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Forest fragmentation in oil palm plantations: impacts on biodiversity and options for mitigation

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Abstract

The impacts of forest fragmentation on biodiversity, such as population isolation, edge effect and ecosystem weakening, are summarized. Two basic approaches to mitigation of these impacts in palm oil landscapes are outlined: Land-sparing and Land-sharing. The Land-sparing approach argues that forest fragments in most oil palm landscapes are of negligible conservation value, and that, instead of trying to increase the biodiversity value of these, money and effort would be better spent investing in protection and management of large contiguous areas of forest offsite, such as are available in biobank projects. Arguments for adopting a Land-sharing approach include protection of ecosystem functions, benefits to local communities, and protection of extant high conservation value species populations. An example of the latter approach is showcased – that of the Kinabatangan Corridor of Life Project in Sabah. Which of these two approaches individual companies should adopt will depend on consideration of local and landscape-level factors, and these can be determined by a thorough biodiversity assessment of the plantation and surrounding ecosystem.

1. Introduction

This summary article briefly describes the impacts of forest fragmentation on biodiversity and ecosystem services, and explores options for mitigation of biodiversity loss for owners of plantations through 'land-sparing' and 'land-sharing' initiatives. It is adapted from material originally prepared for Biodiversity in Plantation Landscapes (Bakewell et al. 2012)[a].

Key words

forest fragmentation, oil palm plantation, biodiversity, land-sparing, land-sharing, wildlife corridors, biobank

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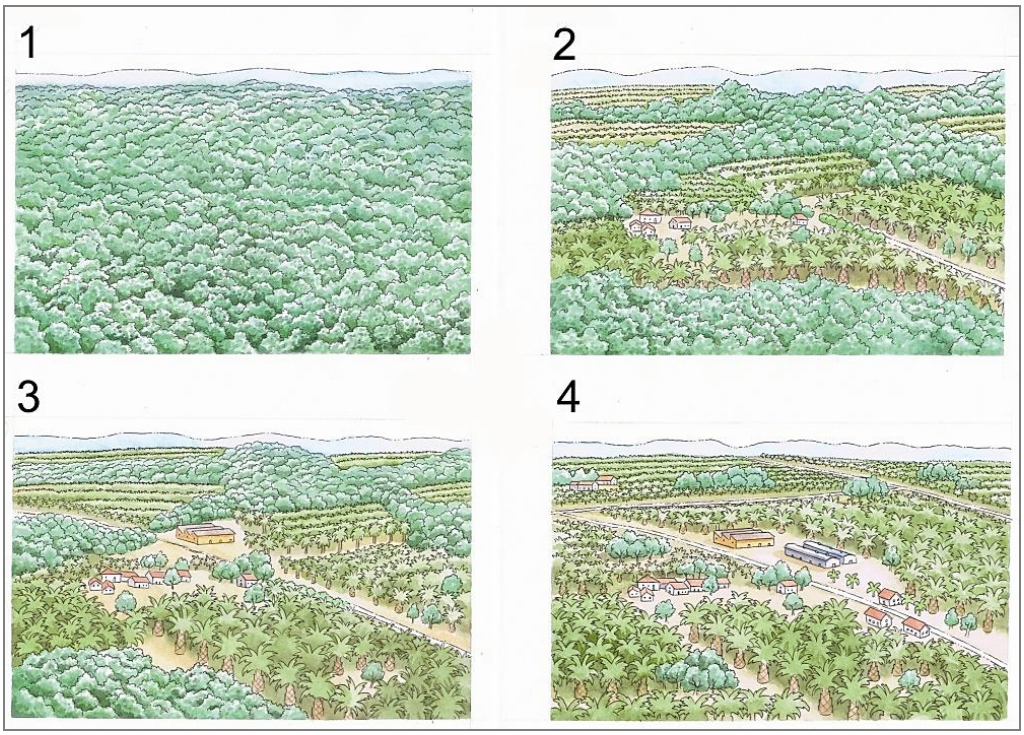
[a] This publication can be downloaded in full from http://oilpalm.wildasia.org/bio-diversity/plantations-manuals/

Figure 1: The process of forest fragmentation.



Credit: Wong Swee Fatt. Source: Managing Biodiversity in the Landscape, NRE 2009

Forest fragmentation typically occurs over considerable time periods at landscape-level, and almost certainly begins before the development of oil palm plantation operations. Where the original habitat is primary forest, the process usually starts with one or more cycles of timber harvesting, usually in the form of selective logging, followed by the clearing of areas of logged forest for agriculture or infrastructure, concentrating on the most fertile areas suitable for crop-growing. As the process continues, what typically remains of the original habitat are widely scattered forest 'islands' in a 'sea' of oil palm. These fragments may be legally protected through some form of gazettement (e.g. wildlife sanctuary or water catchment) or not be suitable for development (e.g. on steep land, infertile soils or in swampy areas).

2. The impacts of fragmentation

Unmodified, natural forest landscapes consist of large areas of 'core habitat' and relatively small areas of 'edge habitat' where one habitat type meets another. These large, relatively uniform core areas provide ample space for species populations to sustain themselves. As areas of natural habitat are cleared or modified for other land-use, there are three major impacts on biodiversity.

2.1. Population isolation

Clearance of an area of natural habitat creates a barrier, which many species are unable to cross. As a landscape is developed for agriculture or infrastructure, areas of natural habitat are most often broken up into a patchwork of smaller areas, each separated from others by varying distances. This fragmentation isolates subpopulations of species, restricting gene-flow and opportunities for pollination, breeding, and feeding. Even though, overall, there may be a substantial proportion of natural habitat remaining in a landscape, each area may be too small to sustain more than a fraction of the original amount of biodiversity. Relict populations of many species may remain in some of these patches, but if there are insufficient resources to sustain the population, they will die out over time.

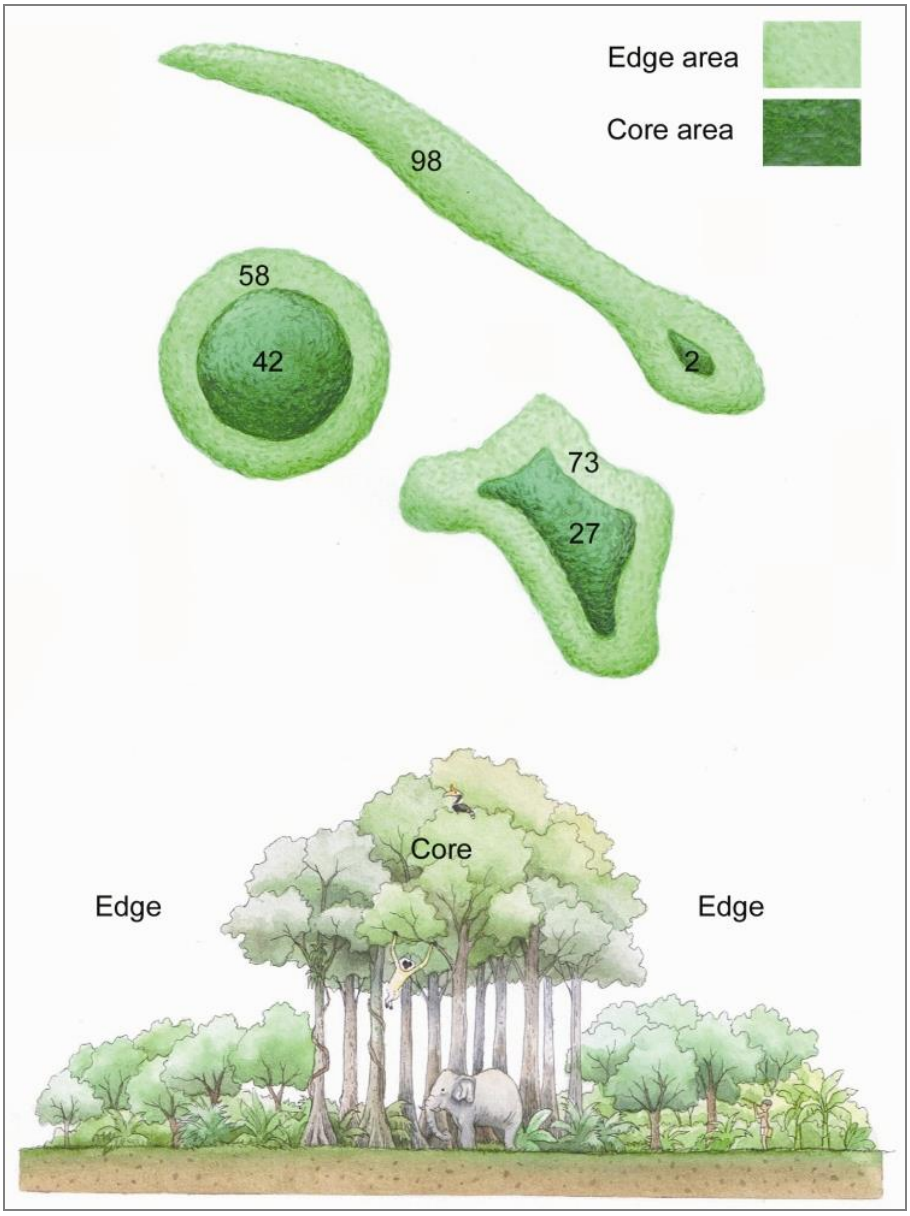
2.2. Edge effect

As large areas of habitat are broken up into many smaller ones, the ratio of edge habitat to core habitat increases. Edge habitat differs from core habitat in many ways, such as levels of light, temperature and humidity, susceptibility to wind disturbance and hunting pressures, etc. Open country pioneer species also increase competition for these areas, often displacing the original inhabitants. For these reasons, many species, which naturally occur in core habitat, are unable to survive near the edges of the habitat. The shape of habitat fragments is therefore an important factor in determining their biodiversity value.

2.3. Ecosystem weakening

Natural ecosystems are extremely resilient, able to withstand or recover from catastrophic

Figure 2: How fragment shape affects relative amounts of core and edge habitat



Credit: Wong Swee Fatt. Source: Managing Biodiversity in the Landscape, NRE 2009

natural events such as fires, floods and droughts. However, as natural ecosystems are degraded or diminished in size, their ability to provide ecosystem services, such as flood mitigation, water catchment, storm damage prevention, climate regulation and others also decreases. This was dramatically demonstrated during the 2004 South-east Asian tsunami. Areas with healthy coastal mangrove ecosystems were much less badly affected than those areas where mangrove forests had been removed or degraded. Degraded natural ecosystems are more fragile and less resilient than healthy ones.

3. What can be done to mitigate the impacts of forest fragmentation?

The most effective way to prevent biodiversity loss in forest habitats is to avoid clearing in large areas of contiguous forest, even where it has been degraded by logging. Studies have shown that, although unlogged primary forest has the highest levels of biodiversity, degraded forest which has been twice logged retains over 75 per cent of bird and dung beetle species found in unlogged forest. In contrast to this, conversion of degraded forest to oil palm plantation results in major losses in diversity and abundance of birds and dung beetles[1]. Studies of soil bacteria [2] and leaf-litter ants [3] found broadly similar results; considerable resilience to logging but severe impacts when forest was converted to oil palm plantations.

There are two possible biodiversity loss mitigation options available, where expansion of plantation land is planned: Land-sparing, which promotes the separation of agricultural and conservation areas, and Land-sharing, which seeks to integrate conservation and productivity goals through the development of 'wildlife-friendly' plantations.

Edwards et al. [4] argue strongly in favour of a land-sparing approach. Their studies of bird diversity and abundance in Sabah, at five sites in logged forest, five sites in oil palm plantations and 12 sites in forest fragments in oil palm, discovered that, by every measure, fragments were less valuable for birds than a similar area of contiguous forest. Compared to contiguous forest, fragments had a 60-fold lower abundance of "priority" birds[b] and 1.8 times fewer birds overall. Fragments even had a lower abundance of birds overall than oil palm, but they did have a higher abundance of priority birds (average three-fold higher than oil palm). Oil palm had a 200-fold lower abundance of priority birds than contiguous forests. They therefore argue that money and effort currently spent on attempting to make plantations 'wildlife-friendly' would be better directed at maximizing production in plantations (even if it means removing remaining forest fragments) and off-setting biodiversity loss by protecting contiguous forest outside the agricultural matrix. In landscapes where proposed oil palm plantation areas are dominated by non-forest habitats but also include small patches of forest, they suggest that biodiversity conservation would be better served by converting the entire area to oil palm production and the palm-oil company paying a biobank to offset a contiguous area of forest equal to or greater than the area of forest lost. Biobanking works by generating tradable Biodiversity Conservation Certificates (BCCs) which each represent an area of rehabilitation and protection of High Conservation Value contiguous forest. The sale of Certificates makes the restoration and conservation of such areas commercially viable and therefore sustainable [5]. One regional example is the Malua Biobank Project in Sabah.

While land-sparing approaches, such as palm plantation companies investing in biobanks, appear to be the most effective way of conserving organismal biodiversity, particularly of priority species, there remain arguments in favour of adopting a land-sharing approach, in which plantations can adapt management practices to mitigate biodiversity losses on site. For example, a land-sharing approach can be justified in situations where ecosystem functions (e.g. carbon sequestration, improving water quality, reducing soil erosion, etc.) can be enhanced, where local communities will benefit in terms of livelihood, recreation and education, and where known HCV species populations are still present and can be linked to larger protected contiguous forest beyond the plantation boundaries.

Examples of land-sharing measures which can benefit biodiversity in and around plantations include beneficial planting, establishment of riparian vegetated buffer zones, increasing epiphyte complexity on palm boles,

[b] "Priority" bird species were those considered of High Conservation Value, as defined by their classification as Rare, Threatened or Endangered on the IUCN Red List

encouraging understorey vegetation and improving connectivity of forest fragments through wildlife corridors [6]. Detailed information about how to undertake these and other practical steps in biodiversity enhancement in oil palm plantations is provided in A Practical Handbook for Conserving High Conservation Value Species & Habitats Within Oil Palm Landscapes,[c] published by ZSL[7] .

Re-establishing connectivity between forest fragments is the most large-scale and ambitious of the land- sharing options, and usually requires multiple stakeholder collaboration. An example of what can be achieved when this is in place is provided by the following case study.

4. A case study in restoring forest connectivity - Kinabatangan - Corridor of Life (K-CoL) Project, Sabah

The Kinabatangan River is the longest river in Sabah, and is arguably the last forested alluvial floodplain in Asia. It is one of only two places on earth where 10 primate species can be found together, and is also home to over 250 bird, 50 mammal, 20 reptile and 1,056 plant species. Since the 1950s, forested land around the Kinabatangan has been converted for various economic activities such as logging and the development of agricultural cash crops such as rice, coffee, cocoa, rubber, tobacco and, more recently, oil palm[d].

The "Corridor of Life" vision is a joint initiative launched in 2002 by the Chief Minister of Sabah with the goal of establishing a forest corridor extending from upland forests to coastal mangrove swamps, where people, wildlife, nature-based tourism and local forest industries could thrive and support each other. WWF-Malaysia has been working with the Sabah Wildlife Department, local communities, several oil palm plantation companies and other stakeholders to re-establish continuous forest along the banks of the river.

A number of oil palm companies[e] with plantations along the Kinabatangan flood plain have been involved in rehabilitating forest for wildlife. Specific steps have included:

- Giving back or setting aside areas of unproductive plantation land (i.e. land which is also critical habitat for wildlife and/or wildlife corridor) and allowing it to revert to natural forest
- Replanting degraded land with native trees
- Protecting existing forest remnants
- Creating wildlife bridges over drains to enable elephants and other large mammals to travel between forest areas.

The Business and Industry Engagement Unit of the K-CoL Project typically begins by seeking to build trusting relationships with the management of the plantation involved. The approach is to seek genuine 'triple win' situations where the oil palm company, local communities and the environment will all benefit. For example, if a company has unproductive land (i.e. land that is critical for wildlife habitat and/or wildlife corridor) where the yield is low because of frequent flooding, there are benefits to be gained in terms of CSR and cutting losses in setting aside this land for biodiversity conservation. Planting of native trees, using seedlings from local village nurseries, brings revenues for local communities, and the net results benefit wildlife.

At some point in the proceedings, it is crucial for WWF-Malaysia to be able to engage the decision-makers within the company. To do this, they have to be able to convince them that there is benefit to the company in engaging in such projects, as there is usually capital expenditure involved. The fundamental factor in building effective multi-stakeholder partnerships is the establishment of trust. This happens over time, frequent meetings, and frank discussion of objectives, and being willing to see things from the other stakeholders' point of view.

[c] Downloadable from www.sustainable*palmoil*.org/files/2012/10/*Practical-Handbook*

[d] K-CoL Factsheet, WWF Malaysia, downloaded from: http://assets.wwfmalaysia.inga.bluegecko.net/downloads/kcolfactsheet.pdf on 28.02.2011

[e] These include Sawit Kinabalu Sdn. Bhd (http://www.wwf.org.my/media_and_information/newsroom_main/?7120), Malbumi Estate Sdn Bhd (http://wwf.org.my/media_and_information/newsroom_main/?11100/Change-of-Heart-Taking-Action-to-Protect-Wildlife-in-Kinabatangan) and Genting Group (formerly known as Asiatic Development Bhd).

Plate 1: A Wildlife Bridge spanning a drain near the Kinabatangan River

Source: WWF-Malaysia

It is also essential that a solution is found which genuinely meets the goals of all the stakeholders.

Another key factor in the success of this kind of project is the use of adaptive management to overcome unforeseen obstacles and challenges. For example, it was initially doubted that highly intelligent mammals such as elephants would use wildlife bridges to cross drains. Since wildlife bridges are fairly expensive (RM20,000 each), it was important to establish whether they would be effective before large-scale implementation. By a process of seeking advice, experimenting with design, and monitoring results using camera traps, an effective design was eventually produced.

Another difficulty encountered was how to plant native trees in areas which are regularly flooded. Some trial plots were established and monitored over a two-year period, until an effective method was established. This involved finding out which species were suitable and knowing how to plant them so that they could resist frequent flooding. This approach of working to solve problems on a small-scale before broad implementation effectively minimizes wastage of resources and effort.

For a multi-stakeholder collaboration such as this to be successful, there must be a genuine 'triple win' situation for companies, local communities and biodiversity.

Plantation companies involved in this project benefit from the publicity generated in a number of ways. There are benefits from being linked to an internationally-known NGO like WWF. Visiting multinational companies to the Kinabatangan can see first-hand the positive steps being taken by the companies to enhance biodiversity. Such projects can attract the interest of not only national but also international media. One plantation MD even received a letter from a Buddhist organization in Taiwan thanking him for his company's efforts to conserve wildlife.

Local communities benefit through partnerships between WWF-Malaysia and the plantation companies. These local communities, mostly housewives, collect seedlings and seeds of native trees and use these to create tree nurseries. The plantation companies agree to buy seedlings for use in forest rehabilitation from them to support the local communities, even when the plantation companies have their own nurseries.

Biodiversity benefits firstly from the protection and creation or rehabilitation of natural habitat. Another benefit is from the active enforcement of local laws. Patrols by the Sabah Wildlife Department and WWF-Malaysia monitor encroachment into riparian buffer zones and apply pressure on those responsible to rehabilitate illegally encroached areas. These patrols also seek to catch illegal poachers of wildlife. As a result, wildlife hunting is now greatly reduced in the area, compared to previously. The benefit of a multi-stakeholder approach in this case is to provide impetus to these enforcement activities. Where companies and communities are investing in local conservation, protection of the natural resources that they are investing in becomes a high priority.

5. Conclusion

Whether a company decides to adopt a land-sparing or land-sharing approach, or a combination of the two, will largely depend on landscape-level considerations in the plantation location. A first step in determining an effective biodiversity management policy will be to carry out a thorough biodiversity assessment, not only within plantation boundaries, but also of the surrounding ecosystem. This will provide baseline data which will help determine whether mitigation of biodiversity loss as a result of forest fragmentation can be most effectively pursued through on-site (land-sharing) or off site (land-sparing) efforts.

Both options provide opportunities for plantation companies to demonstrate commitment to biodiversity conservation, which is becoming an increasingly important consideration for end-consumers.

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