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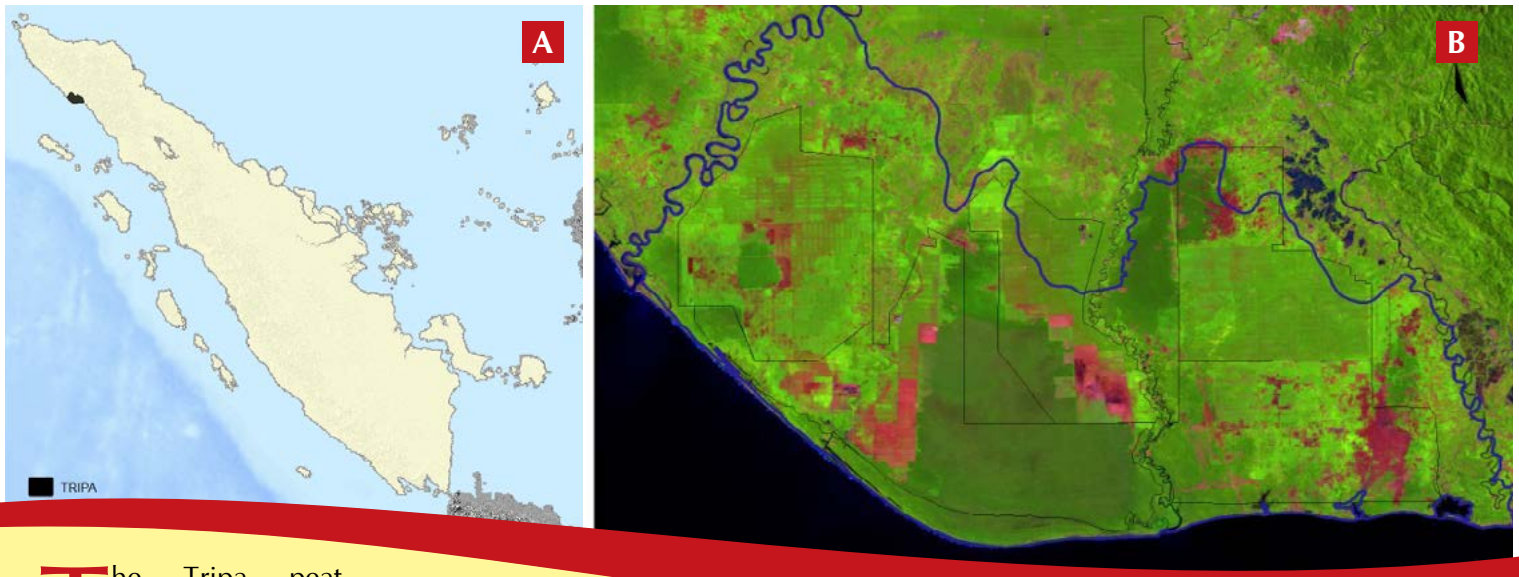
TRANSFORMING LIVES AND LANDSCAPES

Conversion of the Tripa peat swamp forest and the effect on Sumatran orangutan (*Pongo abelii*) habitat and aboveground carbon loss



Cover picture: Location of Tripa in Sumatra (A), Coverage of study area on Landsat TM image (B)

Tripa Series

The Tripa peat swamp forest, which is located on the west coast of Aceh province and falls administratively under the two districts of Nagan Raya and Aceh Barat Daya, is known to be an important habitat for Sumatran orangutan (*Pongo abelii*).

The distribution of this big ape species has been identified mostly in the northern part of Sumatra island, with the population estimated to be 6000–7000 individuals [1,2]. In Tripa alone, the population was estimated to be 280 [1].

The Sumatran orangutan, which is found in both lowland and peat swamp forest, is a 'flagship' species categorised as 'critically endangered' in the IUCN Red List. Under Indonesian law, orangutan is a protected species (Law 5/1990 on Conservation of Natural Resources and the Ecosystem and Regulation 7/1999 on Conservation of Flora and Fauna Diversity).

Despite its identified importance for conservation, the peat forests in Tripa have experienced high change dynamics. To understand these dynamics, assessments of conversions of vegetation cover in the Tripa area have been conducted, including estimation of the loss of aboveground carbon. Historical analyses can be useful to support efforts to protect the remaining peat swamp forest in Tripa.

Highlights

1. Land-cover conversions, including from ecologically important peat swamp forest, in the area of the Tripa peatland were mostly towards commercial uses, such as oil palm plantations
2. The designation of Leuser Ecosystem Zone (*Kawasan Ekosistem Leuser*) in Tripa peat swamp was expected to stem forest conversion but did not do so
3. Conversion of Tripa peat swamp forest has consequences for the loss of Sumatran orangutan habitat and the loss of aboveground carbon stock, aside from consequential greenhouse gas emissions from the development of peat drainage canals.

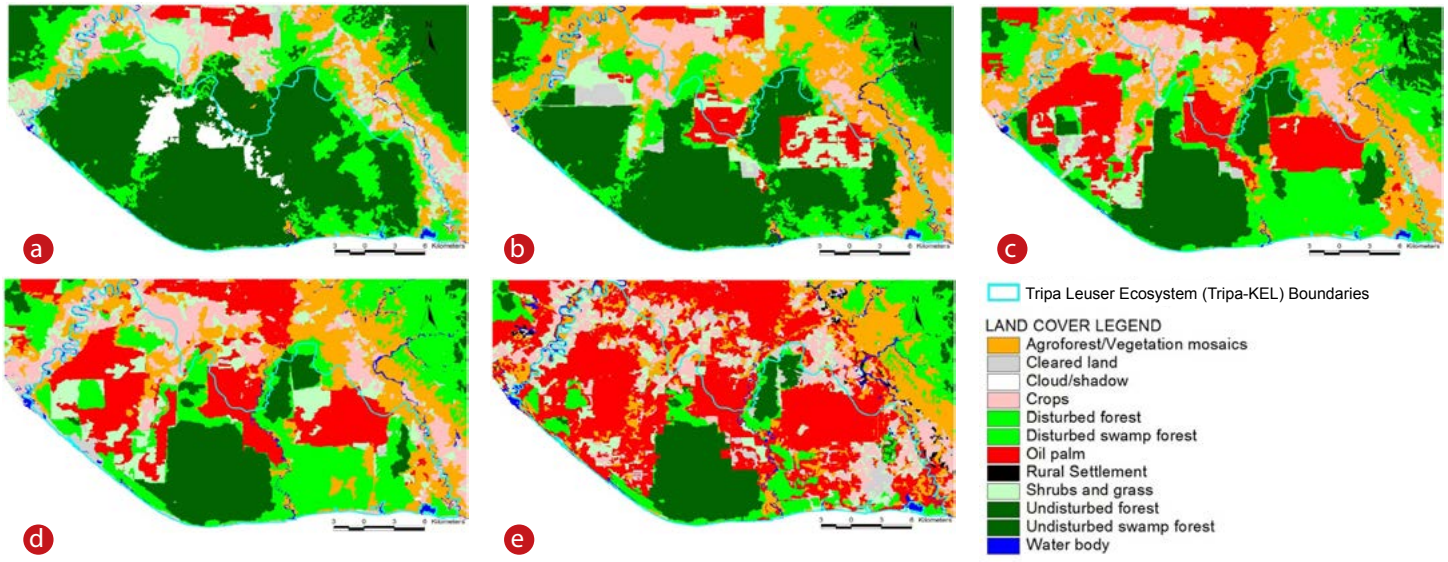


Figure 1. Land-cover changes in Tripa-KEL and vicinity: (a) 1990; (b) 1995; (c) 2001; (d) 2005; (e) 2009

Land-cover conversions, including from ecologically important peat swamp forest, in the area of the Tripa peatland were mostly towards commercial uses, such as oil palm (*Elacis guineensis*) plantations

The assessment of land-use dynamics was based on time-series analyses of land-cover maps in Tripa and vicinity over two decades (1990–2009)[1] (Figures 1 and 2). In the first observation (1990), Tripa was mostly covered by forest: as much as 67 000 hectare or 65% of the area, of which most was peat swamp forest. In the most recent year of observation (2009), forest cover was 19 000 hectare (18% of the area). The largest forest conversion took place from 2005 to 2009, with the loss of approximately 4000 hectare per year.

Oil palm plantations were seen to be the largest land-cover type as well as the most rapidly expanding. In 1995, there was 5800 hectare of oil palm plantations in the area; in 2005 they had grown to 19 000 hectare; and by 2009 they had doubled to 39 000 hectare. Such expansion figures indicate an average growth of 4900 hectare of oil palm plantations per year. Of the conversions to oil palm, the conversion from forest alone was approximately 1700 hectare per year.

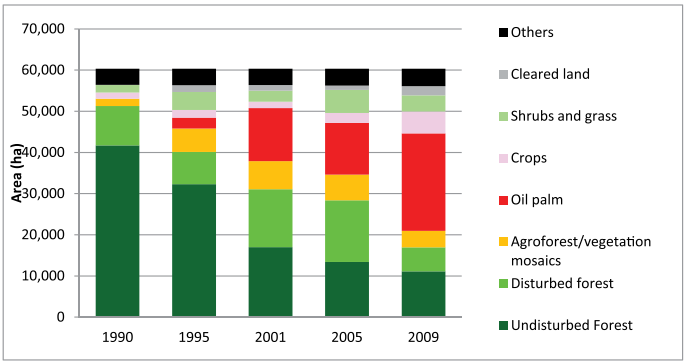


Figure 2. Land-use changes Tripa and vicinity, 1990–2009

1 Land-cover maps were produced based on remote-sensing approaches from Landsat imageries.

The designation of Leuser Ecosystem Zone (*Kawasan Ekosistem Leuser/KEL*) in Tripa peat swamp was expected to stem forest conversion but did not do so

The Tripa peat swamp forest received special designation as part of the Leuser Ecosystem Zone (*Kawasan Ekosistem Leuser/KEL*) based on Presidential Decree No. 33/1998 on Leuser Ecosystem Management.

However, that designation was not reflected in the widely used zonation of the Forestland Designation Map issued by the Ministry of Forestry and Plantations (1998): in this map, Tripa's status was Non-Forest Land (*Area Penggunaan Lain*/APL).

The Tripa-KEL area is approximately 60 000 hectare (Figure 1). To see the dynamics of changes around the establishment of the Zone, Figure 3 shows the percentages of different land-cover types in Tripa-KEL in 1995 (before the Zone was established), in 2001 (after the Zone was established) and in the most recent year of observation (2009).

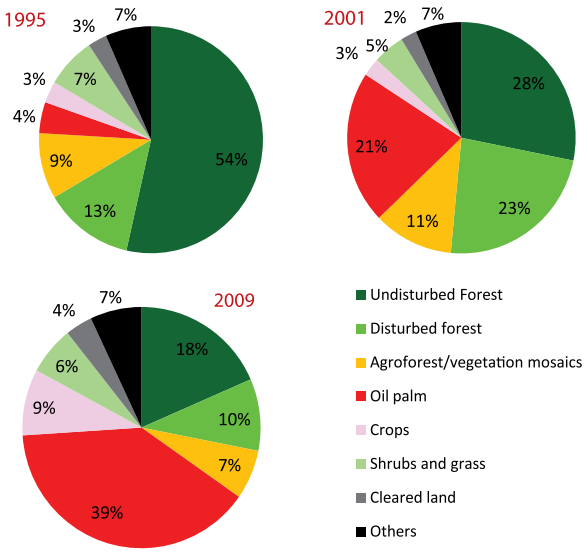


Figure 3. Percentages of land-cover types in Tripa-KEL, 1995, 2001 and 2009

In the mid-1990s, when most of the concession rights were issued, the land cover of the Tripa-KEL was dominated by forest, while oil palm was only around 2400 hectare (4% of the area). In 2001, three years after establishment of the Zone, oil palm had expanded to 12 800 hectare (21% of the Tripa-KEL), and by 2009 it was 23 600 hectare (39%). The remaining forest cover in 2009 was 17 000 hectare (28%).

Overall, expansion of oil palm plantations from the mid-1990s to 2009 reached 1500 hectare per year. Observing the period after the Tripa-KEL was established, oil palm expansion only slightly reduced, to 1300 hectare per year, and the contribution of forest cover being converted to oil palm was approximately 850 hectare per year. During the last period of observation (2005–2009), conversion of forest to oil palm leaped to 3000 hectare per year.

Threats to the Tripa-KEL were unstoppable because the concession permits that had been previously issued continued to be operational. The lower expansion rate between 2001 and 2005 presumably was probably an effect of conflict stemming from the independence movement in Aceh. The increasing expansion per year from 2005 to 2009 was most likely influenced by the growing economy during the post-tsunami reconstruction period and the peace agreement between the *Gerakan Aceh Merdeka* (Aceh Independence Movement) and the Indonesian Government. These events have been cited as the main trigger for the growing timber extraction and forest encroachments.

Despite its special status as the Tripa-KEL, this had no significant impact on the rate of expansion of oil palm expansions. More law, in which peat forest was supposed to be protected, was established under the National Action Plan on Greenhouse Gas Emissions Reduction through Presidential Regulation no. 61/2011. Ironically, peat swamp forest conversion in Tripa has continued to take place at least until early 2012.

For the remaining forest cover of 17 000 in 2009 in Tripa-KEL, if the rate of conversion of 3000 hectare per year persists, Tripa's forest cover will completely disappear within 6 years, that is, by 2015–2016.

Conversion of Tripa peat swamp forest has consequences for the loss of Sumatran orangutan habitat and the loss of aboveground carbon stock, aside from consequential greenhouse gas emissions from the development of peat drainage canals.

Loss of forest directly implies loss of aboveground carbon owing to the loss of vegetation biomass being extracted or otherwise logged. Due to the loss of these biomasses, aboveground carbon stock density in Tripa area decreased from 158 ton per hectare in 1990 to 67 ton per hectare in 2009 (Figure 4).

Estimated aboveground CO_2 emissions[2] from land-cover changes in the Tripa-KEL ranged 9.8–23.8 ton of CO_2 per hectare per year. By taking into account sequestration of carbon owing to an increase of vegetation cover in some areas, annual net emissions ranged 8.3–23.2 ton of CO_2 per hectare per year.

The highest aboveground carbon loss was observed during the period of 1990–1995, during which large forest areas were converted to oil palm plantations, while the lowest aboveground carbon loss was in 2001–2005, which accorded with the slowing of oil palm expansion.

Peat swamp forest stores much more carbon below ground than above. Consequently, this type of forest should also receive special status for the protection of peat soil carbon. Presidential Decree 32/1990 on Protection Forest states that peatland with peat depth of more than 3 metre should receive protection status. Studies in Tripa show that the peat depth varies 130–505 centimetre, with carbon stock of 382 (moderate depth), 1368 (deep) and 1621 ton per hectare (very deep) [3].

2 Conversion factor from carbon stock to CO_2 emissions is 3.67.

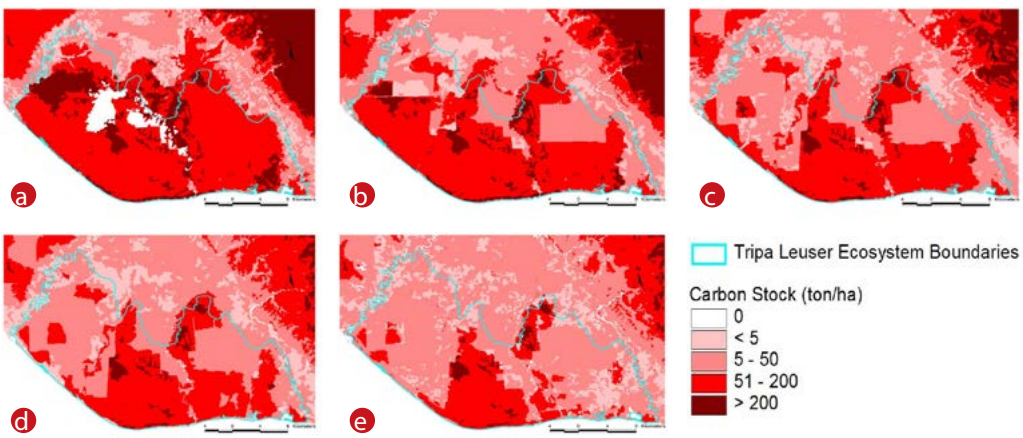


Figure 4. Maps of aboveground carbon stock in Tripa: (a) 1990; (b) 1995; (c) 2001; (d) 2005; (e) 2009

Forest conversion that includes drainage canal construction, such as in oil palm plantations, implies much higher CO_2 emissions compared to conversions on mineral soils. The organically rich soil of peatland is also prone to fire, which can release higher amounts of CO_2. Studies indicate that belowground CO_2 emissions approximately 18 years after conversion, such as occurs in Tripa, are around 78 ton of CO_2 per year [4], which is 4–9 times higher than aboveground emissions due to biomass loss.

Degradation of peat swamp forest in Tripa inevitably affects the ecosystem's function as orangutan habitat: tree species diversity, tree density and dominant species for orangutan food all change and affect the area's ability to sustain orangutan populations. However, complete conversion of forest into a non-natural vegetation cover is a much bigger concern, since this creates an absence of food and hinders the movement of female orangutan [5], which inevitably poses an extreme threat to the population.

Conclusion

Oil palm development in Tripa represents a mismatch between development strategies for an agriculturally important commodity and the need to conserve an ecologically important area. The assessments presented in this brief demonstrate findings on the extent of ecological losses owing to rapid oil palm expansion.

From a carbon perspective, conversion to oil palm from forest, let alone peat swamp forest, brings high carbon debt while conversion from low-density vegetation and low-carbon mineral soils can result in a positive carbon balance (sequestration of carbon). Developing oil palm on degraded peatland is still an option although management aspects, including drainage canals, should be taken into serious consideration to ensure sustainability of the plantations.

Tripa represents an ecosystem that has an even higher degree of conservation importance owing to its function as the habitat of a critically endangered species. Policy options as well as livelihoods-based conservation approaches that rely on thorough and comprehensive evaluations are needed in an area with high change dynamics of land uses under the influence and control of various actors.

Contributors

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Primary Source

Tata HL, van Noordwijk M, eds. 2010. *Human livelihoods, ecosystem services and the habitat of the Sumatran orangutan: rapid assessment in Batang Toru and Tripa*. Bogor, Indonesia: World Agroforestry Centre (ICRAF) Southeast Asia Regional Program.

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Acknowledgements

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