

## GOING GLOBAL WITH CASE STUDIES TROPICAL RAINFOREST HERITAGE OF SUMATRA

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During my time teaching the Stage 6 Geography syllabus and marking the HSC Geography examination, it has been extremely rare to see other teachers using a non-Australian case study for the HSC Ecosystem at Risk topic. This may be due to the difficulty of building up enough content independently or a lack of confidence to move beyond the traditional case studies provided by textbooks. Yet there is no reason why case studies from outside Australia would not be acceptable. Indeed, there are several reasons why international case studies might be preferable. Firstly, they may appeal to particular student interests by taking them to an unfamiliar part of the world. They might also allow your class to explore a particular issue of interest that links in well with other syllabus topics or even cross-curricular areas. For example, the deforestation of mangrove forests across South East Asia is closely linked with the increasing production of aquaculture.

Table 1. Potential obstacles for using global case studies

Obstacle	Solution
Limited availability of fieldwork	<ul style="list-style-type: none"><li>• Complete fieldwork with the other HSC topics</li><li>• Organise an overseas excursion</li><li>• Create a virtual fieldtrip</li></ul>
Access to data and examples	<ul style="list-style-type: none"><li>• Largely available online</li></ul>
Unfamiliarity of students with context	<ul style="list-style-type: none"><li>• Excellent opportunity for student learning and broader contexts</li></ul>
Lack of textbook content	<ul style="list-style-type: none"><li>• Textbooks often steer students to think in particular terms</li></ul>

This year, my HSC class balked at having to study mangroves or sand dunes and I thought they would find an Alpine ecosystem very conceptually difficult. I'm a huge fan of giving students voice and choice in their learning and so after some discussion about the pros and cons, we decided to study an overseas case study topic. The students had been fascinated by tropical rainforests in the Preliminary course and the case study of Palm Oil driven deforestation was still resonating positively from their Stage 5 classes. The **Sumatran Tropical Rainforest Heritage** was shaping up to be a case study

that would generate student interest and allow students to compare and contrast some of the management perspectives used in a High-Income Country (HIC) like Australia with an Upper Middle-Income Country (UMIC) like Indonesia. An excited lunchtime conversation with the Indonesian Teacher at my school sealed the deal! Indonesia is a fascinating country for Australia. It's a very near neighbour with a massive population of over 270 million people that should be a significant partner with Australia. Yet, there have been tense political relations and limited trade for many years.

# ECOSYSTEMS AT RISK: SUMARTRA



Source: [https://upload.wikimedia.org/wikipedia/commons/f/f3/Yuli\\_Seperi\\_Orangutan\\_TNGL-1.jpg](https://upload.wikimedia.org/wikipedia/commons/f/f3/Yuli_Seperi_Orangutan_TNGL-1.jpg)

**About 80% of the world's documented species can be found in tropical rainforests, even though they cover only about 6% of the Earth's land surface – less than half the area they covered not so very long ago (WWF, 2020).**

The Tropical Rainforest Heritage of Sumatra was inscribed as a natural UNESCO World Heritage site in 2004. It was listed as *In-Danger* in 2011 and its conservation outlook is identified as *Critical* by International Union for Conservation of Nature (IUCN) demonstrating that this really is an Ecosystem at Risk. Although there are a very broad range of reasons justifying the management and protection of the Tropical Rainforest Heritage of Sumatra, the massive extent and the high levels of biodiversity are perhaps most significant factors. The rainforest is home to a variety of large endemic mammals such as the Orangutan, Sumatran Tiger, Elephant and Rhinoceros which are found nowhere else on Earth.

## Relevant syllabus content

**TWO case studies of different ecosystems at risk to illustrate their unique characteristics including:**

- spatial patterns and dimensions: location, altitude, latitude, size, shape and continuity
- biophysical interactions including:
  - the dynamics of weather and climate
  - geomorphic and hydrologic processes such as earth movements, weathering, erosion, transport and deposition, soil formation
  - biogeographical processes: invasion, succession, modification, resilience
- adjustments in response to natural stress
- the nature and rate of change which affects ecosystem functioning
- human impacts (both positive and negative)
- traditional and contemporary management practices.

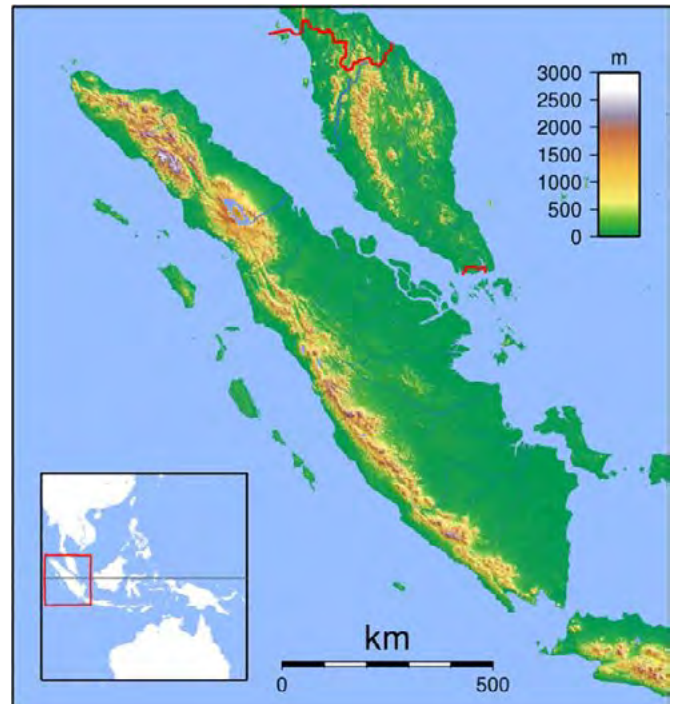
*Stage 6 Geography Syllabus (page 26)*

## THE TROPICAL RAINFOREST HERITAGE OF SUMATRA

### Spatial patterns and dimensions

Although originally occupying the whole island, The Tropical Rainforest Heritage of Sumatra is now largely confined to three national parks. There are 2.5 million hectares of Tropical Rainforest in Gunung Leuser National Park, Kerinci Seblat National Park and Bukit Barisan Selatan National Park.

The Bukit Barisan mountain range stretches along Sumatra, which means its rainforest can be found at altitude ranges from sea level to around 3 500m. The change in altitude allows for two distinct ecoregions to form. The lowlands rainforests create a buffer zone between the sea and mountains. Above 1000m montane rainforest grow in the slightly cooler climate.



Source: [https://commons.wikimedia.org/wiki/File:Sumatra\\_Locator\\_Topography.png](https://commons.wikimedia.org/wiki/File:Sumatra_Locator_Topography.png)

### Biophysical interactions

As with all ecosystems, this terrestrial rainforest ecosystem has a number of biophysical interactions that contribute to its unique character and functioning.

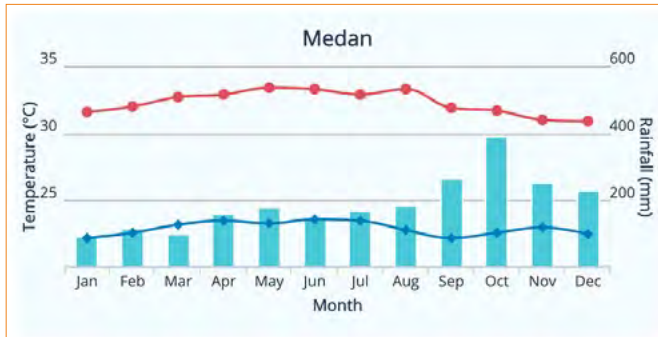
### The dynamics of weather and climate

Like all tropical rainforests, the lush, dense forest growth relies on high levels of heat and water being available to facilitate growth. Being located between 5° North and South of the equator, Sumatra experiences low pressure systems forming within the intertropical convergence zone (ITCZ). Many parts of Sumatra receive up to 4000



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millimetres of rainfall annually. Day time temperatures usually reach above 30°C. However, the high altitude of the Bukit Barisan mountain range also creates cooler Montane rainforest with high levels of precipitation, but cooler temperatures of less than 25°C.



Climate graph from Medan, Sumatra Source: [www.worldweather.wmo.int](http://www.worldweather.wmo.int)

## Geomorphic and Hydrologic processes

The convergence of the Indo-Australian tectonic plate and the Eurasian plate creates a subduction zone under Sumatra which has been responsible for producing the Bukit Barisan mountain range. An undersea earthquake in this same convergence zone which sparked the 2004 Boxing day tsunami. This convergent plate line is responsible for frequent volcanic activity on Sumatra. While this helps to produce rich fertile soils, it is also a source of natural stress events.

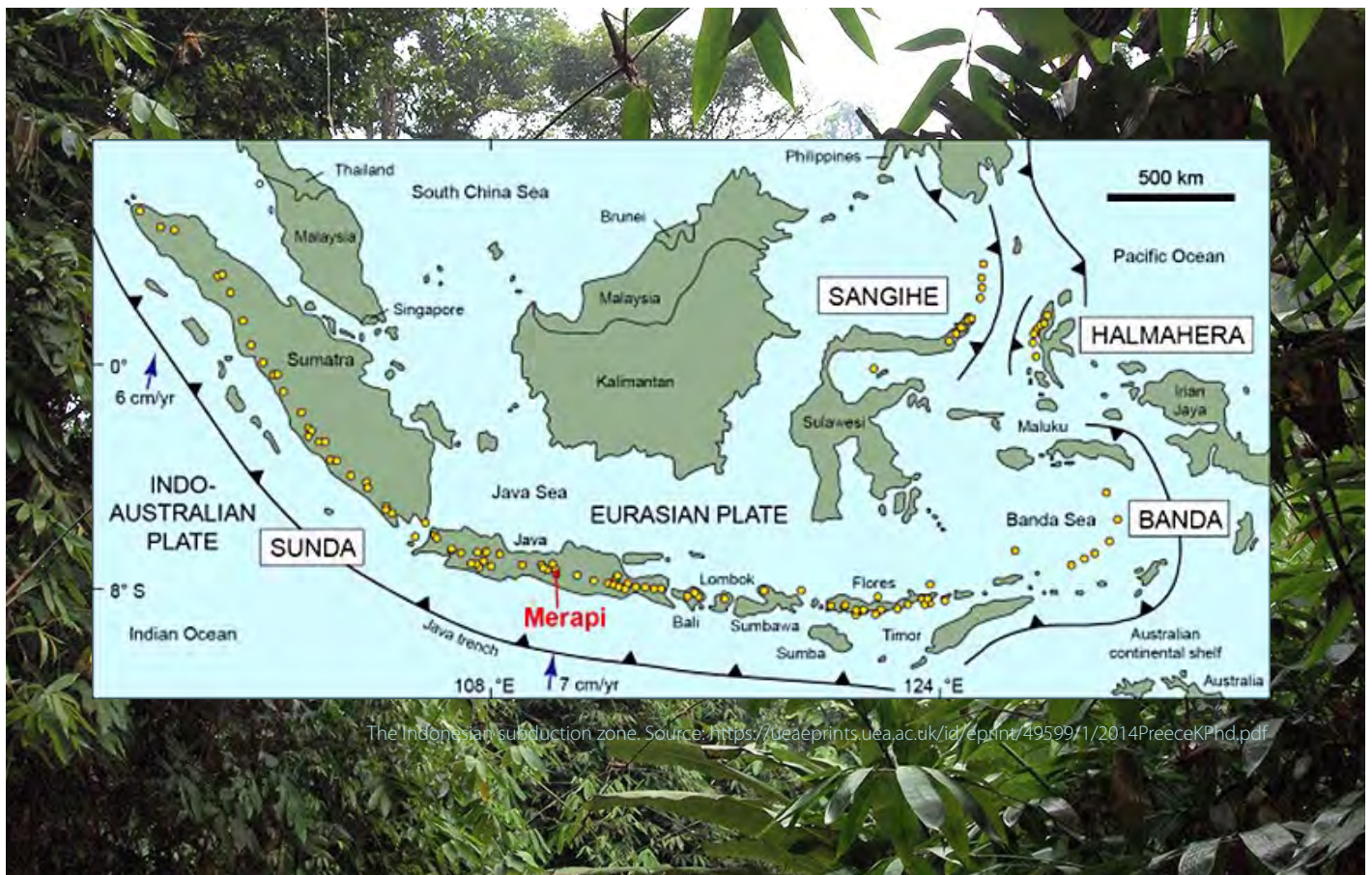
The Bukit Barisan mountain range also drives the rainfall and hydrology of Sumatra. Orographic rainfall will make its way East or West towards the coastline. As the water and eroded organic material slows on the coastal plains swamps and peat marshes have formed from the abundant organic matter.

## Biogeographical processes

The layered canopy of tropical rainforests is central to its functioning. The thick canopy traps heat producing a very high level of humidity. Different layers of the rainforest use a range of adaptations to suit conditions. For example, the understory plants need particular leaf structures to utilise the limited light. While the giant canopy trees and emergent rely on buttress roots to support their growth which can reach up to 60m.

The plant processes of Invasion and succession are a core resilience mechanism which allow the forest to restore functioning after a stress event such as a landslide or a volcanic eruption.

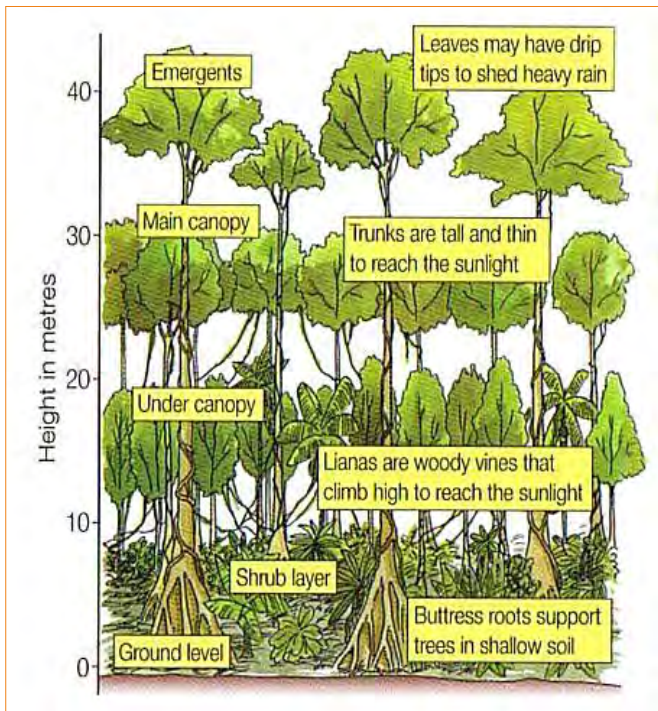
Like all rainforests the Sumatran rainforest is a site of extraordinarily high biodiversity. The interconnections with the rainforest are significant. For example, orangutans are the largest arboreal (tree-dwelling) animals and their fruit-eating results in ecologically significant seed-dispersal helping to shape the rainforests. Orangutans are a keystone species.



The Indonesian subduction zone. Source: <https://ueaeprints.uea.ac.uk/id/eprint/49599/1/2014PreeceKPhd.pdf>



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Typical rainforest canopy structures

## Adjustments in response to natural stress

The rainforest is well suited to its local conditions. However, the high levels of rainfall and steep topography occasionally produce landslides. Though volcanic activity provides the most serious natural stress events on Sumatra. During eruptions forest area can be destroyed by pyroclastic flows or flows of lava. Low lying areas are also subject to damage from tsunami following underwater seismic activity.

These natural stress events will all produce an invasion and succession response which allows the rainforest to recolonise areas after a natural stress event.

## The nature and rate of change which affects ecosystem functioning

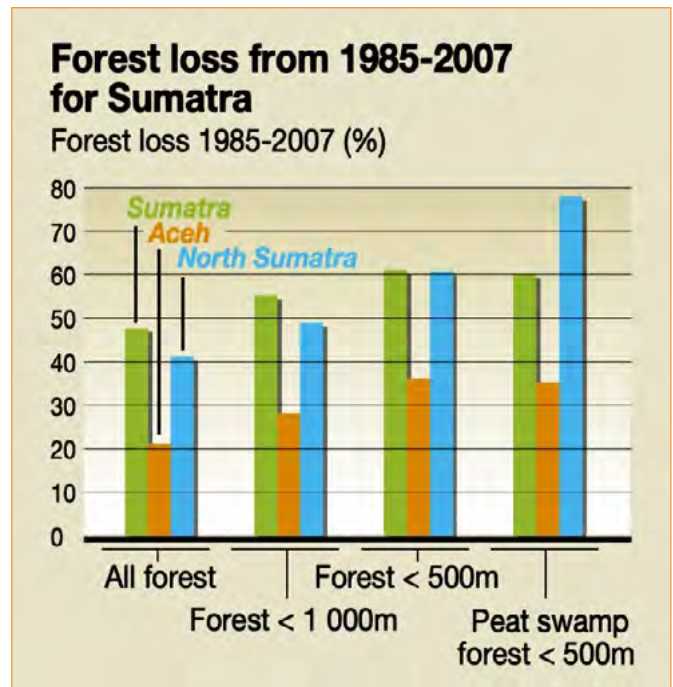
**Table 2. the nature and rate of change in the Sumatran tropical rainforest**

Rapid changes	Logging Palm oil plantations
Intermediate changes	Poaching and hunting
Gradual changes	Climate change Tourism transition

## Human Impacts

Land clearing is the most serious threat and occurs mainly for the extraction of timber resources and to utilise the land for agriculture. The deforestation of large tracks of Sumatran rainforest results in the fragmentation of forest into smaller, more vulnerable areas.

Logging is conducted both legally and illegally. Logging is an important source of revenue in a UMIC nation. Unfortunately, most logging is illegal and does not contribute to Indonesia's development.



Source: UNEP, 2011

The main form of agriculture on Sumatra has been the establishment of palm oil plantations. Palm oil consumption has rapidly expanded in the last 30 years.

Underneath the lowland rainforests a thick layer of peat has formed. When clearing land for plantations this peat is dried and becomes prone to fires. Fire is also used by companies to clear the deforested land. Such fires pose a significant air pollution issue for neighbouring South East Asian nations such as Singapore and Malaysia.

Poaching and hunting is a significant threat to large Sumatran mammal species, such as the Orangutan, Tiger and Elephants. This may occur due to the international pet trade or to prevent damage to palm oil crops. However, hunting for meat is still a significant activity in Northern Sumatra where most megafauna are found.

National park creation is a positive impact. The federal Indonesian government has also been able to create a moratorium on further land clearing.

One of the few hopes for the Sumatran Tropical Rainforest is that the values of ecotourism might be able to generate more revenue than that from resource extraction.

## Traditional and contemporary management practices

### Traditional management practices

Traditionally there have been a variety of styles of management practiced on Sumatra. The farmers of Ache cleared land for permanent agriculture but also used and valued the rainforest for hunting and gathering. In the interior of Sumatra, however, indigenous groups collectively known as Orang Rimba practiced a semi-nomadic, forest dependant lifestyle.

The Orang Rimba exist on a continuum with some groups living as relatively settled slash and burn farmers while others (*kubu*) maintained a hunter-gather existence. For the Orang Rimba, an intensely thorough ecological knowledge passed on through cultural means like language, stories and dances is the most important management practice. Orang Rimba groups also maintain various taboos, such as a prohibition on the hunting of elephant or eating rice (preferring gathered yams instead). Their semi-nomadic lifestyle was another management practice which allowed for periods of ecological recovery. The Orang Rimba migrate large distances following the death of a loved one in a practice known as Melangun.

The traditional peoples of Sumatra largely kept the rainforest as a common which could be used to provide for people without title held land ownership.

### Contemporary management practices

Unfortunately, since the 1980s exploitation of the timber resources and the establishment of palm oil plantation has been the main goal of ecosystem management. The Indonesian authorities have been primarily concerned with economic development meaning a lack of governance is the more significant aspect of management in Sumatra.

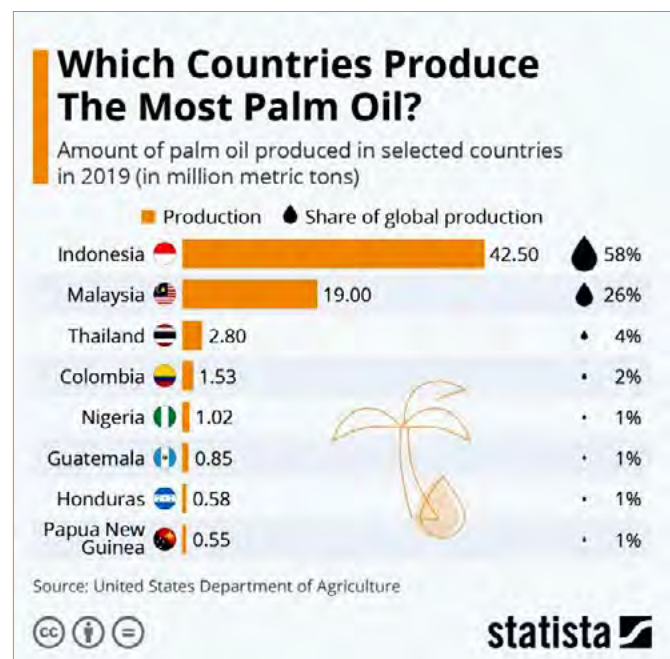
The most significant management actions aimed at protecting the rainforests have come from international NGOs such as WWF and Greenpeace. Their monitoring activities have provided significant base line data. In some cases, larger international NGOs partner with smaller local groups, such as Eyes on the Forest to monitor the land grabbing and disregard for tenurial rights shown by multinational corporations. The Sumatran Rainforest Institute uses the promotion of agroforestry to address the economic disadvantage that drives poaching and illegal logging. The growth of coffee and cacao trees also provides a microclimate buffer between rainforest and cleared land.

Individuals have worked to establish reserves. Although these are a good methods of preserving a genetic pool, these reserves often lack the range and extent required by large mammals.

**Table 3. Contemporary Management Practices**

<b>Local Management Practices</b>	– Establishing reserve populations.
<b>Federal Management Practices</b>	– Logging Laws – National Park Creation
<b>Global Management practices</b>	– Paris Agreement – REDD+ – CITIES – UNESCO World Heritage Listing

There have been recent agreements to prevent further logging from Sumatra at the national level. In 2017, the Indonesian President approved an extension on a moratorium banning extensions of logging. The area protected now exceeds 66 million hectares. However, illegal logging has proved very difficult to prevent and the management authorities are often the main perpetrators of the logging.



Major global producers of palm oil Source: <https://cdn.statcdn.com/Infographic/images/normal/23097.jpeg>

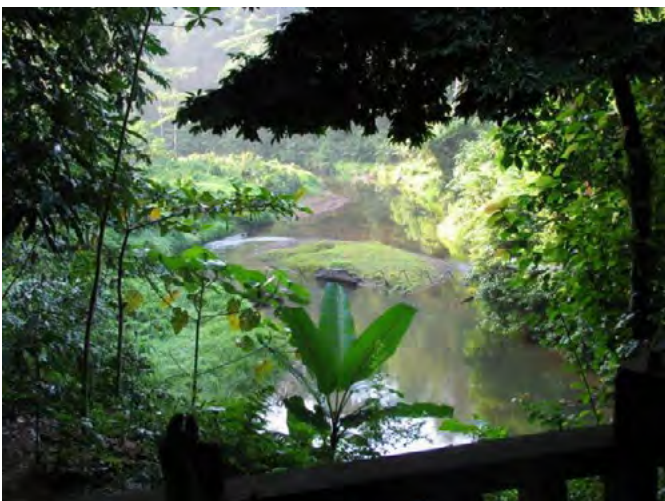


The promotion of palm oil as an export commodity has prevented the rainforest from undergoing succession. Similarly, the large tracks of rainforest required to support large mammals like tigers and elephant mean that smaller reserves and fragmented tracks of land are not sufficient in quantity to support healthy populations. Between 1985 and 2007, nearly half of the forest on Sumatra disappeared. The two Indonesian provinces where Sumatran orangutans occur, Aceh and North Sumatra, have witnessed a total forest loss of 22.4% and 43.4%, respectively from 1985-2008/9 (UNEP, 2011)

A challenge faced in the management of timber is that the demand comes from international sources. If illegally logged timber is being feed into a global supply chain then consumers are unable to make ethical choices. Similarly, many products that use palm oil will not be required to make consumers aware of this. Genetic marking of timber has proven to be a useful way of preventing illegally logged timber from entering the global market. Many transnational corporations are also ensuring that the palm oil they use is sourced ethically.

There is a strong link between indigenous rights and rainforest protections. Similarly neighbouring countries of Singapore, Malaysia and Thailand have made complaints about the impacts of Sumatran forest fires.

Similarly, there is little reason for optimism in protecting this ecosystem as risk unless the economic value of the forest can be shown to outweigh the value of the timber and palm oil resources. The UNEP produced a report outlining the economic value of rainforest ecosystem services to Sumatran agriculture. As the global economy moves towards carbon accounting there is also an opportunity for Indonesia to revalue to its forests as assets in a global carbon market. The REDD+ international agreement does this and gives additional rationale for preserving forested lands.



Source: IUCN World Heritage Outlook



Source: IUCN World Heritage Outlook

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- ABOVE: Sumatra's rainforest situation critical according to World Heritage Outlook. Source: <https://worldheritageoutlook.iucn.org/explore-sites/wdpaid/902335>
- LEFT: This image depicts the natural values of the Sumatran rainforest Source: <https://whc.unesco.org/en/list/1167>