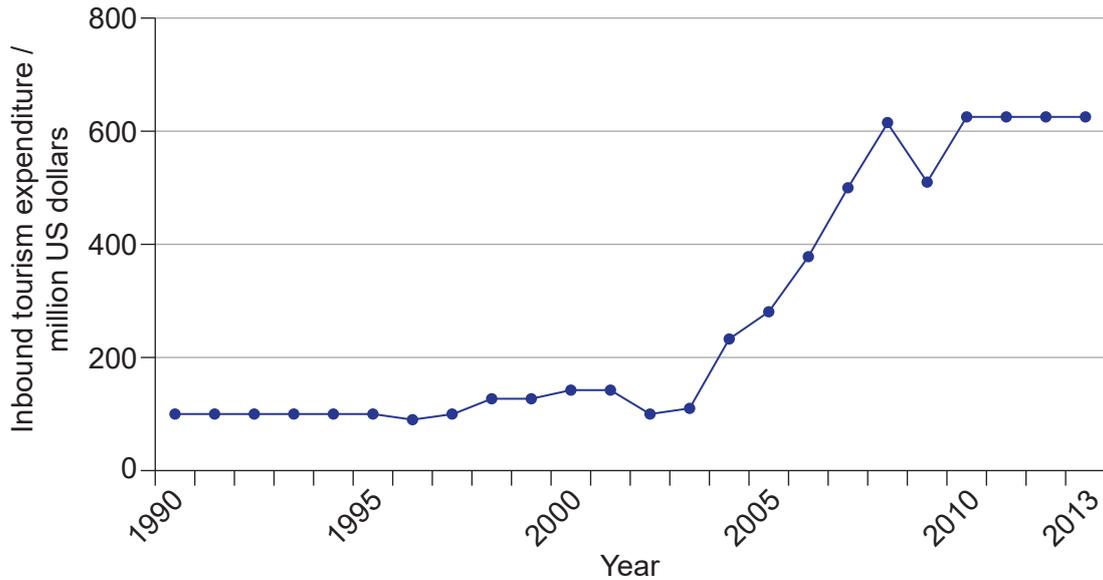
[Source: Achieving Conservation and Equity amidst Extreme Poverty and Climate Risk: The Makira REDD+ Project in Madagascar, Laura Brimont *et al*, *Forests* 2015, 6(3), 748-768. © 2015 by the authors; licensee MDPI, Basel, Switzerland. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution license (<http://creativecommons.org/licenses/by/4.0/>). Adapted map used with permission from Wildlife Conservation Society.]

Figure 9(a): Fact file on ecotourism

- The high level of biodiversity makes Madagascar an attractive location for further development of ecotourism.
- The World Travel and Tourism Council predicts that the tourist industry will increase at an average rate of 1.1 % per year and will support 912 000 jobs (13.2 % of total employment) by 2025.

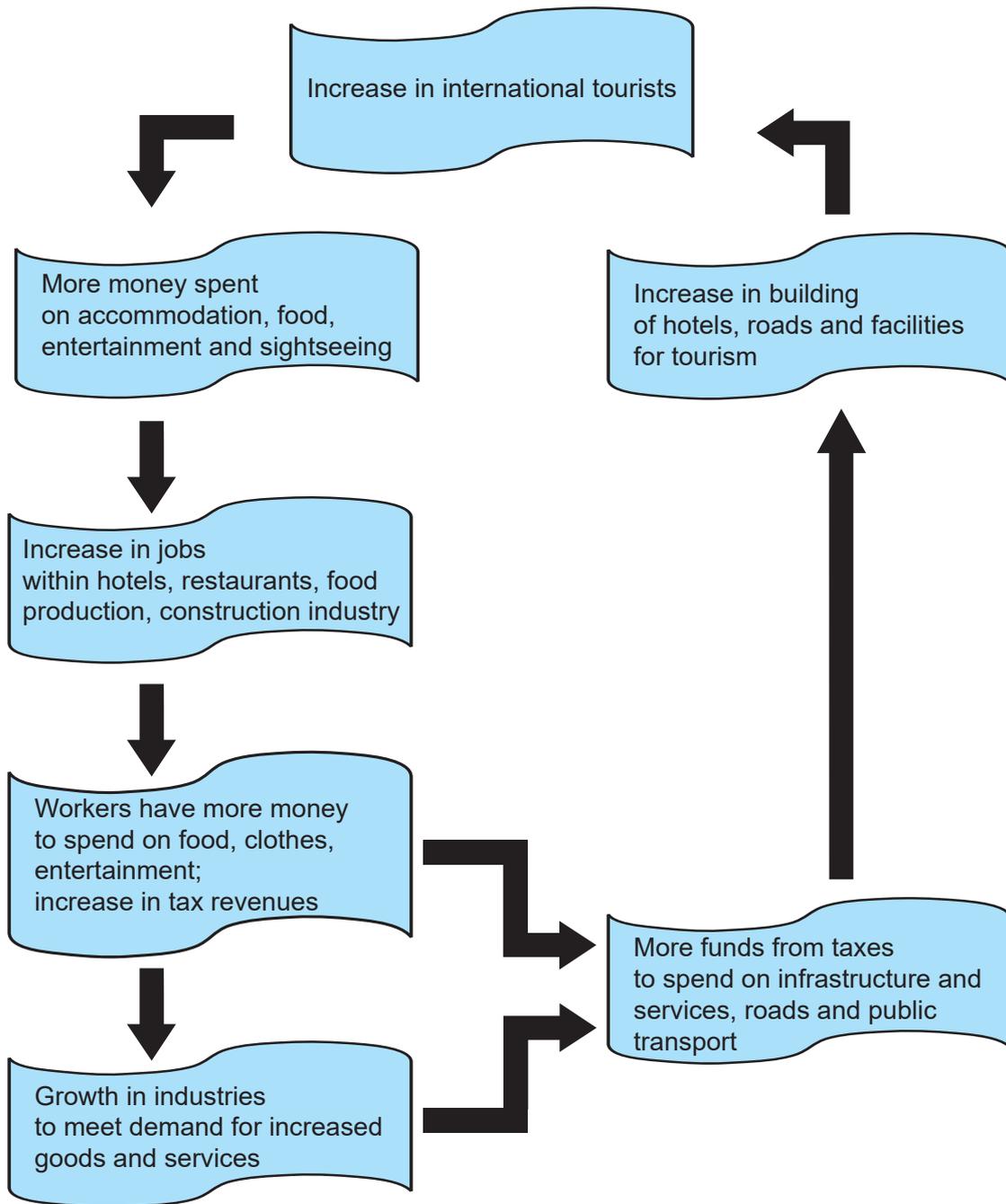
[Source: Data from World Travel & Tourism Council. 2015.]

Figure 9(b): Income from international tourism in Madagascar (1990–2013)



[Source: World Tourism Organization (2018), 'Basic data and indicators, Series 1.33: Inbound tourism – Total expenditure', *Compendium of Tourism Statistics*, dataset [Electronic], UNWTO, Madrid, data from 2013. © UNWTO 92844/24/18]

Figure 9(c): Tourism multiplier effect



[Source: © International Baccalaureate Organization 2018]