

**Environmental systems and societies**  
**Standard level**  
**Paper 1**

Friday 4 May 2018 (afternoon)

1 hour

# Resource booklet

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**Instructions to candidates**

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

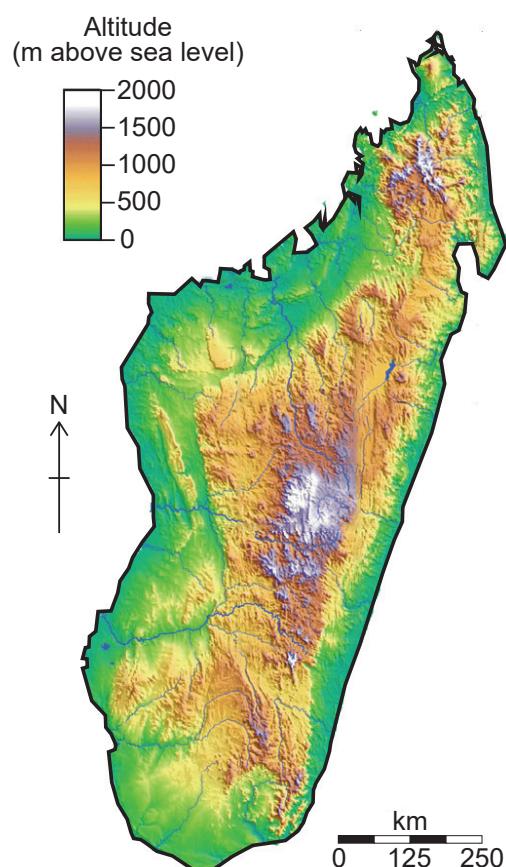
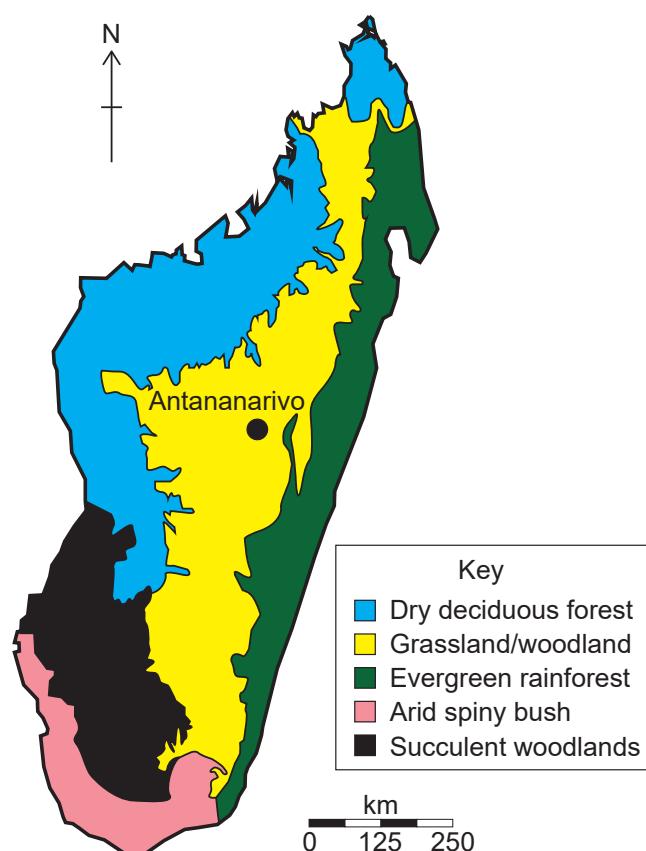
15 pages

2218–6302  
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**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****Figure 1(c): Map showing different biomes within Madagascar**

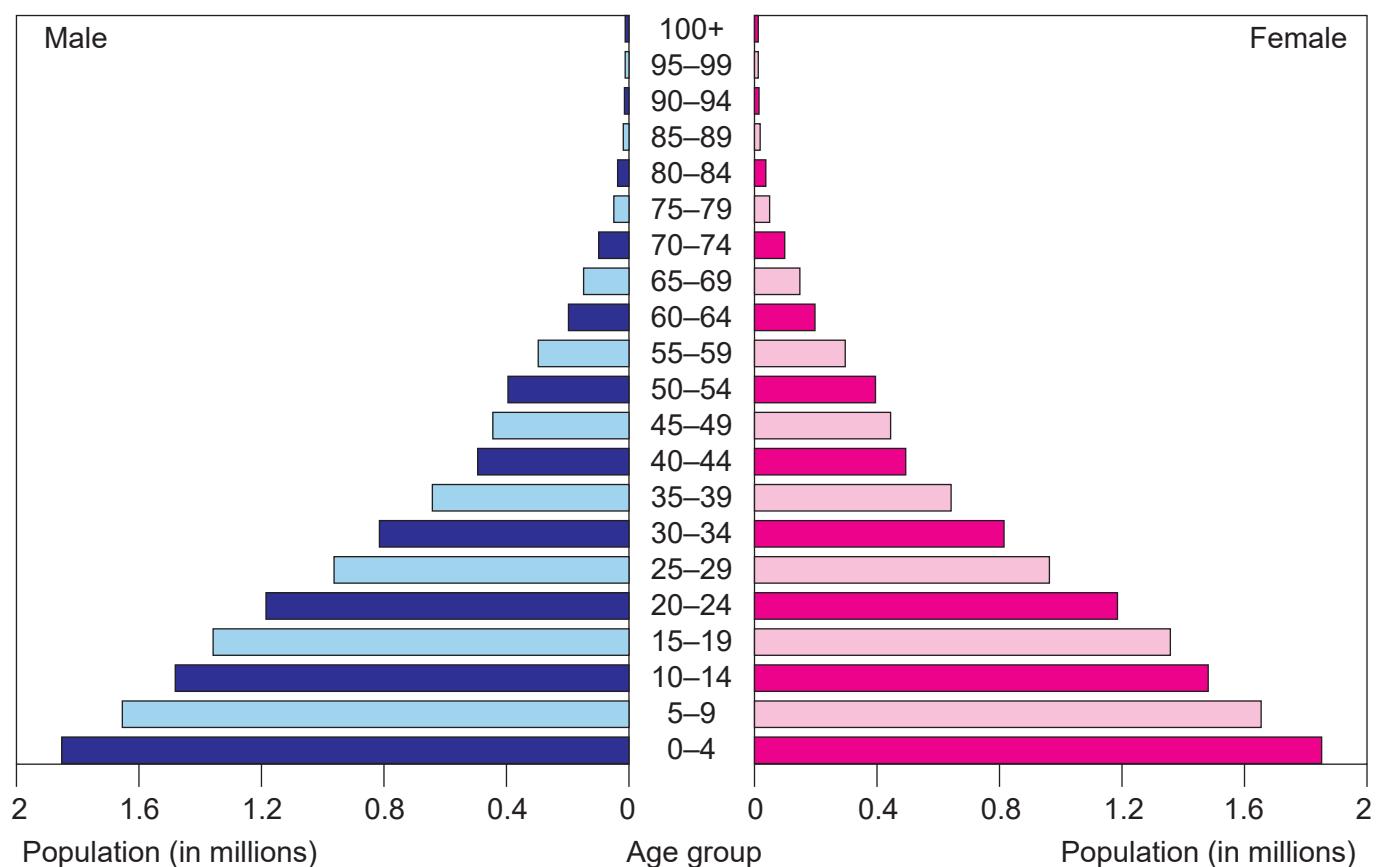
[Source: vidiani.com. Licensed under CC BY-SA 3.0 (<https://creativecommons.org/licenses/by-sa/3.0/>)]

[Source: Adapted from PNAS article, Geogenetics of Madagascar's mouse lemurs, Anne D. Yoder, C. Ryan Campbell, Marina B. Blanco, Mario dos Reis, Jörg U. Ganzhorn, Steven M. Goodman, Kelsie E. Hunnicutt, Peter A. Larsen, Peter M. Kappeler, Rodin M. Rasololainson, José M. Ralison, David L. Swofford, David W. Weisrock  
Proceedings of the National Academy of Sciences Jul 2016, 113 (29) 8049-8056; DOI: 10.1073/pnas.1601081113 (<http://www.pnas.org/content/113/29/8049>)]

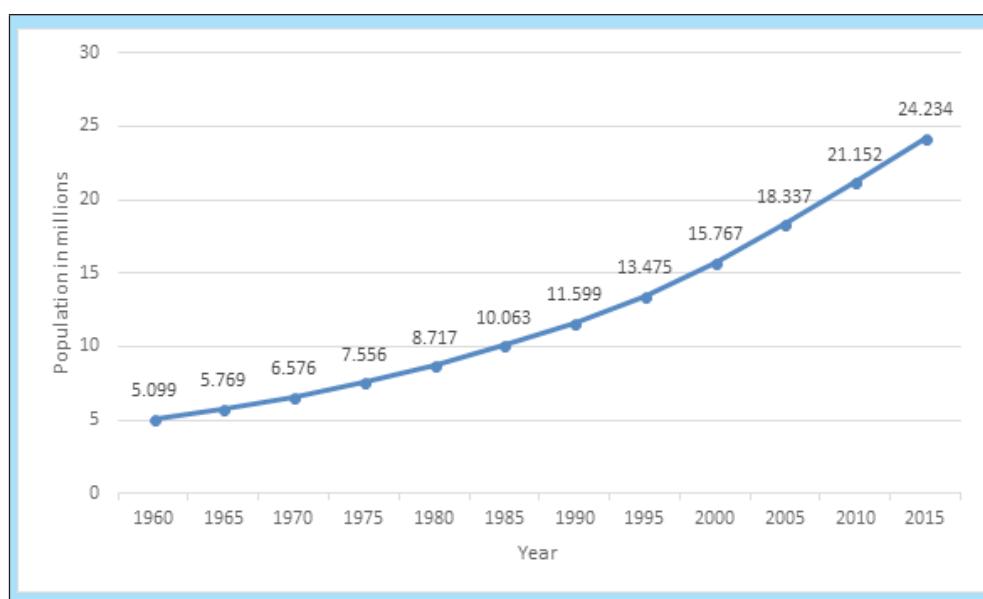
### **Figure 2: Fact file on Madagascar**

- 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 CIA, 2018 <https://www.cia.gov/library/publications/the-world-factbook/index.html> and Rhett A. Butler/WildMadagascar.org]

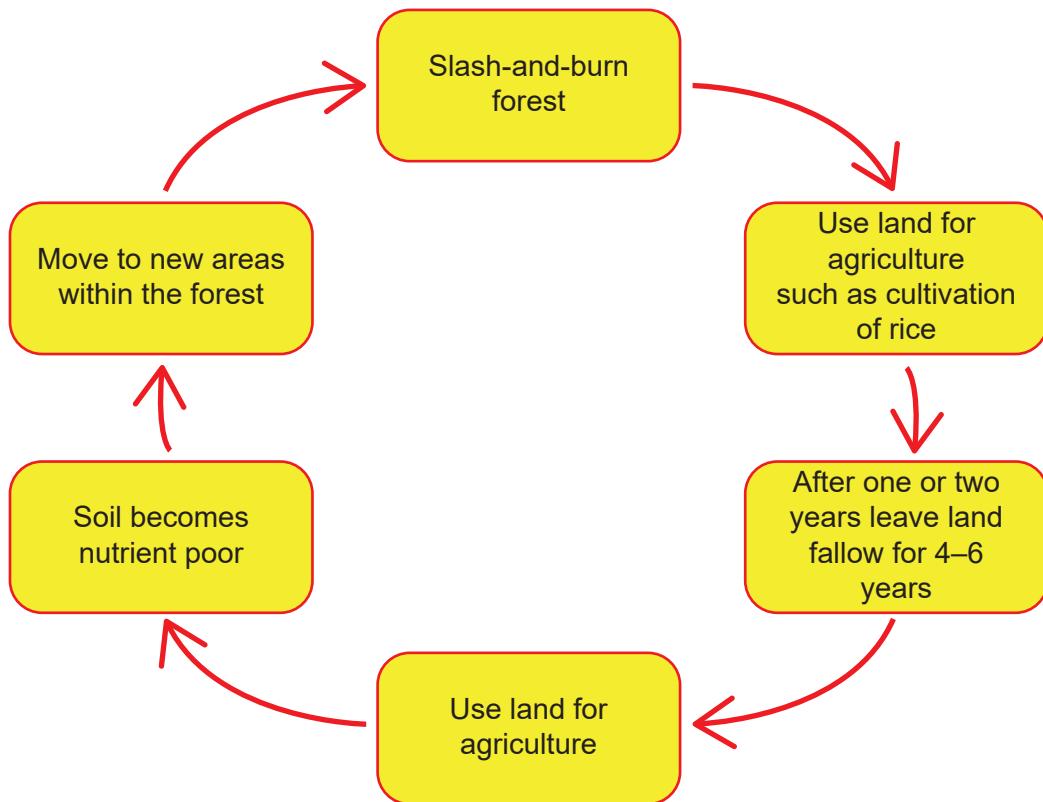
**Figure 3(a): Age–gender pyramid for Madagascar in 2016**

[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 ([bbsc.worldbank.org](http://bbsc.worldbank.org))]

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



[Source: © International Baccalaureate Organization 2018]

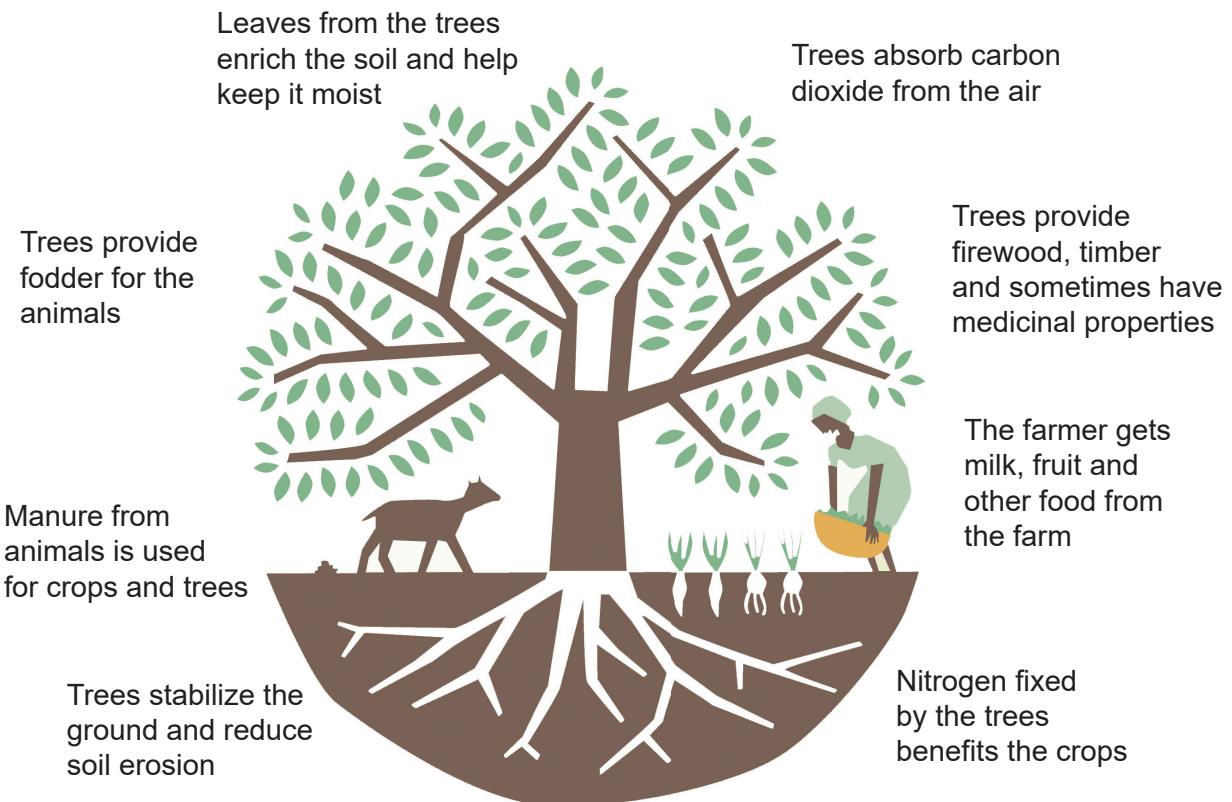
**Figure 4(b): Clearance of forest for traditional tavy method of agriculture**



[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](http://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 (%)
<b>Plants</b>	12 000	90
<b>Orchids</b>	1000	85
<b>Palms</b>	194	99
<b>Amphibians</b>	244	100
<b>Reptiles</b>	370	92
<b>Bats</b>	38	75
<b>Lemurs</b>	99	100
<b>Fish</b>	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**

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



Grandidier's baobab (*Adansonia grandiflora*)

[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](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](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*)

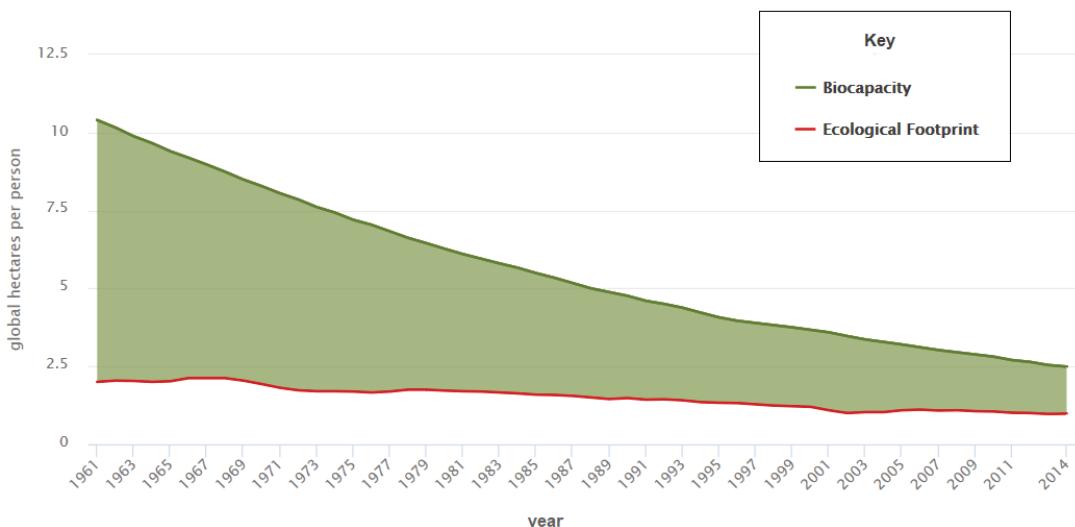
[Source: Frank Vassen/Wikipedia. File licensed under CC BY-2.0 <https://creativecommons.org/licenses/by/2.0/>]

### 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>]

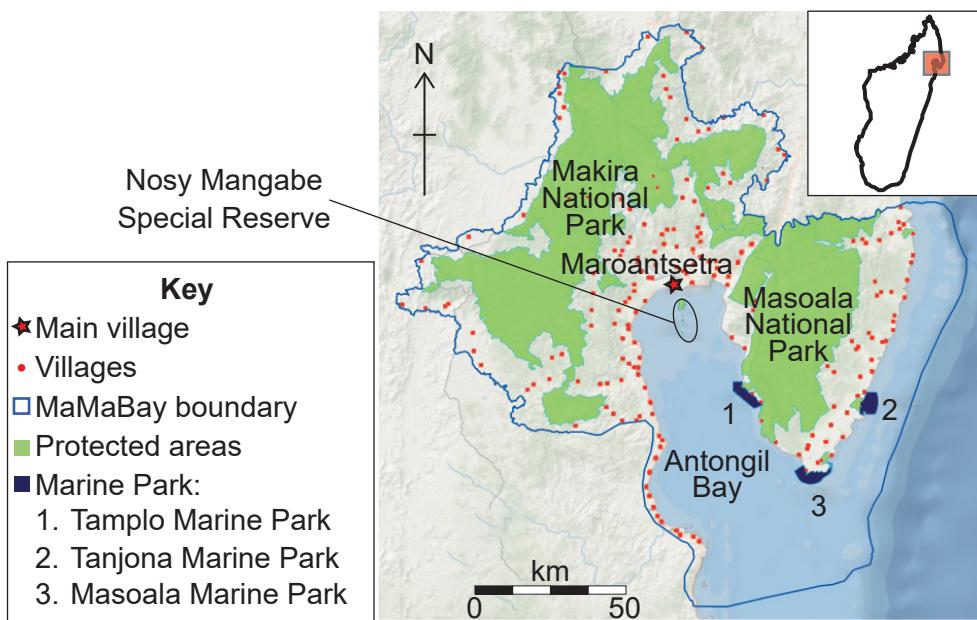
\* biocapacity: amount of biologically productive land, measured in total hectares per person

**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.

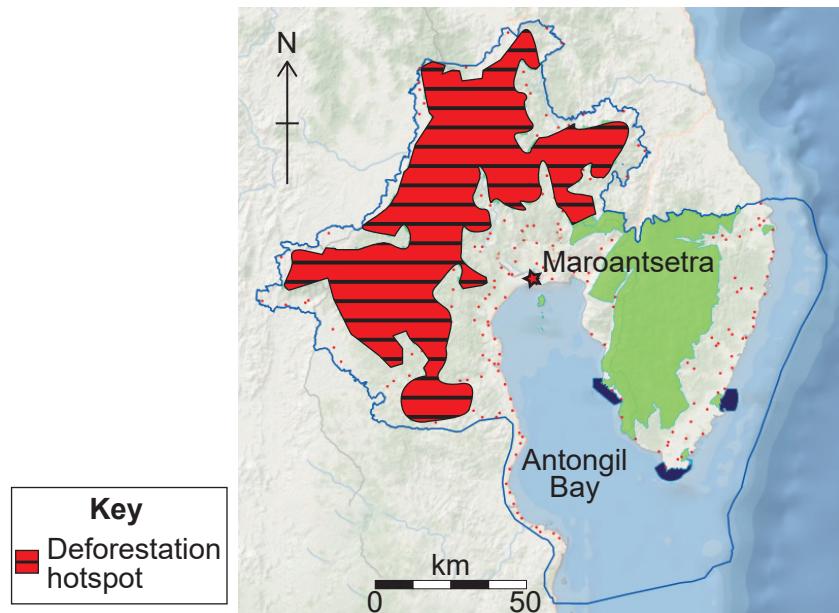
[Source: © International Baccalaureate Organization 2018]

**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**



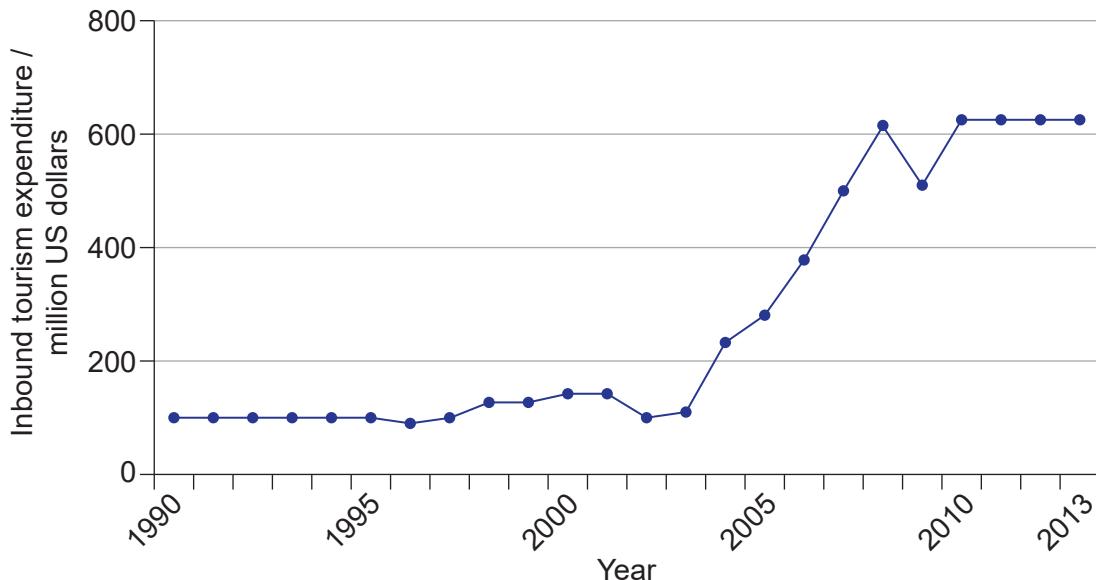
[Source: Achieving Conservation and Equity amidst Extreme Poverty and Climate Risk: The Makira REDD+ Project in Madagascar, Laura Brumont *et al.*, *Forests* 2015, 6(3), 748-768. © 2015 by the authors; licensee MDPI, Basel, Switzerland. This article is an open access article distributed under the terms 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

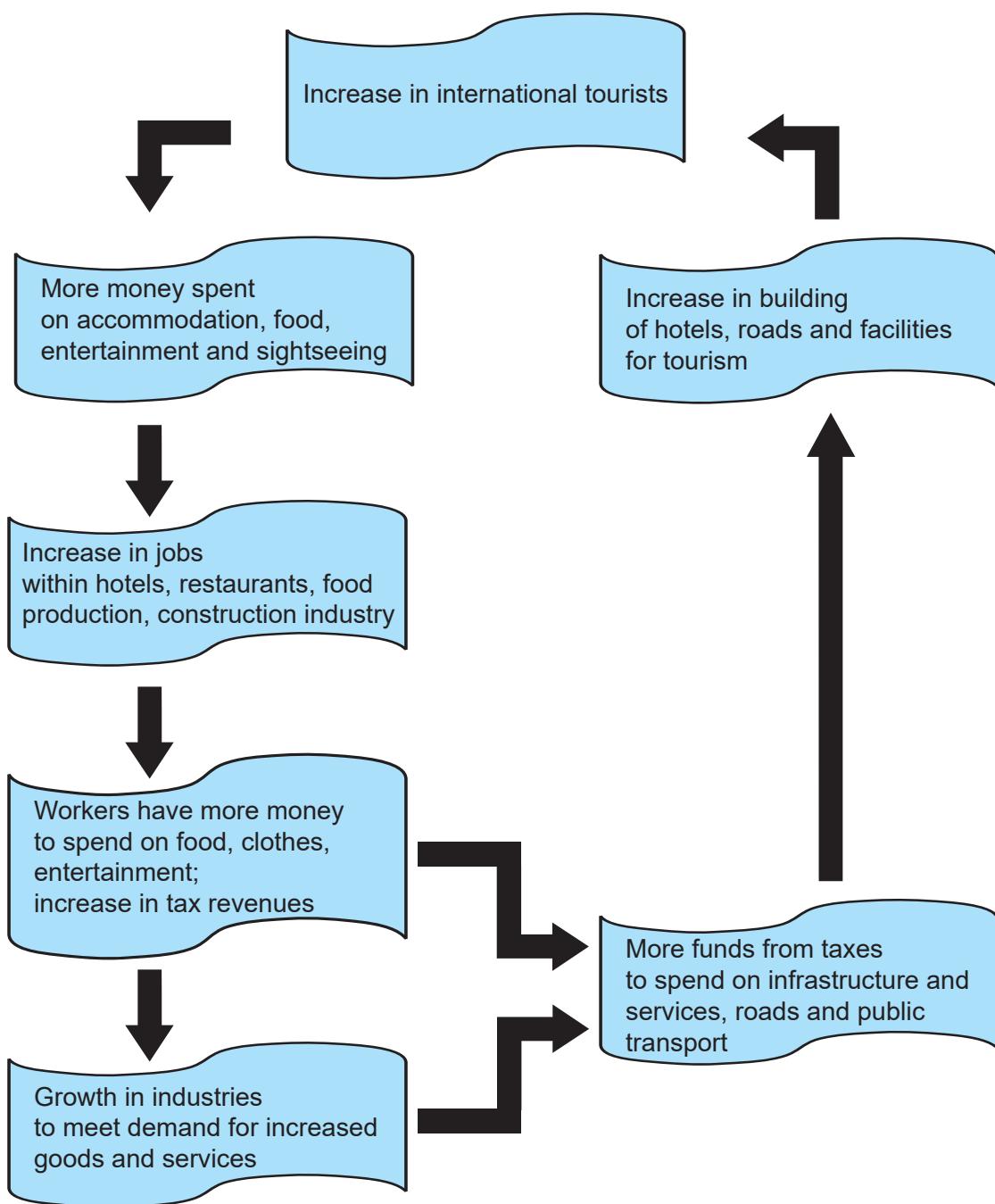
- The high level of biodiversity makes Madagascar an attractive location for further development of ecotourism.
- The World Travel and Tourism Council predicts that the tourist industry will increase at an average rate of 1.1 % per year and will support 912 000 jobs (13.2 % of total employment) by 2025.

[Source: Based on data published in 2015 from World Travel & Tourism Council.]

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



[Source: © UNWTO, 92844/42/19. World Tourism Organization (2018), Compendium of Tourism Statistics, dataset [Electronic], UNWTO, Madrid, data updated on 03/12/2018.]

**Figure 9(c): Tourism multiplier effect**

[Source: © International Baccalaureate Organization 2018]