Figure 16. Time limit on business as usual or length of time current emissions can be sustained before stocks are fully depleted

Geographic variation in 'time limit of business as usual emissions' under a scenario where all *kawasan hutan* is protected but emissions shift to other woody vegetation; where the time limit is > 5 years, leakage can be 100% for a 5-year commitment period.

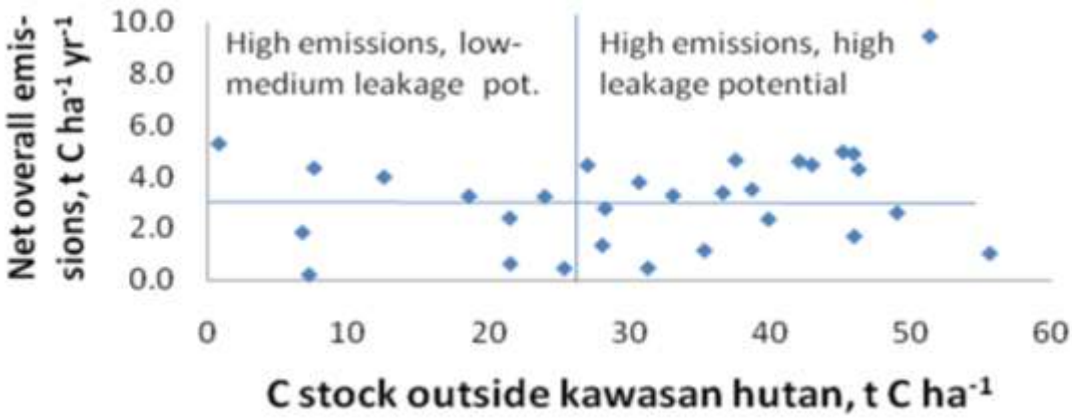


Figure 17. Carbon stock outside institutional forest and net overall emissions in provinces of Indonesia

Uncertainty in our data

Details of our calculations are subject to errors and uncertainty. Because both emissions and carbon stock are derived from the same look-up table for typical carbon stocks per land-cover class, the stock/emission ratios are not very sensitive to uncertainty in this table. The pixel-level reliability of the image interpretation is > 80% for nearly all land-cover classes and in the aggregated-level data at district scale we expect this type of classification error to have evened out. The national-scale data are largely insensitive to classification error (but sensitive to any bias in the estimation).

2.4 REDD+ and forest transition theory

The increasing and decreasing of forest and tree cover of many landscapes in geological history has an anthropogenic counterpart in 'forest transition' patterns (Mather 1992, 2006, Rudel et al. 2005, 2009 Zomer et al. 2009). The temporal interpretation of forest transition has a spatial and institutional equivalent. There usually is a spatial gradation from 'core forest', through 'forest margins' to 'mosaic landscapes', often with a 'degraded' or 'low-intensity use' zone between (Chomitz 2007). Such a low-value, intermediate zone often persists because of contest between forest institutions which see it as 'degraded forest', that needs to be restored under their control, and local communities and farmers who want to control the transformation according to their needs and ambitions (Fay and Michon 2005, Scott 1998). Any integrated landscape restoration efforts must include sensitivities on 'forest' or 'garden' terminology that is code for institutional struggle for control (Michon et al. 2007, Kusters et al. 2007). The close link between public forest institutions and large-scale commercial interests has undermined these institutions' credibility in leading the restoration, yet they are nevertheless an important part of the change process.

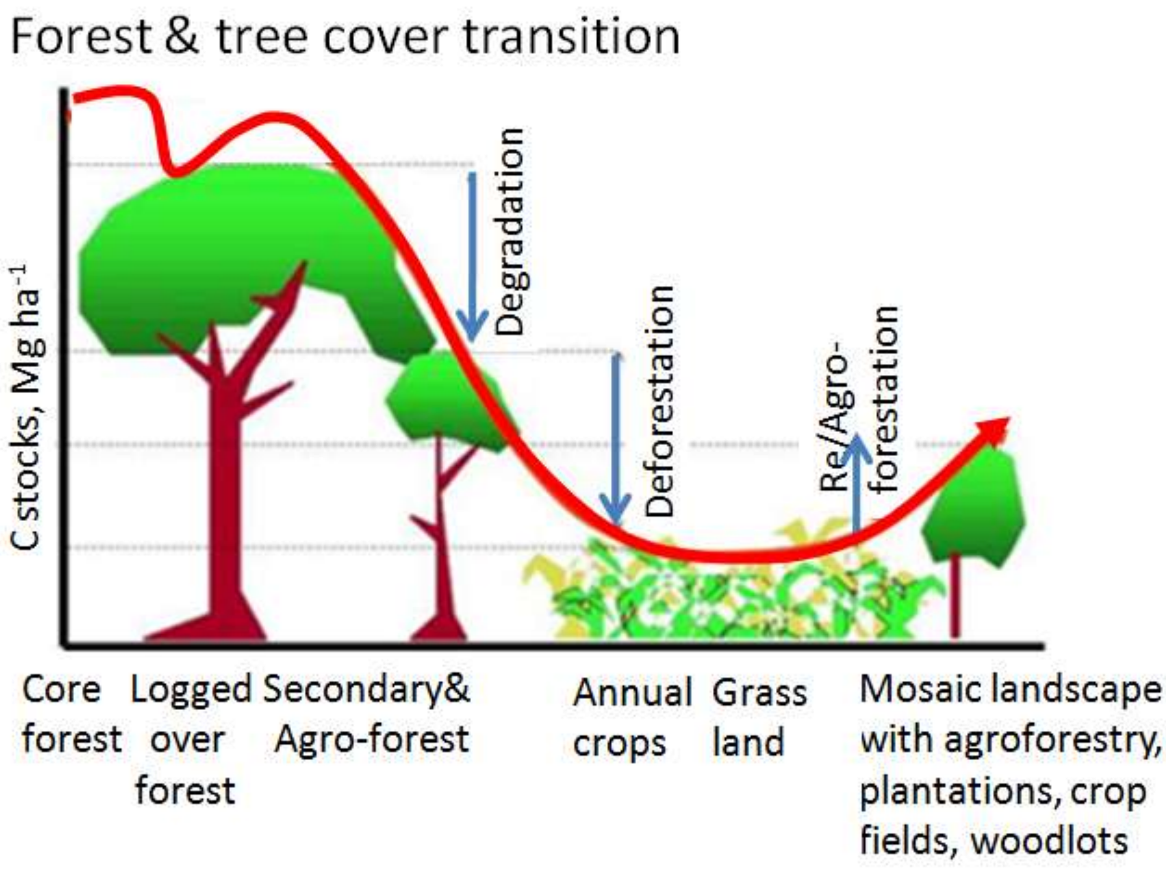


Figure 18. Forest or tree-cover transition as visualised in ASB Phase 1 (van Noordwijk et al. 1995) analysis for Indonesia

The combination of REDD+ and A/R-CDM policy instruments can be mapped on to such a forest transition curve (Figure 16). Efficiency arguments of demonstrable emission reduction will pull REDD to the steepest part of the curve; fairness arguments will require investment in areas of lower threat as well.

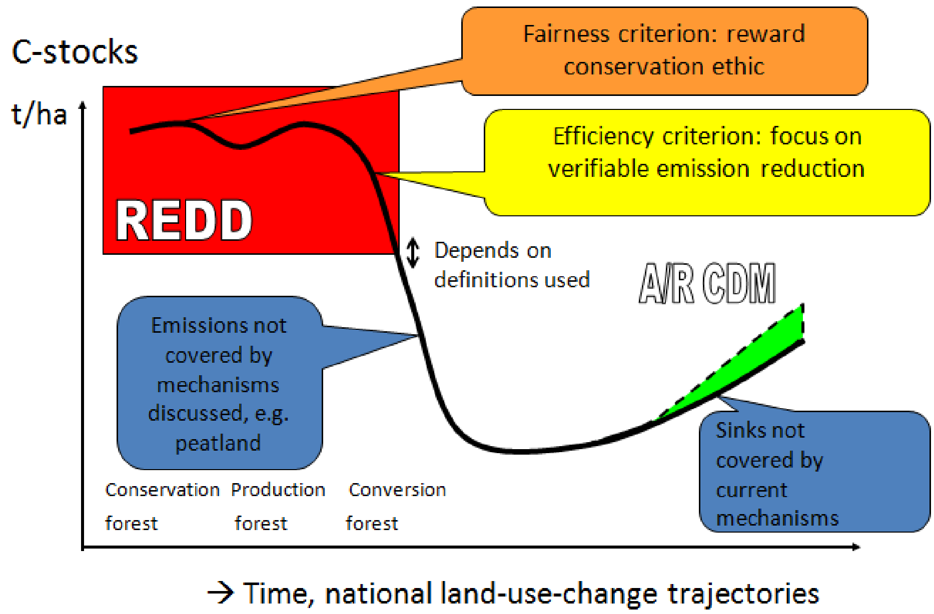


Figure 19. Schematic representation of REDD and A/R-CDM policy instruments imposed on a forest transition graph (van Noordwijk et al. 2008)

Based on a statistical analysis of data on human population density, forest cover and change in both, a five-stage classification of Indonesia was developed (Figure 20).

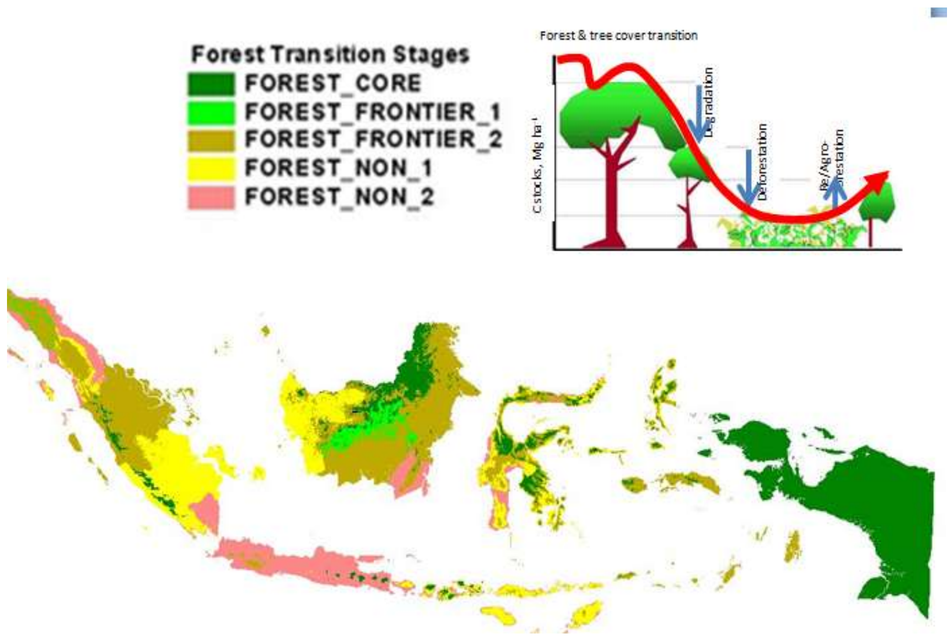
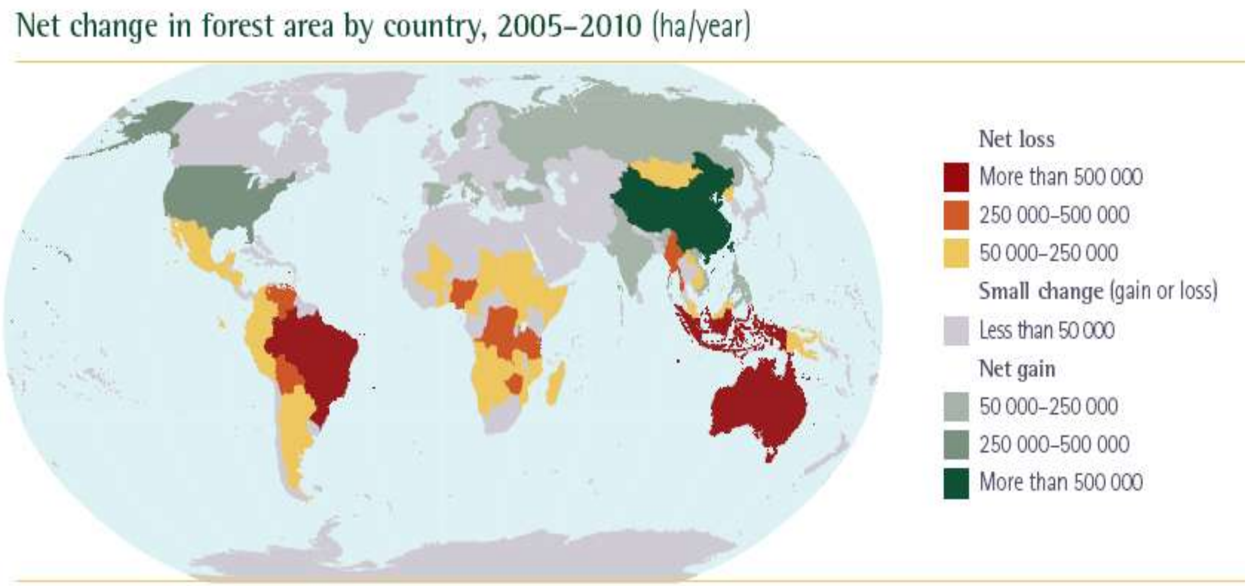


Figure 20. Classification of Indonesia in five stages of 'forest transition' based on dynamics of tree cover, human population density (Dewi et al. in prep.)

Reversal of a negative trend in forest area is now reported (FRA 2010; Figure 21) at continental scale in Asia, as increases in China, Vietnam and India more than offset ongoing loss in Indonesia, Malaysia and Papua New Guinea. The forest that continues to be lost, however, has a higher carbon stock density than the forest that is (re)gained and carbon accounting continues to register net loss (figures 22B, 23). At landscape level, the same pattern was described for a coffee landscape in Lampung (van Noordwijk et al. 2005)

A



B

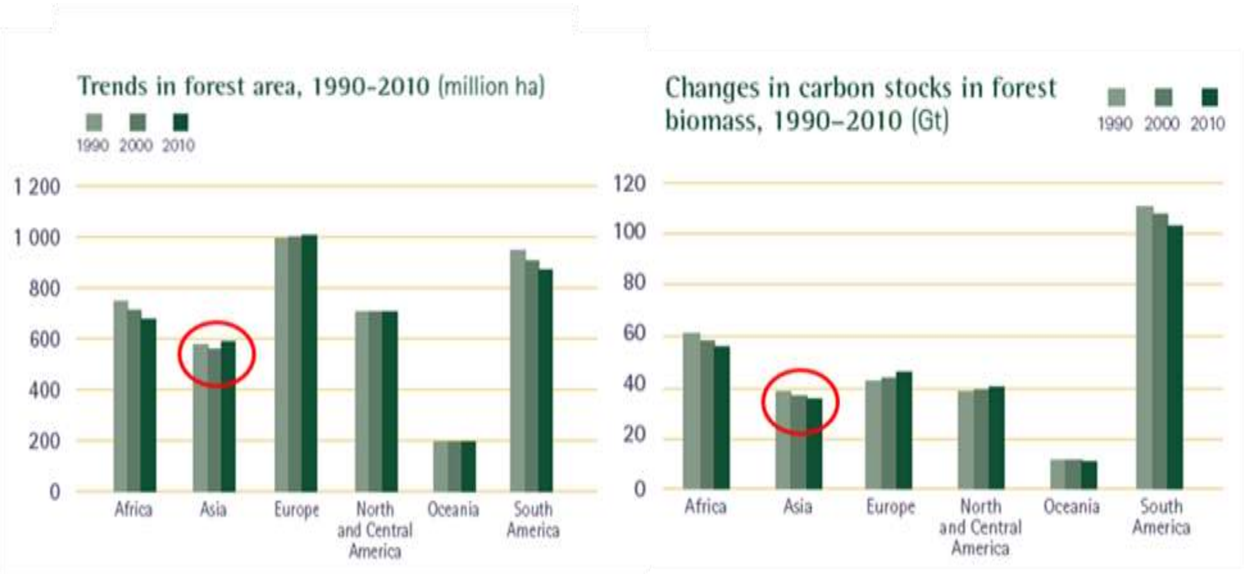


Figure 21. Net change in reported national and continental forest area in the 2010 Forest Resource Assessment http://foris.fao.org/static/data/fra2010/KeyFindings-en.pdf

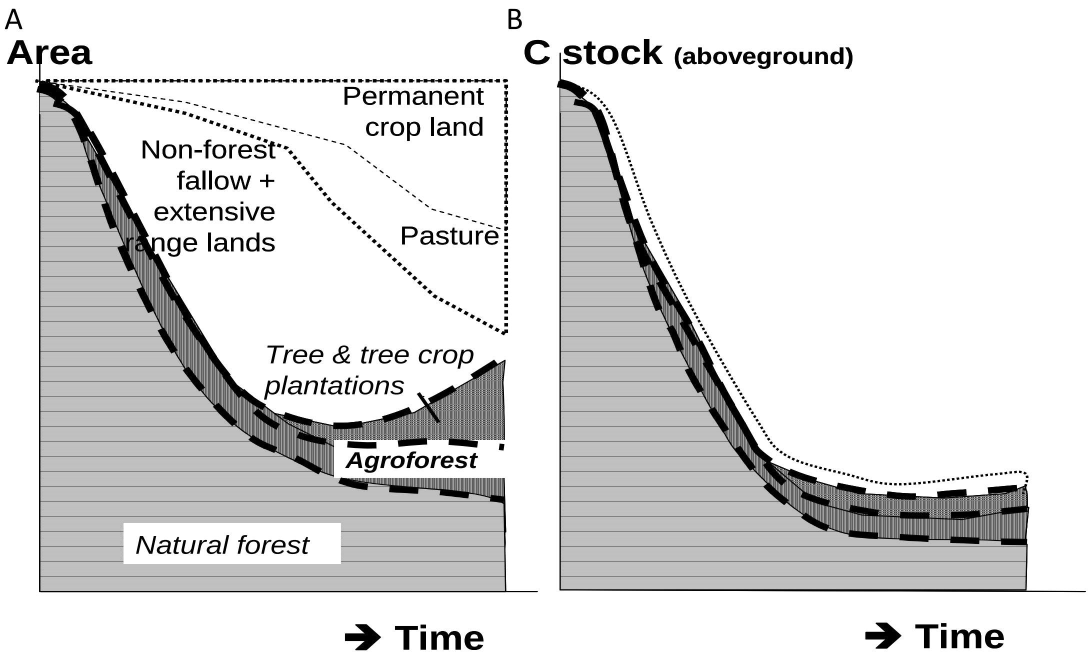


Figure 22 A. The 'forest transition' (upward trend of forest cover following downward one) masks the loss of natural forest and replacement by fastwood and tree-crop plantations. B. Due to the much lower time-averaged carbon stock of plantation forestry, the terrestrial carbon stock trend can be quite different from one based on total forest area

Analysis of the drivers of land-use and land-cover change can benefit from a distinction in direct (proximate) and indirect (ultimate) drivers (Table 7). The drivers that cause each step in the forest transition may differ, but act simultaneously.

Table 7. Example of national REDD strategy to deal with drivers and cross-sector links and leakage

Direct drivers	Indirect drivers	Options for mitigating/deflecting drivers	Secondary emission consequences
A. Drivers of forest degradation (reduction in carbon stock)			
A1. Increase in logging intensity A2. Forest management focussed on commercially interesting species (selective culling)	National economic gains through concession fees. Global and local market demand for timber and wood products	Respect for community rights and long-term interests. Reduced Impact Logging. Certification of Sustainable Forest Managament. Wood-product substitution	International leakage of unmet demand. Emissions linked to product substitution
A3. Reduction in fallow length in swiddens	Restricted access to other parts of forest. Increased local population density	Improved fallow and integrated soil fertility management	GHG emissions linked to fertilisers and legumes
A4. Increase in grazing intensity	Restricted access to other parts of forest	Support for cut-and-carry systems replacing free-roaming grazing	Potential decrease in CH_4 emission per livestock unit
A5. Increase in intensity of collecting firewood or charcoal production	Urban markets for fuels. Price of other energy sources	Regulation of market access. Subsidising fossil fuels as substitutes for 'biofuel'. Efficient stoves. Stimulating other sources of clean energy	Potential increase of fossil fuel emissions, not accounted for outside Annex B
A6. Increased intensity or frequency of fire	Conflicts over rights of access ('fire as weapon')	Clarification of rights based on historical claims plus *de facto* stewardship	direct reduction of net emissions
A7. Increased drainage intensity of the surrounding landscape	Engineering of roads and waterways. Agricultural intensification Pulpwood or oil palm plantations on the edge of peat domes	Strict spatial planning aligned with eco-hydrology	Changes in emission profiles of wetlands
B. Drivers of forest conversion to planted forest (reduction in carbon stocks)			
B1. Establishment of tree-crop plantations B2. Establishment of fastwood plantations	National economic gains through concession fees, export and employment. Overcapacity in pulp and paper industry	Shift of plantation development to previously deforested/degraded land. Shift to non-forest peatlands	GHG emissions linked to fertilisers, drainage of peatlands and increase of Biological Nitrogen Fixation
C. Drivers of deforestation (clear felling without intention of natural forest regrowth or plantation forestry)			
C0. Legal and illegal clear-felling for lumber	Demand for wood	See B	See B
C1. Land clearing for permanent open-field agriculture C2. Land clearing for permanent pasture	Global and national markets for food, fibre and fuel. Migrant labour force	Intensification of agriculture beyond the forest margin through research/ extension, input markets, feeder roads. Restrictions on labour mobility	GHG emissions linked to fertilisers, drainage of peatlands and increase of BNF
C3. Land clearing for mining operations	Global and national markets for coal, metals	Reduced impact mining. Alternative energy sources	Industry and energy sector emissions
C4. Land clearing for urban/industry sector, roads	National development plans	Land-use and infrastructure planning	Transport sector emissions

For Indonesia, however, human population density appears to be the strongest single 'ultimate' driver, as aboveground carbon stock across the districts of Indonesia correlates well with the logarithm of human population density (Figure 23).

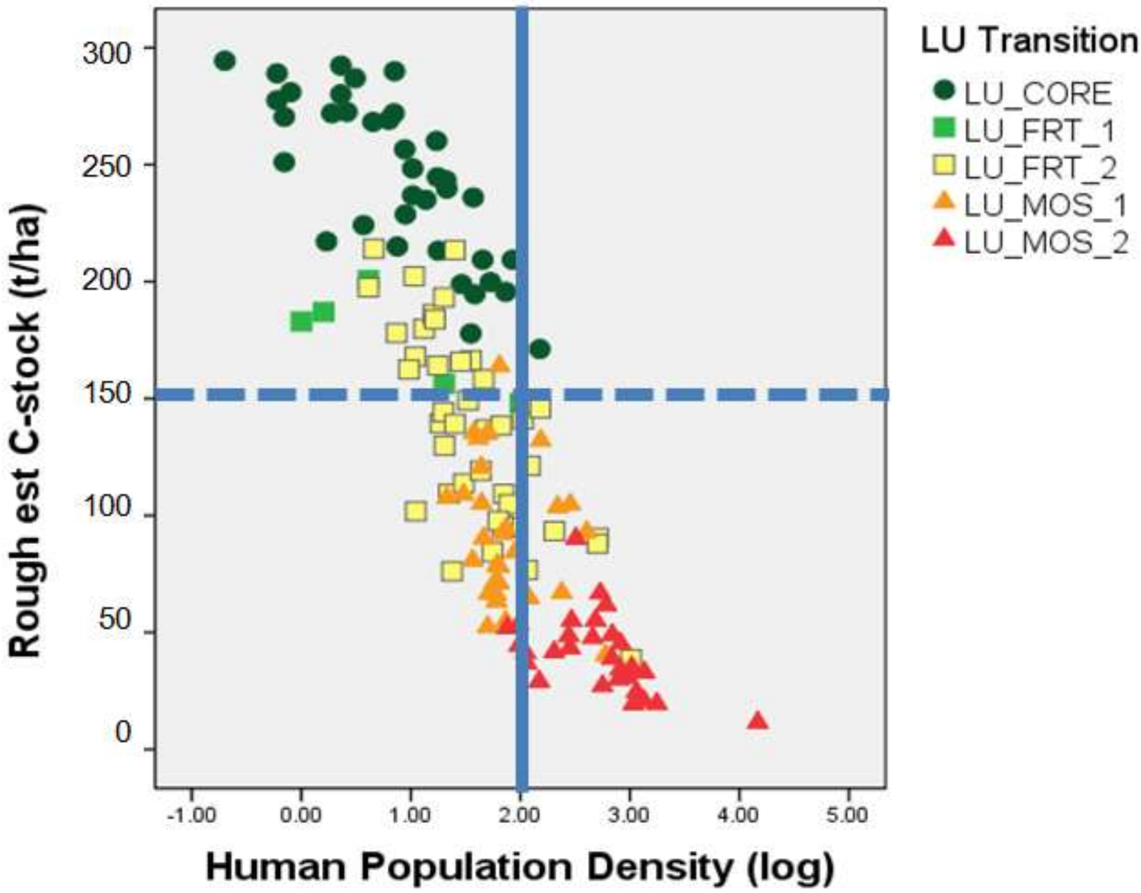


Figure 23. Relationship between aboveground carbon stock and human population density at district level in Indonesia. Source: ALLREDDI 2010 (http://www.worldagroforestrycentre.org/sea/ALLREDDI)

The transition from core forest to 'forest margin I' (Fig. 20) occurs at low human population densities (< 10 km^{-2}) in landscapes where infrastructure is usually limited and where local and state-based perceptions of land tenure differ. Only government-sanctioned, relatively large-scale efforts tewnd to be economically attractive here. In contrast, the transition from 'forest margin 1' to 'forest margin 2' occurs at higher population densities in landscapes where *de facto* tenure claims are established and where infrastructure already provides market access.

Reducing emissions from the downward branch of the tree-cover transition thus requires a combination of measures.

1. Changes in government development planning (infrastructure, human migration), issuance of concessions in forest margin 1.
2. Changes in the economic incentives for further conversion towards low- carbon-stock livelihood options in forest margin 2.

The analysis of opportunity costs suggests that economic benefits from conversion in forest margin 1 tend to be lower than those in forest margin 2. An efficiency-based REDD strategy may therefore be tempted to focus on shifting the larger-scale actions that currently lead to conversion in forest margin 1 and let the further changes in forest margin 2 continue. The opportunities for economic incentives to make a difference in forest margin 2 depend on the shape of the trade-off curve between profitability and carbon stock. For Indonesia, as well as globally, there are a range of shapes in the trade-off domain, with 'agroforest' generally closest to the upper right corner of the graph.

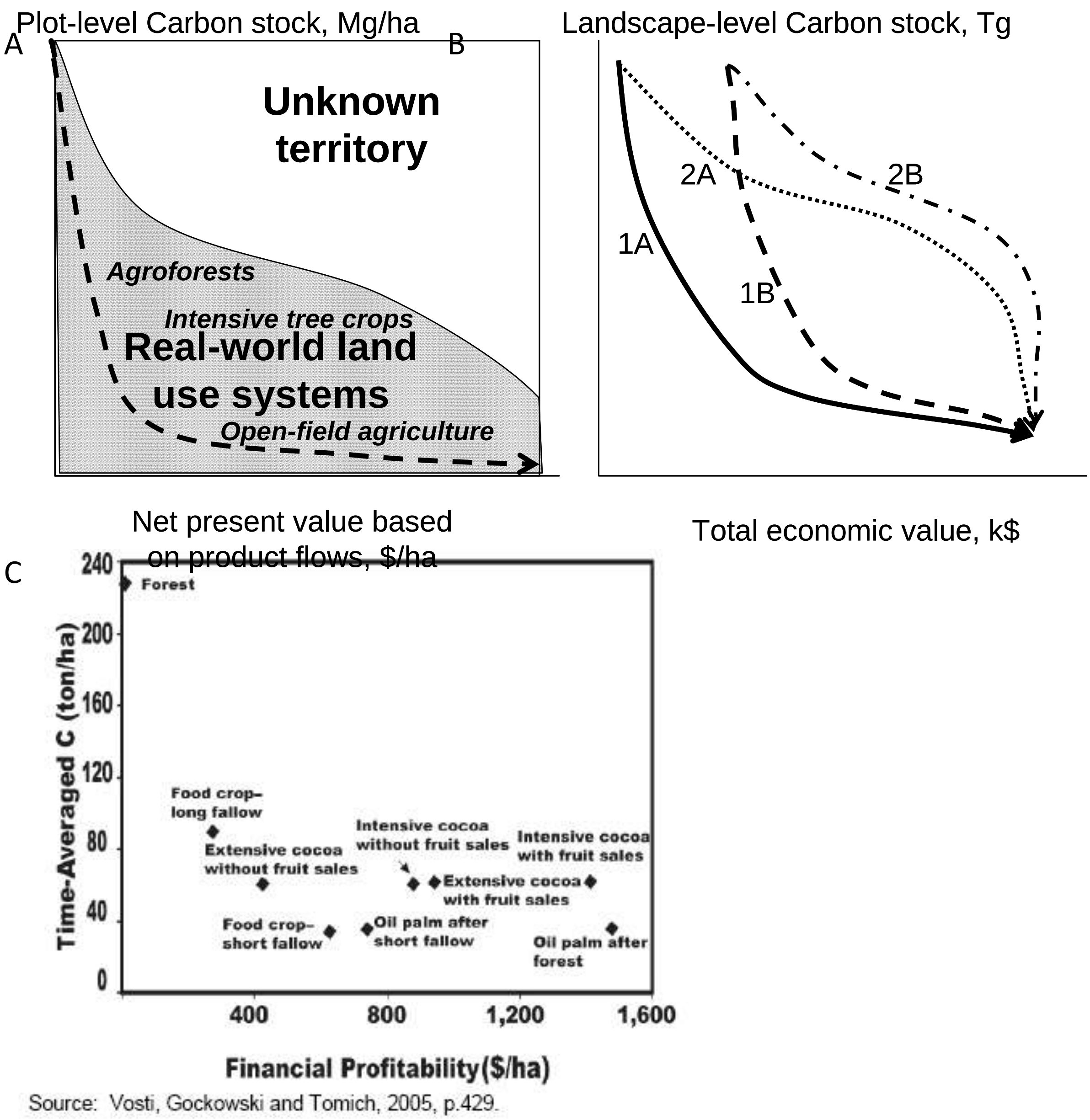


Figure 24 A. The plot-level trade-off between time-averaged carbon stock ('environmental service') and net present value based on sustainable production of tradable products is normally confined to the lower left triangle. **B**. The landscape-scale trade-off curves for open-field agriculture (lines 1A and 1B) tend to be convex, with (1B) or without (1A) financial incentives linked to the level of carbon stocks maintained; for agroforest and tree-crop based systems, carbon-based incentives can lead to convex curves with shift of maximum total economic value

2.5 Peatland NAMA/LAAMA versus REDD+

The peatlands of Indonesia have long been bypassed by development efforts because they were not easily accessible, require considerable infrastructure investment and had lower stocks of commercially attractive timber than mineral-soil forests. In the past decades, however, when other forests became depleted and land became scarce, extractive industries took care of the accessible fringes of peat forests, with the high-value species such as *ramin* and ironwood extracted over larger distances. Market interest in the bark of the *gemor* tree (*Alseodaphne*) since the early 1980s formed the basis of a specific extractive industry in the peatlands of Kalimantan, without any effort to domesticate the tree for sustained production as yet. Use of *jelutung* (*Dyera costata*) resin developed into local systems of 'private tree tenure' in communally claimed forests along the rivers of Kalimantan, linked to colonial-era agreements that such lands would remain under the control of local communities. Current forest classification and spatial planning, however, has not reconciled local and national claims in this zone. In other parts of Indonesia, including the western coast of Aceh, rubber (*Hevea brasiliensis*) was introduced in peatland forest areas, with minimal drainage and fertiliser use, leading to 'jungle rubber' systems that support local livelihoods at low investment costs.

Local forms of peatland use for agriculture developed, including the 'Sonor' system of slash-and-burn for opportunistic rice production in southern Sumatra (Chokkalingam et al., 2009), in years with a long dry season. The economic benefits of Sonor were estimated to be only 0.11 USD/t CO_2 emitted, a low value, but still positive. Restricting Sonor without alternative employment and income opportunities will reduce human livelihoods.

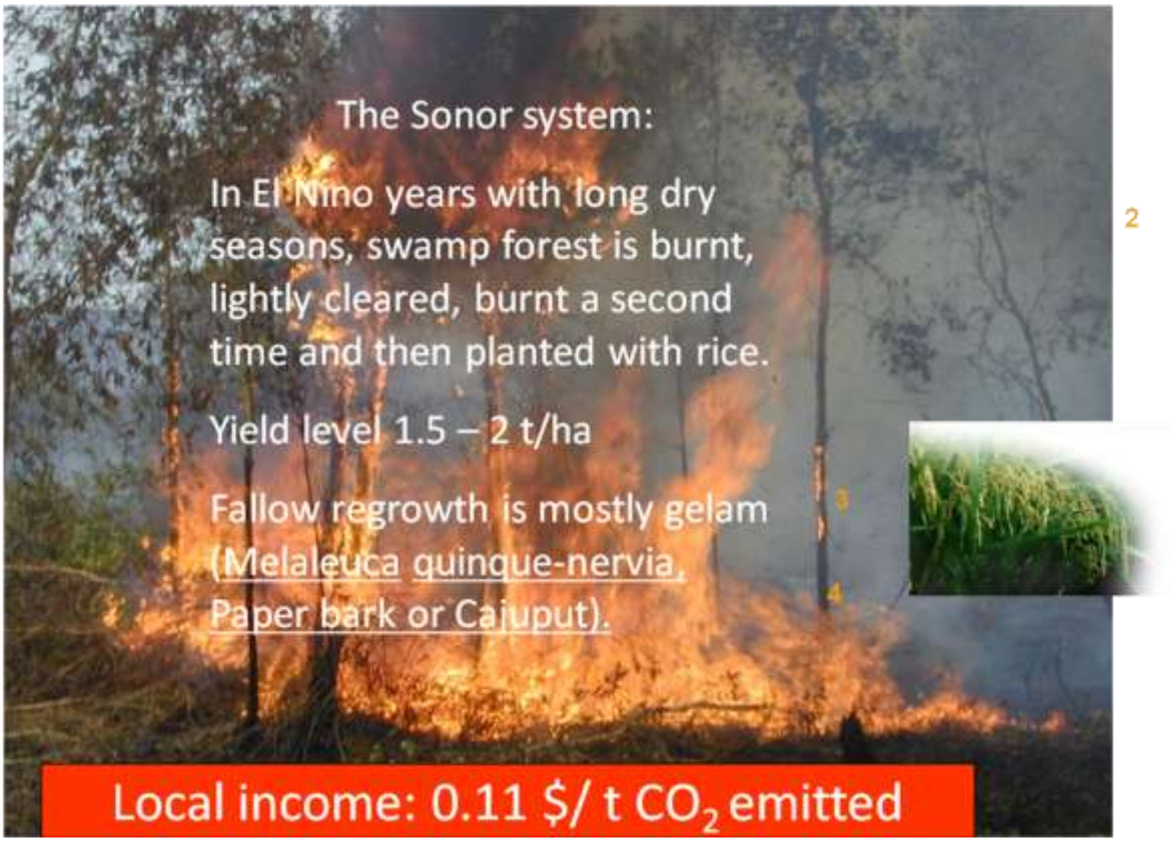


Figure 25. Analysis of the *sonor* system of southern Sumatra by Suyanto et al.

Large-scale clearing of peatlands for agriculture has in several instances led to strong acidification where 'acid sulphate' soils were involved. Several areas, including transmigration sites in Jambi province, were effectively abandoned for agriculture. The 'mega-rice project' (MRP) in Central Kalimantan similarly failed to deliver on expectations of profitable agricultural production systems based on annual food crops. Tree-crop systems (rubber and oil palm) emerged as the more profitable land use for the migrant communities that stayed in the area after the MRP became Ex-MRP.

Figure 26. Peatland area in Central Kalimantan, with rectangular and linear elements of 'development' imposed on a mosaic of meandering rivers and inter-riverine peat domes

A tricky issue is the relation between peatland emissions and REDD+. The internationally agreed scope of REDD+ is restricted to 'forest': the first D refers to change from 'forest' to 'non-forest' status, the second D to loss of carbon stock within the forest category and the '+' to increments of carbon stock within 'forest'. Increments in carbon stock outside of forest have not been included in REDD+ and the A/R-CDM mechanism is supposed to deal with transitions between 'non-forest' and 'forest'. Part of the peatlands fall under the 'forest' definition, either in its 'institutional' version (*kawasan hutan*) and/or its tree-cover-based biophysical counterpart (> 30% tree cover). A substantial part of the peatland emissions, however, derive from land that lost its institutional and/or biophysical forest status before the accounting periods but continues to emit in ways that are unavoidable. From an emission reduction perspective it does not make sense to split hairs over details of forest and peatland definitions that determine eligibility. The more comprehensive NAMA umbrella allows the two to go side by side. Interestingly, the two largest bilateral REDD investments in Indonesia so far—, Norway-Indonesia Letter of Intent and the AUSAID support for Central Kalimantan Peatland Forestry program—go beyond the specifics of REDD delineation and addresses the peatland as a comprehensive ecosystem. Management of peatlands involves landscape-scale management of water as much as it involves land allocations and land-use planning.

Locally appropriate and adapted use of peatlands can include forms of agroforestry, combining the exotic riparian-zone tree crops (rubber and/or oil palm) with valued species of local flora, including *jelutung* and *gemor*. As long as the 'extractive frontier' is not closed, however, returns to labour of opportunistic extraction are likely to exceed those of growing, tending and harvesting tree products in agroforestry. Further identification of usable tree species is needed.

Planned and unplanned, controlled and uncontrolled emissions

Conceptually and for policy debates it makes sense to separate emissions from peatland along two axes: planned versus unplanned and controlled versus uncontrolled.

Table 8. Two-way classification of emissions across the planned/unplanned and controlled/uncontrolled axes

	Planned at government level Resulting from land-use planning, concessions for logging and/or conversion; permits for drainage	**Unplanned at government level** Based on local actors and/or companies in interaction with climatic variability
Controlled	Land clearing for oil palm, fastwood plantations and other tree crops. Drainage	Land clearing for oil palm and other tree crops. Local land clearing, including *sonor* for rice. Use of fire as a weapon in land-use conflicts
Uncontrolled	Deeper drainage than agreed. Fertiliser use	Wildfires escaping

The direct causes of emissions from peatland are fire, drainage and fertilisation. The latter is poorly recognised in current scientific studies. It differentiates rubber agroforest from plantation-style tree crops (oil palm and rubber monocultures).

There is considerable ambiguity on the current regulatory framework for use of peatland for activities that enhance or reduce emissions.

- The government's regulations restricting the use of 'deep' peatlands have shifted the threshold depth between 1 and 3 m in the past two decades but have not been obeyed by either national or local governments.
- The partial degazetting of forests for the 'mega-r ice program' is still the subject of contest between provincial and national authorities.
- Drainage of, or adjacent to, peatlands contributes to CO_2 emissions but water management is not yet fully integrated with climate-change mitigation planning.
- Fertiliser use on peatland increases emissions but is not regulated.
- Uncertainties in carbon stock and emission estimates.

It is clear that emissions from Indonesia's peat areas are large but the uncertainty around the estimated amount is high as well. Uncertainties in carbon stock estimates stem from soil maps that include peat soils as a separate category only where peat depth exceeds 50 cm, with various other wetland soil categories that include shallower peat layers that still can lead to substantial emissions when cleared. Moreover, inaccuracies in soil maps and short-range variation in peat depth make rules about the peat depth where conversion can be allowed difficult to enforce.

Overall, the current emission estimates and scenarios are the results of decision making that was not fully aware of the consequences. Some level of 'accepting errors of the past' has to take place, with a focus on future improvement. In the discussion on 'emission reduction', the level of current emissions makes it relatively easy to improve the situation, converging on globally acceptable.

2.6 Payments for environmental services or enhanced cooperation?

Over the past decade, the concept of 'payments for environmental services' has become popular but, as van Noordwijk and Leimona (2010) argue, there is a wide gap between theory and practice, with multiple paradigms applicable under a range of conditions (figures 27, 28).

PES * Land Use Planning

Paradigms within Payments for Environmental Services	Prerequisites: Property rights	Threats to ES	Inter-agent trust
CES – Commoditized ES markets	Clear	No illegal threats	>= medium
COS – Compensating Opportunities Skipped	Clear	No illegal threats	>= medium
CIS – Co-Investment in Stewardship	Can be contested	Can support local control of semi- and illegal threats	Can start at low level

Land use planning defines 'expected performance standards' on ES and therefore the baseline for 'additonality' assessment

Figure 27. Three paradigms (CES,COS and CIS) that are now recognised within the umbrella term payments for environmental services (PES) (van Noordwijk and Leimona 2010)

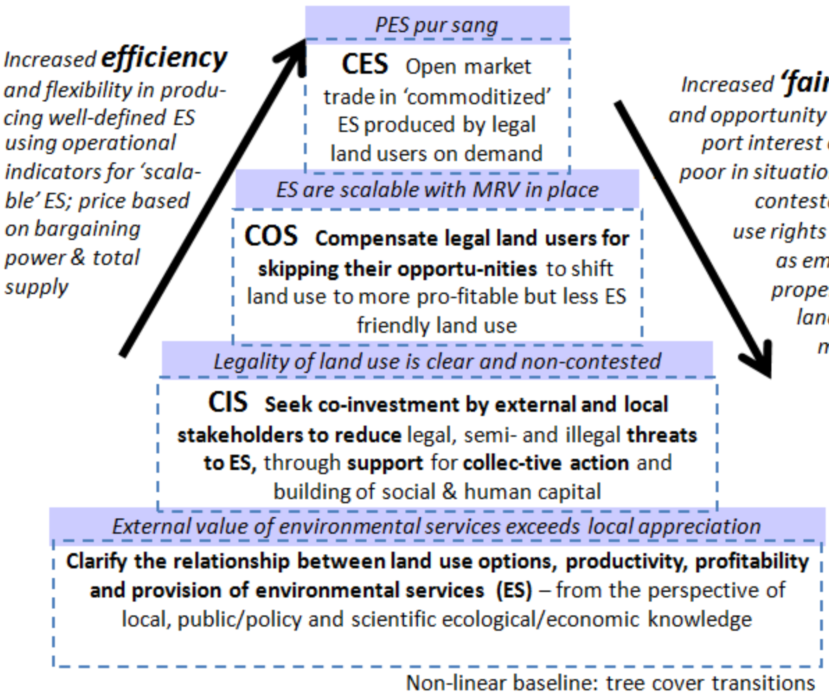


Figure 28. Range of applicability of the CIS, COS and CES paradigms and their relationship with efficiency and fairness

The value chain of incentives for emission reduction links action on the ground to global consequences (Figure 29).

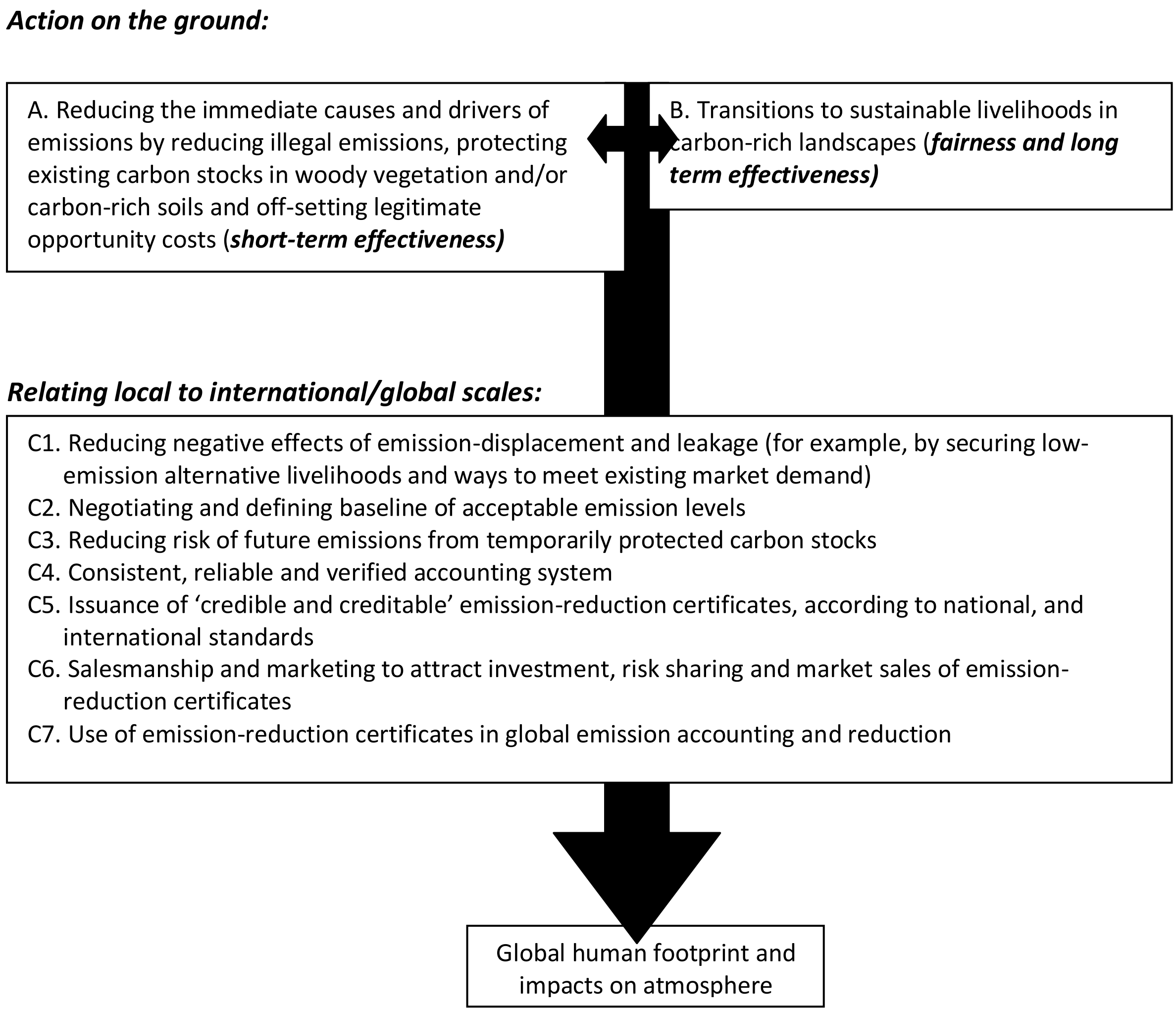


Figure 29. REDD value chain

2. Site-level case studies

3.1 Central Kalimantan Forest Partnership site analysis[5]: Sustainable livelihood options and carbon rights as basis for efficient and fair emission reduction in the Central Kalimantan ex-mega-rice project

Kalimantan Forests and Climate Partnership (KFCP) was an initiative in the form of pilot projects to demonstrate effective ways of reducing emission from peatlands through a REDD scheme. While the international rules on REDD were not clear and emissions from peatland may or may not be included, there was widespread consensus that this type of emission reduction was feasible, urgent (high emissions) and probably cost effective. As the emissions from peatlands came from a relatively small area with a small local population, the social aspects may have been manageable. However, they were not trivial and deserved full attention. The study sites in Block A (south) and Block E (north) in the ex-mega-rice project area, Kapuas district, Central Kalimantan, were chosen as representative of degraded forest and forest. The area represented a demonstration site for REDD under the Kalimantan Forest and Climate Partnership supported by the Australian Government. Administratively, these villages belonged to two sub-districts (*kecamatan*) of the district (*kabupaten*) of Kapuas: Kecamatan Mantangai and Kecamatan Timpa. Overall, there were 14 settlements along the Kapuas River.

Summary analysis

A. Livelihood strategies differed between the villages and between blocks, alongside the condition of the remaining forest

In the lower parts of Block A, the villages of Mentangai Hulu and Kalumpang were found to depend primarily on rubber and a rice/fallow rotation, with fishing and forest extraction of secondary importance. The importance of gold mining (in Mentangai Hulu) and extraction of rattan (in Kalumpang) differentiated the two villages.

In the Sei Ahas and Katunjung villages in the upper parts of Block A, agriculture (rubber and paddy) and forest extraction were of similar importance as livelihood sources. Logging of timber was the second most important source of livelihood in Sei Ahas village, while bark extraction of *Alseodaphne coriacea* (*gemor*) for mosquito-repellent coils was the most important source of income in Katunjung village.

In Block E, livelihoods primarily depended on fishing and forest extraction of *gemor*. Agriculture (rice as part of a swidden fallow system) and smallholder tree plantations were less important.

B. Dynamics of livelihood patterns could be understood in the light of policies in four periods: prior to 1970, before the mega-rice project (1970–1995), after the mega rice project (1996–2006) and recent (2007–2008)

The patterns alternated between six main activities: (i) rice cultivation (swidden/fallow rotations); (ii) smallholder tree crop plantations (mostly rubber); (iii) forest timber extraction; (iv) collection of non-timber forest products; (v) fishing; and (vi) other employment.

Prior to 1970, there was no commercial logging in the area. Timber was used for local consumption and construction. Non-timber forest products such as rattan (*Calamus* spp.), *damar* (*Shorea* sp.), *jelutung* (*Dyera costulata*), *gaharu* or eaglewood (*Aquilaria malaccensis*), *katiau* (*Ganua motleyana*),

[5] The report was prepared by Suyanto, Gamma Galudra, Noviana Khususiyah, Jim Roshetko, Laxman Joshi, Niken Sakuntaladewi, Meine van Noordwijk and Ujjwal Pradhan for the Kalimantan Forests and Climate Partnership.

kalanis (a tree root that gave rise to the toponym Tanjung Kalanis), *ehang*, *nyatu* (*Palaquium javense*) and animals (snake, bird and deer) were very important sources of livelihood. The swidden system with upland rice was practised in both Block A and Block E. Fishing for local consumption was a very important source of livelihood. Smallholder tree-crop plantations were not yet well developed.

Before the mega-rice project (1970–1996), commercial logging became important for local livelihoods. The timber concession companies (PT Mangkatib Raya I, PT Mangkatib Raya II, PT Jayanti Jaya, PT Sumber Alam and PT Sumber Usaha) operated in this region in the early 1970s, employing local people as labourers to log commercial timber species from the original mature high forests. Jobs linked to logging commercial timber became the most important source of local livelihoods. Logging was supposedly selective and based on sustainable yield calculations, but in fact was more intensive than that.

The mega-rice project (1997–2006) was based on deep drainage, 'salvage logging', land clearing, transmigration of villages involving farmers from outside the area and irrigated rice. The few independent experts who had advised against the project were correct: it provided economic benefits through logging and for the suppliers of the heavy equipment needed, but not for the rice farmers, many of whom started looking for other types of employment. After the Reformasi period, the mega-rice project was declared to be a 'mega-disaster' and efforts started to focus on rehabilitation of the area and the relative importance of logging timber began to decline. Smallholder plantations (mostly rubber and rattan) and swidden-rice cultivation (rather than the permanent systems intended by the project) were very important in Block A, while in Block E non-timber forest product collection and fishing resumed their primary livelihood roles. Small-scale gold mining emerged as an important employment opportunity in Tumbang Muroi village in Block E.

Since 2007, the current spatial pattern, described above, has been related to the continued presence of forest in Block A with primary access from the river and the transformed landscape in Block E with its transport pathways provided by the primary drainage canals. Fishing systems have adapted to the canals. Smallholder rubber plantations, stimulated by the high rubber prices after 2005 and adapted to peat soils, emerged as a livelihood component. Extraction of *gemor* continued in the forest, although the resources were locally depleted already; no domestication of the trees for cultivation closer to the villages has emerged as yet.

C. Various poverty indicators for the study area showed that the area was poor relative to the provincial baseline, while livelihood activities were differentiated by relative wealth and gender

Qualitative poverty indicators used locally included not only income, but also the level of education, health, employment opportunities and quality of housing. Dropout rates from schools for students aged 13–15 years were very high (24%), indicating a problem in education at junior high school level

The share of expenditure for primary food supplies in the study site was high (75–79%) and above the provincial average. Protein consumption relative to carbohydrates was low. Using the national poverty indicator, 8.3% of the population was below the poverty line. The percentage of respondents living below the international poverty line (USD 1 per capita per day) was high (33–53%, depending on the village).

The composition of income sources differed strongly between Block A and Block E. As described above, villagers in Block A were more dependent on agriculture (rubber), while villagers in Block E were very dependent on natural resources (forests and fish). Fishing provided income for everyone, especially for the poorer households. Income from fishing reduced the overall inequality of income distribution at both sites, as the concentration coefficients were less than one. Income from fishing was thus relatively high for the poorer segments of society, while about 97% of respondents engaged (part time) in fishing.

Forest extraction reduced the inequality of income in Block A but it increased the inequality of income in Block E. Since forest was less available in Block A and accessing forest far away was costly, not many villagers in Block A were interested in forest extraction work. However, forest remained an important resource for poor people who had limited access to other income sources. In contrast, the forest areas in Block E were more available and accessible. *Gemor* was an important source of income. About 35.5% of incomes in Block E came from *gemor* and about 57% of respondents engaged in *gemor* collection.

D. Gender differentiation in decision making

The involvement of women in production activities was quite prominent. For example, in every village, women influenced decisions on what type of plants were to be cultivated on agricultural land. However, there were differences in the level of involvement. The role of women in decision making was stronger in Block A than in Block E

The level of participation by women in livelihood activities varied. In some livelihood activities—such as fishing, rubber tapping, swidden-rice cultivation, rattan and *kalanis*-root harvesting—women participated at a higher level than men.

The most specific role for women in household economic activities was found to be in marketing products. According to the respondents, women had a greater bargaining position in transactions and had greater market knowledge than men. Although, in general, women participated less in income-generating livelihood activities than men, they still contributed substantially to household income. This contribution was often hidden. Household income was often seen as income solely acquired by men, rather than as a joint effort, while the non-financial components remained hidden from the discussions held.

E. Profitability of swidden-rice cultivation, rubber and *gemor*

Swidden-rice cultivation was not profitable when the opportunity cost of labour was calculated at going market prices. On the other hand, smallholder rubber plantations and *gemor* collection were profitable. The opportunity cost of smallholder rubber production relative to the emissions caused was 1.04 USD/tCO_2e emitted. This can be interpreted as the cost or the price of avoiding one tonne of CO_2 emission by not planting rubber, with its associated shallow drainage of the peat. Without taking account of the transaction costs of carbon projects, if the mode of payment is up-front or on a yearly basis, the price of carbon at 5 USD/tCO_2e would be very attractive compared to the profitability of smallholder rubber.

In the study area, the practice of swidden-rice cultivation has declined over the years. However, it is still considered to be important as part of the overall livelihood portfolio because of the importance of rice for food security, under uncertain income and price conditions. It was still attractive for some villagers since the return to family labour (income) was positive (IDR 24 038), although it was lower than the daily wage for agriculture (IDR 30 000 per day). Swidden cultivation is very labour intensive, especially absorbing family labour, with less dependence on financial capital for external inputs. Labour costs accounted for 90% of total cost, the rest was on expenditure for fertiliser and seed. Fertiliser and pesticide was applied to 25% of plots.

The total cost of rubber production in the first year was high as a cost for establishment, which consisted of 61% for labour costs and 39% for external input costs. After the first year, investment was low during the immature period. Labour was needed for partial clearing to make tapping paths and subsequently for tapping. Most trees, if not all, could be tapped before they reached the age of ten years and gradually a net profit is derived as the investment was paid off. The time needed to achieve positive cash flow depends on fluctuating rubber prices. At current prices, a net profit per hectare of IDR 3.3 million was realised, when wage rates were used for family labour inputs, and total revenue of IDR 6.4 million per ha without accounting for family labour . Since rubber trees are established and managed primarily by family labour, the income from mature trees was high close to the total revenue. When total revenue was allocated to labour (at a net present value of zero for land), income or return to family labour for mature trees was IDR 65 365 per day, which was higher than the wage rate for agriculture at the site.

Every villager was found to have free access to harvest *gemor* trees in the forest. No local ownership had yet emerged for *gemor* trees. Farmers usually went to the forest for a 7–14 day expedition to harvest the bark. Non-labour costs for such expeditions were around IDR 525 000 per person for food, levy to enter *tatah* and fuel for 13 person-days in the forest. In one trip a farmer could harvest 430 kg of *gemor* bark and transport it back to the village by boat. The current price for dry *gemor* at the study site was IDR 4000 per kg. The price for dry *gemor* in areas close to Palangkalaraya was reported [6]to be IDR 6500 per kg (. The calculated return to labour was high (IDR 89 179 per day), three times the daily wage for agriculture and 50% above the return to labour for smallholder rubber.

F. Role of fire

Fire in peat soils has frequently recurred in the Block A area since 1997, when the peat areas were opened up for the mega-rice project. Similar events occurred in 2005/2006 in Block E. In addition to economic loss, fires also caused smoke/haze that hampered village activities and affected people's health (particularly eye and respiratory problems, including breathing difficulties and coughing). Smoke/haze also affected transportation systems owing to limited visibility that increased the risk of accidents.

In most villages, local fire regulations only involved sanctions if the fire had spread to neighbouring land. However, Desa Katunjung initiated Village Regulations (PERDES = Peraturan Desa), but these had not yet been implemented as they awaited approval at the *kabupaten* level.

In some villages, such as Mentangai Hulu, Kalumpang, Sei Ahas and Katunjung, fire teams (Regu Pemadam Kebakaran = RPK) or community groups for fire management (Kelompok Masyarakat Pengendali Kebakaran = KMPK[7]) already existed. In these villages, people were urged to inform the RPK, village head and local authorities when they planned to open up land using fire.

Villagers in Blocks A and E confirmed that there were regulations on using fire for land clearing. However, their understanding of the regulations varied. Some mentioned that the regulations prohibited the use of fire, while others said that the regulations included a procedure to obtain permission prior to land clearing. This lack of understanding showed that the land clearing regulations had not been successfully promulgated among villagers. In managing fire, farmers reported that they followed traditional rules/local laws inherited from their elders on sanctions/penalties when the fire spread to neighbouring land.

Farmers reported that they used 'slash-and-burn' techniques for land clearing for food as well as tree crops. They said they did not know a cheaper or more practical way to clear land for planting. They also felt that they did not need permission to do anything on their own land, except to inform their neighbours, so they could help in the activity and prevent the fire from spreading.

[6] Kompas 13 July 2009.

[7] RPK (Regu Pemadam Kebakaran = Fire Extinguishing Team) were formed in cooperation with the CARE organisation. Each RPK consisted of a team of 15–21 people who had been trained in fire prevention and management. Each team had one spray unit. KMPK (Kelompok Masyarakat Pengendali Kebakaran Hutan = Community Group for Forest Fire Management) had a similar function to the RPKs. KMPKs were formed by the government with 9–10 people in each team, with each KMPK having one spray unit.

There were three main uses of fire by local farmers: to start a swidden, to clear for planting rubber and to create access for fishing activities. Slash-and-burn activity to open up land normally took place at the end of the dry season, so the plot was ready for planting at the start of the rainy season. These three activities potentially could cause escape of fires to surrounding vegetation.

G. Multiple functions of drainage canals

The community strongly felt that blockage of *tatah*, or drainage canals, would result in the loss of their livelihood options to harvest non-timber forest products.

In the study areas, three types of man-made ditch were found that functioned as drainage systems:

1. canals;
2. *handil;* and
3. *tatah*.

Canals were found in the mega-rice project at four levels (primary, secondary, tertiary and quaternary). The canals were established to drain water from peat areas so that the land could be cultivated.

A *handil* is a ditch that has been built voluntarily by locals as a drainage system in addition to providing transportation to support their agricultural activities (for annual crops as well as tree-based systems). Traditional use of *handil* as part of agricultural management was only found in the villages of Block A that had been in existence since before 1970. According to the locals, the idea to established *handil* came when they could not find any more available land close to the river: all land had already been opened up and was owned by others. Consequently, farmers formed a group to establish *handil* so that they could open up land for cultivation that was far away from their settlement. Most *handil* were built from the end of a *saka*[8] with prior agreement on land allotment based on the number of people in a group.

A *tatah* is a ditch that originally functioned to connect the river with forest areas, making it easy to access timber in the forests. Recently, with the diminution of timber harvesting in the forests, *tatah* were used to access non-timber forest products such as *gemor*, rattan and *damar* resin.

The community strongly felt that blockage of *tatah* would result in the loss of their livelihood options to harvest non-timber forest products. Nevertheless, they could accept the construction of water gates and changes to make the *tatah* into small reservoir systems which the community could still use to access forest. Similarly, the community also opposed any program that planned to block any *handil*. According to locals, blockage of the *handil* would cause difficulties in accessing their agricultural land and their land would be flooded, resulting in reduced crop production.

H. Opportunities and challenges for emission reduction

Emission reduction strategies need to deal with the hydrological integrity of the peat dome and drainage.

The deep drainage channels of the mega-rice program need to be closed as a first step (ongoing efforts), as its impacts can reach across the dome as a whole. The more superficial drainage of *handil* and *tatah* canals probably does not extend beyond the village scale, but reducing their local impacts is still a priority for emission reduction. As these canals provide a transport function that is important for local livelihoods as well as draining the peat, water management systems for the canals that allow transport but reduce drainage are needed. Avoiding dry conditions in the canals actually is important for the transport function as well as the objective of reducing drainage, so some new solutions need to be found.

[8] A *saka* is a river tributary with length less than 2.5 km

A major challenge for effective emission reduction in the area is the need for an integrated approach across the peat dome, while the riparian edges of the dome are in the traditional sphere of influence of the villages and temporary settlements. Voluntary approaches to canal management are needed that recognise the opportunity costs for local livelihoods. Given the importance of fisheries to local livelihoods, especially for the poorer households, interactions between canal management and fish production need to be considered. The levels of financial compensation needed to achieve canal management on an outcome basis ('no new canals and modification of existing ones to reduce their drainage effects'), shall be a priority topic for REDD implementation in the area.

Beyond the drainage issue, landscape-level management to control fires to reduce emissions also need attention, as the village institutions and scope for fire control are effective close by the village, but not further out in the landscape. Such efforts, beyond providing employment opportunities, will benefit the local livelihood systems as the smoke episodes are very unhealthy and may affect forest productivity (phenological data of the orangutan research station suggest low levels of forest fruit production half a year after the last smoke/haze episode).

The initial ideas for the KFCP also include reforestation or tree planting in degraded peat areas in Block A, as a third component beyond drainage reduction and fire control. The types of trees to be planted will need to take the livelihood strategies into account, as well the specific objectives of carbon storage. Tree carbon sequestration rates will be small relative to drainage and fire effects, so the interactions with those two processes can be important. Among the local tree resources, *gemor* appears a logical candidate for planting and more intensive management. The study of tree-based land-use options will provide further analysis of this opportunity.

The livelihood data have revealed that a relatively large fraction of the population is poor and has few resources to invest and little opportunity to take risk. Villagers' response to initial canal blocking efforts have been negative and new options need to be discussed at local level and/or stimulated by outcome-based rules and incentives, rather than prescription of activities.

3.2 Investment in carbon stocks in the eastern buffer zone of Lamandau River Wildlife Reserve, Central Kalimantan province, Indonesia: a REDD+ feasibility study[9]

While the international rules and (financial) incentives at a national scale are still being negotiated, a large number of sub national and site-specific 'REDD+ demonstration projects' have been identified and designed and many more are in the making under the REDD+ umbrella. REDD+ demonstration projects are not only about reducing carbon emission, but they also ought to effectively and efficiently address the land use–livelihood nexus while exploring alternative development pathways, with implications for both carbon emission and local livelihoods. A key risk in designing REDD+ demonstration projects with a narrow focus on climate change is that this may continue to reward poor governance and do little to alleviate poverty.

The Lamandau River Wildlife Reserve forest conservation and community development project was one of a portfolio of four REDD+ projects supported by the Clinton Climate Initiative–Forestry program: Addressing the Challenges of Scaling-Up REDD+ Activities in Indonesia. The World Agroforestry Centre in collaboration with RARE, the Clinton Climate Initiative–Forestry, Yayasan Orangutan Indonesia (Yayorin) and Orangutan Foundation (UK) conducted a feasibility study assessing the potential for enhancing carbon stock in the eastern buffer zone (23 600 ha) of Lamandau River Wildlife Reserve, Central Kalimantan province. Beyond the current carbon stock and

[9] Summary of a report edited by Laxman Joshi, Janudianto, Meine van Noordwijk and Ujjwal Pradhan. The feasibility study was conducted with the financial support of the Climate Change Initiative of the Clinton Foundation with contributions from the World Agroforestry Centre (ICRAF) Southeast Asia Program, Yayasan Orangutan Indonesia, Orangutan Foundation (UK) and RARE

a projected baseline of 'business as usual', assessment of current rights and livelihood strategies in the area is needed for study of 'additionality' (carbon stock increases above baseline attributable to project interventions), 'leakage' (negative impacts on carbon stocks outside the project area attributable to project interventions) and 'permanence' (or leakage in time). We used the RESFA (REDD/REALU Site-level Feasibility Appraisal[10]) as the framework for studying the key livelihoods, land-use change, carbon stock and tenure issues to develop prospective scenarios and impact predictions.

The buffer zone of the Lamandau River Wildlife Reserve is part of a landscape with an average human population density of 40 km^{-2} (three times the average for Central Kalimantan province). The buffer zone was used for fishing and small-scale extractive activities and was one of the main production areas of *jelutung* (*Dyera costulata*) trees in Indonesia. *Jelutung* were managed through a locally recognised tree-tenure system.

Overall feasibility was assessed through answers to five questions.

A. Who are the land users, what do they do and what alternative options exist for them?

B. Who has claims of ownership and legality of current land use, who not?

C. How much carbon is currently stored in the landscape, linked to land-use practices?

D. Where do the various land-use practices take place and how much are they changing?

E. What can be done to reduce threat to carbon stocks and enhance carbon storage? How can leakage be prevented, additionality be claimed and permanence made likely?

A) The socio-economic part of the feasibility study indicated that nearly a fifth of the people in four surrounding villages reported involvement in activities inside the buffer zone, dominantly (82%) as *jelutung* tappers. The majority of *jelutung* tappers, however, are landless people from other sub-districts who can be regarded as forest-dependent communities who depend on the buffer zone (and the reserve) for their daily livelihoods. While there is an active migration history of local people (changing jobs, opportunistic behaviour), interest in farming among the local people has declined significantly. This is also because of the chronic problem of flooding and sea water intrusion in the fields. There is very little logging activities at present. *Jelutung* tapping, fishing and salvaging submerged timber in the river derived from previous logging activities are important economic activities, all with low-carbon impact. Old rubber agroforests in the buffer zone indicate a further step of forest domestication. Newly planted rubber is common in the villages surrounding the buffer zone. Illegal logging still takes place, but not at a large scale. However, if protection of forests is relaxed, there is a good possibility of increased logging as this is still seen as a good way to make quick money. Diversification of crops and active management and planting of *jelutung* trees in and around the reserve may offer viable options.

B) The study on tenure rights found that prior to declaration as a protected area, the buffer zone was used by local people for shifting cultivation, hunting, settlements and collection of firewood, building material and *jelutung* tapping. Some local communities still claim that the land is theirs; however, legality of this claim is rather weak. There is an interesting tradition in tree-level tenure where, within customary rules, individuals make private claims over valuable trees like *jelutung*. The local government considers the buffer zone as Production Development Zone (Kawasan Pengembangan Produksi), while the Forestry Department treats it as Conversion Production Forest (Hutan Produksi Konversi). In principle, both types can be legally allocated for forest plantation concessions or crop estates such as oil palm. Enhanced community control over the buffer zone may enhance the security of the existing woody vegetation and avoid conversion to an intensive system.

[10] http://www.worldagroforestrycentre.org/SEA/Publications/files/leaflet/LE0155-09.PDF

Village Forest (Hutan Desa) and People's Plantation Forest (Hutan Tanaman Rakyat) designations are among the viable options to provide such security. However, a Community Forestry (Hutan Kemasyarakatan) arrangement might offer better options for tenure security as many local communities outside the villages also use the forest buffer zone. Their interests need to be taken into account, beyond those of neighbouring villages.

C) In terms of existing carbon stock, the peat soils of the buffer zone contain approximately ten times as much carbon (841 t/ha) as is stored aboveground (average 84 t/ha). Lowland peat swamps have an average depth of 1.3 m, but depths up to up to 4.5 m were measured, with a carbon stock of 7 t/ha per cm of peat. Aboveground carbon stock in high density logged-over forests is about 77 t/ha, or only 33% of the 230 t/ha reported for non-logged lowland forests in Kalimantan. The current carbon sequestration rate for the buffer zone is about 1.3 t/ha per year. Grassland has a low carbon stock (< 1 t/ha). Pandanus and *nypa* palm stands contain about 40 t/ha; rubber agroforests mixed with *jelutung* have 75 t/ha, while young rubber agroforests have only about 22 t/ha.

D) Analysis of the patterns of land use and land-use change indicated that, in general, there has been little recent land-use change within the buffer zone in terms of clearance and agriculture intensification, perhaps because of the protection measures in place. There are some agricultural activities within the buffer zone and particularly alongside the river where access is relatively easy and where secondary swamp forests have been converted to shrubs and in some cases to more open areas. However, outside the protected areas, the land-use change is more dynamic with significant increase in managed tree-based systems (tree crops and forest plantations) at the expense of forest. There was no significant change of land-cover types in the period 2000–2006 although some changes were observed along the riverbanks and some inland. The baseline scenario indicates positive carbon gain (1.3 tC/(ha yr)); enrichment planting with species like *jelutung* may provide both carbon benefits and income benefits to local forest-dependent people. Among the various scenarios explored, conversion to oil palm plantation has the highest carbon emission (also highest profitability and preferred by local people for job opportunities). This is the biggest threat.

E) The current state of the buffer zone of the reserve is the result of a dynamic history of pressures and response by local communities to emerging opportunities and of initiatives that are effective in protecting the wildlife reserve and the buffer zone. The protection of the reserve and buffer zone since 2005 has been effective in terms of forest restoration, biodiversity conservation and, consequently, carbon storage. Compared to areas close to checkpoints, areas at greater distance have lower carbon stocks. Additional control and checkpoints may also have some positive influence. The primary challenge may be to maintain this level of protection, which has been based on voluntary, time-bound project resources. Additional measures or activities are unlikely to significantly enhance carbon stocks and reduce carbon emission. Additional planting of tree species, especially in open and degraded areas may be beneficial. At present the biggest threat seems not from the forest-dependent people or the communities around the protected area, but from possible large-scale, oil palm plantations. The idea has been discussed in the past and is still on the table[11]. This would lead to a net aboveground carbon loss of 40–50 t/ha, with belowground (peat) losses dependent on the level of drainage and land management regime, but potentially larger and spread out over a longer time period than aboveground losses.

Regarding feasibility of a REDD$^+$ project in the buffer zone, the carbon stock gains may be modest compared to other locations in Kalimantan or Sumatra where larger above- and belowground carbon stock losses may occur with greater likelihood. The co-benefits of biodiversity conservation and livelihood improvement for forest-dependent people will have to be a major consideration to justify

[11] Documents and data support to this statement are available through the local regional development planning agency office (BAPPEDA Kabupaten Kotawaringin Barat) and our partners (Yayorin and UN Habitat's Partnership for Local Economic Development (KPEL)). We cannot publish the evidence in this report, however.

project costs. The study concludes that a credible and potentially creditable emission reduction through a REDD+ pilot project will be feasible if the project includes activities to strictly control logging, land clearing and burning inside protected areas, in combination with enhancement of *jelutung* (for controlled tapping) and other valuable trees in and outside the forests and allowing local people to continue fishing and extracting submerged logs. This will increase the likelihood of success of any project for reducing carbon emissions while protecting local livelihoods of the forest-dependent people.

3.3 Human livelihoods, ecosystem services and the habitat of the Sumatran orangutan: rapid assessment in Batang Toru and Tripa[12]

Outside of the national parks and formally protected areas in North Sumatra and Aceh, orangutan and people share landscapes that consist of remaining natural forest, forests that have been modified by human use, agroforests created by farmers, open farmland and settlements. The orangutan habitats are important for other rainforest fauna and flora that are under threat and the habitats store carbon and modulate water flows. In other words, these habitats provide environmental services that support human livelihoods inside and outside the landscape. Current global interest in reducing or avoiding carbon emissions provides an additional rationale for seeking alternative pathways for improvement of human livelihoods: pathways that are compatible with survival of orangutan populations and preservation of carbon stocks. Such alternative pathways will have to be fine-tuned to local conditions, expectations and perceptions of people living in the area, local and provincial governments and external stakeholders. In support of such a process of stakeholder negotiations, this report provides background data and makes a start on scenario analysis for two landscapes with habitat and remaining populations of the Sumatran orangutan: Tripa, Aceh and Batang Toru, North Sumatra.

The two landscapes have similar as well as contrasting characteristics. A comparison of the two highlights the concepts of 'segregation' and 'integration' of multiple functions in a landscape. The establishment, nearly a century ago, of the Gunung Leuser National Park in Aceh as a conservation area represented 'segregation' of functions, where people were excluded from the conservation area. Forests outside the protected area were transformed into open-field agriculture, intensive tree-crop production systems or plantations for the pulp and paper industry. These areas excluded orangutan. For conservationists, the primary way to achieve their goals was to try and increase the size and connectivity of 'protected areas', yet people continued to infringe on the existing areas and contested the legality of forest allocation to logging concessions and/or conservation agencies.

In the Batang Toru landscape, on the other hand, a more integrated and gradual transition from natural forest to human habitat has survived for a number of reasons. Here, the villages, generally located at lower elevations than the natural forest, maintained an active interest in the regularity of water flow and other ecosystem services that the forest provided. Maintaining a balance in such 'integrated' landscapes depended on appropriate incentives, rather than the 'command and control' approach of protected areas.

Renewed focus on forest preservation appeared to provide new opportunities for conserving the habitat of the 'red ape'. Economic incentives provided in a REDD framework could be used to shift the balance towards protecting forests and reducing carbon emissions from deforestation. This could have substantial 'co-benefits' to local people as well as conservation. In such cases, a REDD

---

[12] Summary of 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.

scheme might provide co-benefits by providing upfront investment and performance-based rewards for local people not to convert forest to plantations and thereby protect the forest and the orangutan habitat. Other orangutan forest areas that are not so rich in carbon (because located on mineral soil) could also provide co-benefits. In particular, they could be important watersheds, providing many services for downstream communities who could reward upstream residents for protecting forests and, hence, the watershed.

In collaboration with PanEco and Yayasan Ekosistem Lestari, a team from the World Agroforestry Centre conducted a rapid assessment of ecosystem services and human livelihood options provided by the remaining habitat of the Sumatran orangutan outside the Gunung Leuser National Park. We used a rapid analysis of carbon stock assessment (RACSA) method to assess the carbon stock (above- and belowground) at plot level and calculated land cover for carbon stock at landscape level. We calculated the net present value of important crop and tree commodities in Tripa and Batang Toru and analysed the costs and benefits of each commodity. To find solutions for better management at the two study sites, applications of the FALLOW model were developed, which allowed comparison of several possible scenarios. An attempt was made to translate such scenarios into opportunities for human livelihoods, orangutan population size and carbon emissions and stocks.

Summary of findings

- A livelihoods and economic study was conducted to assess current livelihoods and drivers of land-use change in both landscapes. Further analyses focused on economic incentives and alternative opportunities to produce multiple benefits from land uses. In the Batang Toru landscape, irrigated paddy rice was still the main land use that provided subsistence needs, with additional market orientation for some farmers. Mixed gardens with high economic value trees, such as rubber, *kemenyan* (benzoin) and various fruits, were important for cash income and additional subsistence needs. However, the *kemenyan* systems appeared to have become economically marginal. Improvement of production and/or marketing systems would be needed to avoid a destabilisation of the northern part of the Batang Toru forest block. Eco-certification of rubber, which is being researched elsewhere in Sumatra, that is produced in a sustainable and biodiversity-friendly way may in future allow farmers to get a better price for their rubber products. The 'integrated' landscape concept survived the analysis. Integration of functions is helped by the fact that the dominant commodities in the agroforests are not on the menu as normal food sources for orangutan and other wildlife. The three primary threats to orangutan conservation in this landscape are 'external' in their origin: the logging concession; the planned gold mining operations; and the continued immigration of people from Nias who open up forest for new farms and are reported to be opportunistic hunters of orangutan.
- In Tripa, expansion of oil palm companies was rapid, with land-use concessions (HGU) leading to the conversion of peat forest areas to oil palm. The Aceh Barat Daya government, one of the two *kabupaten* with jurisdiction over parts of the Tripa swamp, had ruled that community members could establish oil palm plots of up to 2 ha per household. This regulation led to massive land conversion by smallholder farmers. The smallholder oil palm sector is now driving land-use change in Tripa and may be the greatest potential threat to the remnant peat swamp forest of Tripa and, thus, the orangutan.
- The aboveground carbon stock estimate for undisturbed forest in Tripa was similar to that in Batang Toru (averages of 246 and 243 t/ha, respectively). Most of the forest in Tripa, however, is disturbed, with an average aboveground carbon stock of 122 t/ha. Lowland peat swamps in Tripa have an average depth of 3.2 m, with average belowground carbon stock of 1350 t/ha and 4.19 t/ha/cm (root carbon stocks are not included in this estimate as yet). Soil-based carbon

stock in Batang Toru ranged 32–58 t/ha for the top 15 cm, with lowest values measured in durian agroforest and highest in undisturbed forest.

- Undisturbed forest in Batang Toru contained many tree species supplying orangutan food. Ten dominant tree species found in Tripa (including *Eugenia jambos* as most common

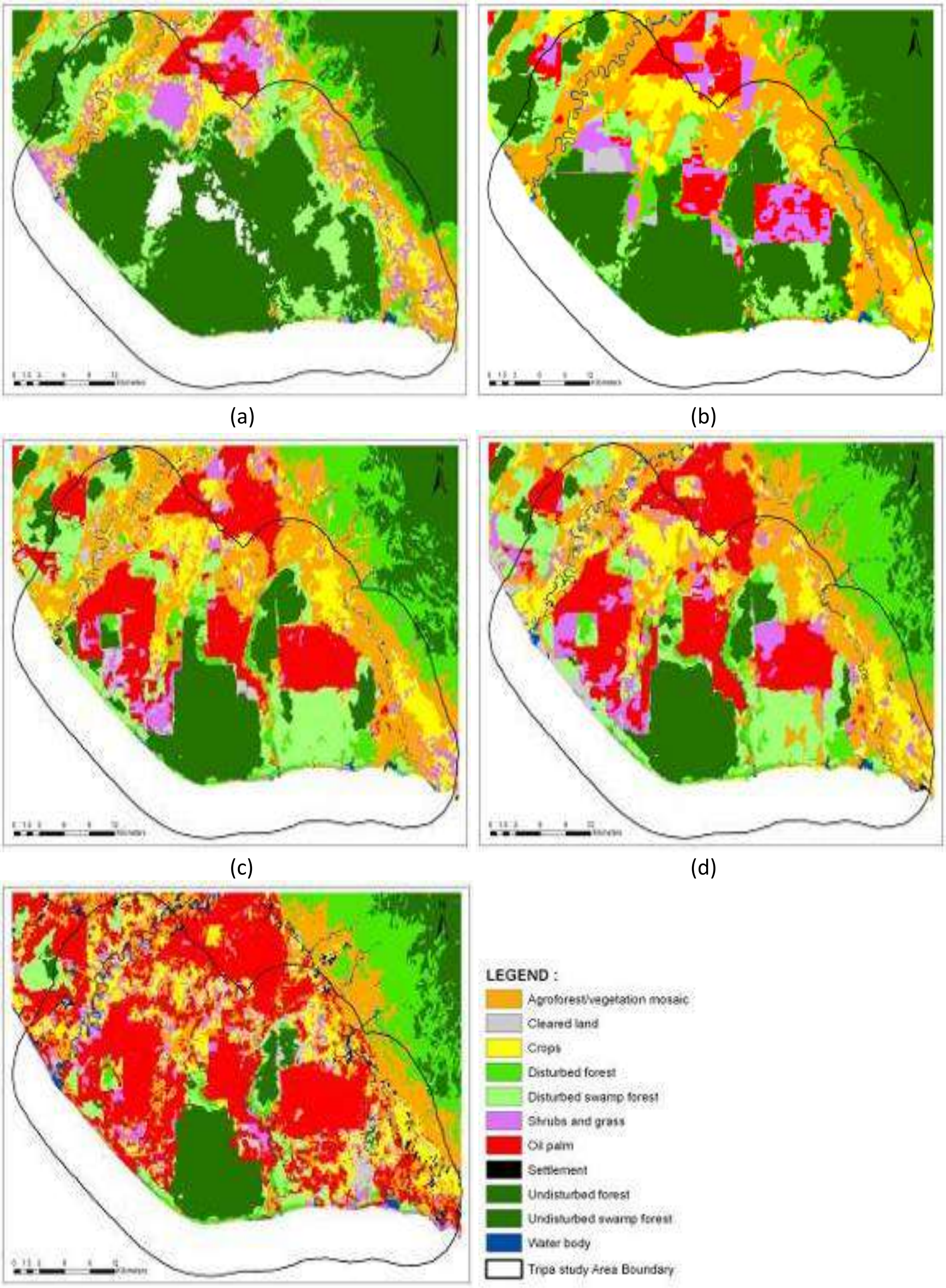


Figure 1. Land-cover maps of Tripa study area: (a) 1990; (b) 1995; (c) 2001; (d) 2005; (e) 2009

species) were identified as sources of orangutan food. Trees in Tripa were more diverse than those in primary forest in Batang Toru, with a Shannon-Wiener index of 3.5 and 2.9, respectively.

- In Batang Toru, by contrast, land use was relatively stable for the whole period of observation. For the 1994–2009 period, loss of undisturbed forest was 1.17% per year; loss of disturbed and undisturbed forest was 0.5% per year (for a total loss of 5% of the landscape); and loss of disturbed, undisturbed and agroforest was 0.24% per year. Agroforests (with rubber, *kemenyan* or mixed fruit tree as main species) increased until 2001 (from 22 to 27.4% of the area), but had then declined to 23.6% in 2009. Other crops and monoculture plantations increased by 1.5% per year, from 11.9 to 15% of the area. The aboveground carbon stock density in the orangutan habitat decreased from 235 t/ha in 1994 to 225 t/ha in 2009, while for the study area it decreased from 185 t/ha in 1994 to 174 t/ha in 2009. Net emissions ranged from 1.3 $MtCO_2e$/yr to 1.8 $MtCO_2e$/yr during the 1994–2009 period. Emission factors from aboveground biomass changes in the orangutan habitat were highest during 2001–2006 (1.35 tCO_2e/(ha yr)).
- At landscape level, the average aboveground carbon-stock density in the 1020 km^2 assessed in Tripa decreased from 148 t/ha in 1990 to 61 t/ha in 2009, while for the 480 km^2 subset of this that is conceded to oil palm plantations, carbon density decreased from 114 t/ha in 1990 to 48 t/ha in 2009. The annual emission rates owing to land-use conversion in the study area ranged between 0.94 $MtCO_2e$/yr and 2.2 $MtCO_2e$/yr, with the highest value in the period 1990–1995 when forest conversion to oil palm plantations peaked. The lowest rate, during 2001–2005, was because of a slowdown of activities during the conflict. Post-tsunami and after the peace agreement, emissions increased again.

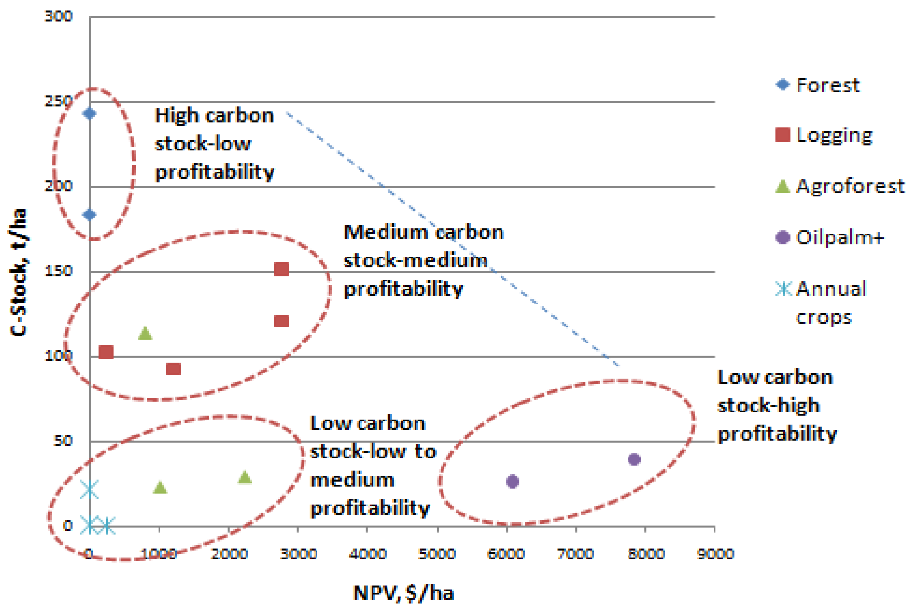
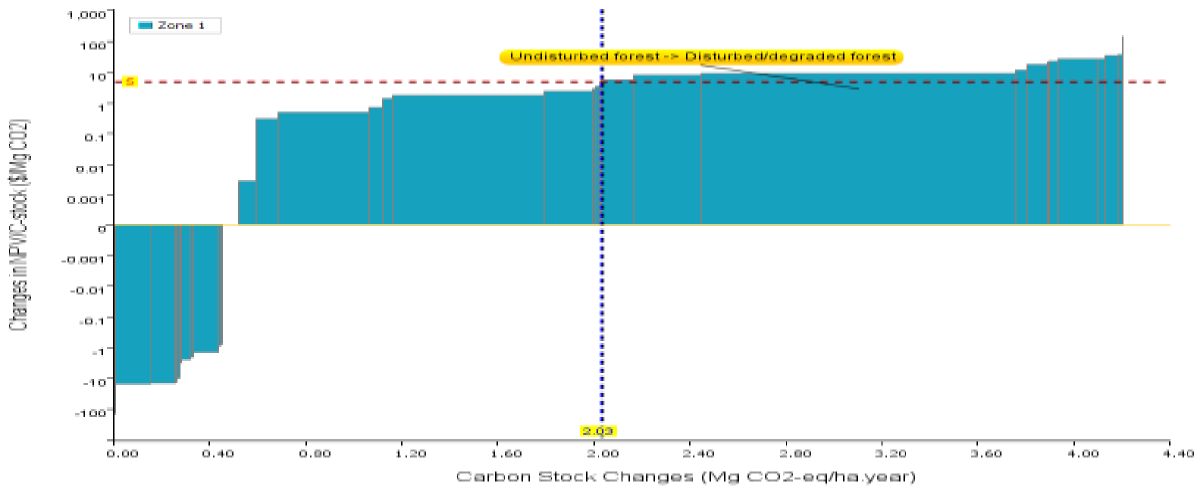


Figure 2. Trade-off between profitability (net present value = NPV) and typical carbon stock of the land-use systems encountered in Tripa and Batang Toru

- Analysis of opportunity costs of avoided emissions (or ‘abatement costs’) in Tripa and Batang Toru showed that the opportunity cost between natural forest and oil palm was slightly over 10 USD/tCO_2e. Carbon stock and profitability could be classified into four groups: 1) High carbon and low profitability (for example, forest); 2) Medium carbon and medium profitability (for example, logging and agroforest); 3) Low-carbon stock and low-to-medium profitability (for example, annual crops and agroforest); and 4) Low-carbon stock

(a)



(b)

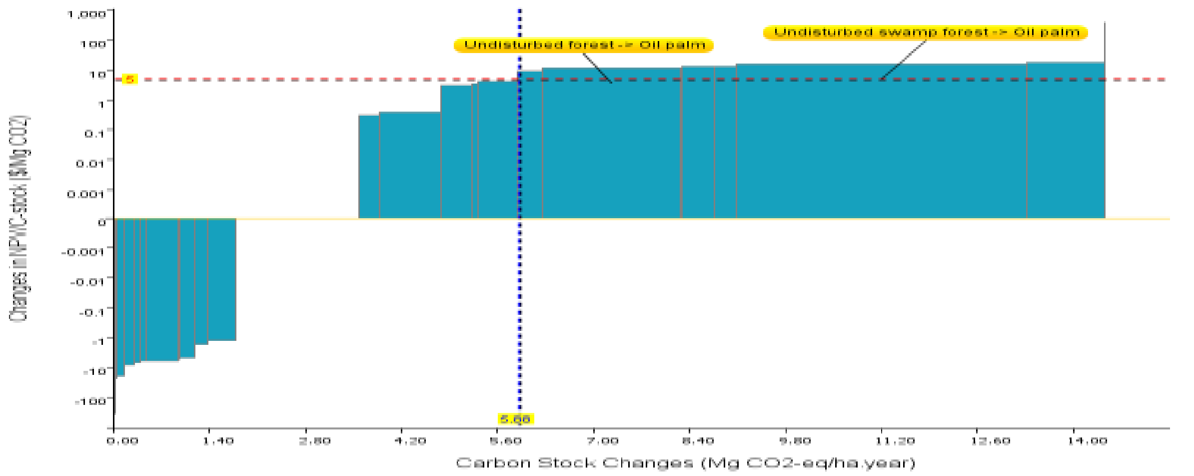


Figure 3. Abatement-cost curves for CO_2 emissions throughout the entire period of analysis (1994–2009): a) Batang Toru; and b) Tripa

and high profitability (for example, oil palm). Based on these criteria, change of land use in Batang Toru was much slower compared to Tripa. In Batang Toru, the dominant change, and the highest emission contributor, was from undisturbed forest to disturbed forest, which reflected logging and other timber extraction activities taking place in parts of the forest. The opportunity cost for logging activity from natural forest was 8.27 USD/tCO_2e for all the periods of analysis.

- On the other hand, forest in Tripa decreased dramatically to more profitable but low-carbon stocks, that is, oil palm (both plantations and smallholder plots), while annual crops and agroforest remain constant. In Tripa, forest conversion to oil palm plantations produced high average annual emissions. Over the whole observation period, average annual emissions from Tripa (14.45 tCO_2e/(ha yr)) were substantially higher than those from Batang Toru (4.2 tCO_2e/(ha yr)). The opportunity costs of natural forest and natural peat swamp forest conversion to oil palm plantations were the highest. By taking into account peat emission during land-use conversion, the average emission in Tripa was estimated to be 20 tCO_2e/(ha yr). Using the threshold of 5 USD/tCO_2e, the emissions from land-use conversion that could have been avoided ranged between 6 tCO_2e/(ha yr) to 15.3 tCO_2e/(ha yr) over different periods of observation. The proportion of high-opportunity-cost emission is also much higher in Tripa than in Batang Toru. For Batang Toru, conversion that could have been avoided was 48% (2.03 tCO_2e/(ha yr)) of the total emissions, while in Tripa it would have been lower (41% based on only the aboveground carbon-stock emission, totalling 5.88 tCO_2e/(ha yr)) and even much lower when belowground emission from peatland conversion had been taken into account (35%, totalling 7.03 tCO_2e/(ha yr)) .

- FALLOW modelling scenarios in Batang Toru and Tripa highlighted the need to consider both livelihood and emission levels as dynamic baselines. While opportunity costs refer to current economic value, scenarios of land-use change indicate that income opportunities for local communities are key. A number of activities that enhance emissions also increase the number of people who can obtain income. When such effects are included at the landscape level, opportunity costs could increase to 15 USD/tCO_2e for comprehensive emission reduction scenarios, while they could be 5 USD/tCO_2e for limited activity, with lower relevance for biodiversity conservation. The FALLOW model also indicated that about 60% of the income opportunities that might be lost in Tripa if oil palm expansion was restricted could be absorbed by other land-use activities.

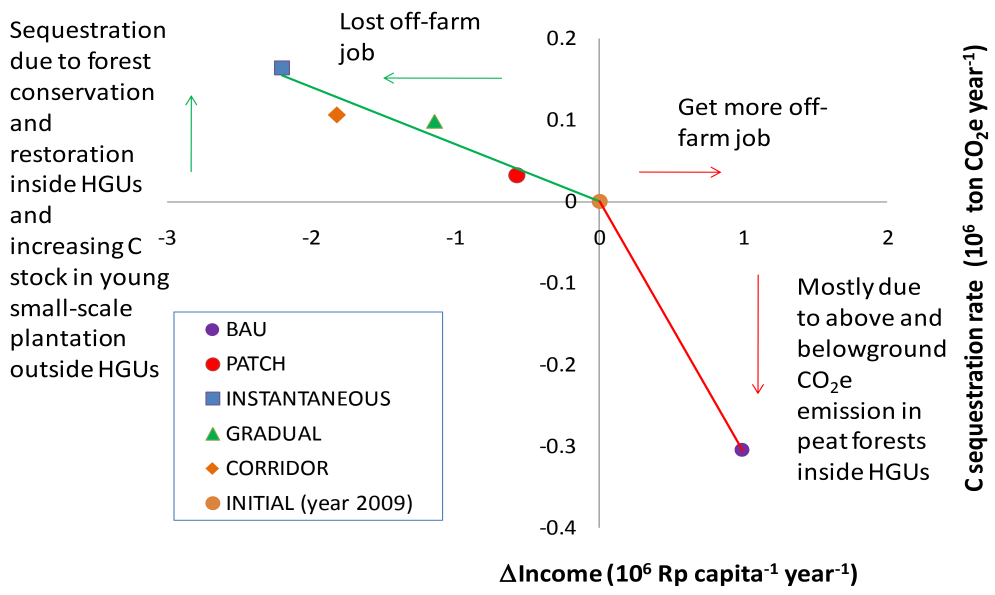


Figure 4. Difference in annual income and annual CO_2e sequestration rate calculated for each scenario for a 30-year simulation over the simulated landscape in Tripa relative to the condition measured in year 2009 (that is, income of Rp 3.5 x 10^6/capita or Rp 6.5 x 10^6/labour with a labour fraction of 0.54 from total population in Tripa) and total aboveground carbon-stock of 5.5 x 10^6 tonne in the landscape). The wage rate as labourer in big-scale oil palm plantations used to calculate income was Rp 1.2 x 10^6/month). Calculated by the FALLOW model

- Orangutan populations are likely slow to respond to ecological restoration owing to their low birth and dispersal rates. Further examination of the corridor scenarios explored how attractive such options could be from a conservation perspective, with a potential gain of 10–200 individuals in the area over 30 years.

3.4 Stewardship agreement to reduce emissions from deforestation and degradation: Lubuk Beringin's Hutan Desa as the first Village Forest in Indonesia[13]

Contested rules between the state and local communities over use and protection of forest are a threat to Indonesia's forests, environmental services and livelihoods. Success in forest protection and emission reduction requires conflict resolution. The recent 'village forest' (Hutan Desa) regulation by the Minister of Forestry (P.49/Menhut-II/2008) details how to reconcile forest management targets and livelihood interests of forest-edge villages within the framework of a permanent forest estate. Lubuk Beringin in Bungo district, Jambi province, became the first village in Indonesia to secure such an agreement. Our analysis of the process, stakes and social capital bridging local, district and national scales of Hutan Desa aims to assist in reducing transaction costs for wider application, as part of any REDD scheme, locally appropriate mitigation action as part of national strategies, and as co-investment in stewardship for local, national and global benefits.

REDD is often seen as a form of (or at least closely related to) payments for environmental services. Van Noordwijk and Leimona (2010) distinguished three paradigms of such services.

(1) Commoditization of environmental services (for example, via carbon-offset and credit markets, payment on delivery) or CES.

(2) Compensation for opportunities skipped (for example, the forest maintenance payments in Costa Rica with weak conditionality) or COS.

(3) Co-investment in stewardship (e.g. investing across multiple capitals, sharing risk, expressing shared responsibility) or CIS.

The first two paradigms require clarity of property rights at the start of the process, legality of activities that threaten environmental services and enforcement of laws that set minimum standards of behaviour. The third paradigm is feasible where any of the preconditions of the first and second paradigm are not met. Van Noordwijk and Leimona claim that the opportunities for co-investment in stewardship are therefore much more widespread than those for the other two paradigms. A historical analysis of the environmental services payments concept (Gomez-Baggethun et al. 2009) lead to a similar conclusion. It is also aligned with the German and Keeler's (2010) perspective on hybrid institutions that combine formality and informality in shaping more productive engagements with seemingly intractable natural resource management challenges at farm and landscape scale.

A case study of conflict resolution in the form of Hutan Desa agreements is described here, as a low-cost but essential precursor for any REDD scheme. The Hutan Desa agreement was facilitated by expectations of REDD benefit flows to government agencies that had a veto on any agreement and little interest in moving such agreements along before REDD entered the debate. We will start with a description of the rules and associated conflicts over planning and control over forests in Indonesia (section A), followed by an account of the Lubuk Beringin village in its local context (section B). The emergence of new rules for reconciling the interests of such a village with those of national forest

[13] Summary of Akiefnawati et al. 2010.

authorities in the form of Hutan Desa is presented (section C), along with the process that had to be followed to obtain the first such permit. Then, (section D) the emergence of the Hutan Desa agreement for Lubuk Beringin is discussed in the context of trust, threats and incentives (for example, what pre-disposed Lubuk Beringin to become a pioneer in this aspect? How difficult will it be to scale out?) and followed by consideration of the relevance of this case for the global REDD debate (section E).

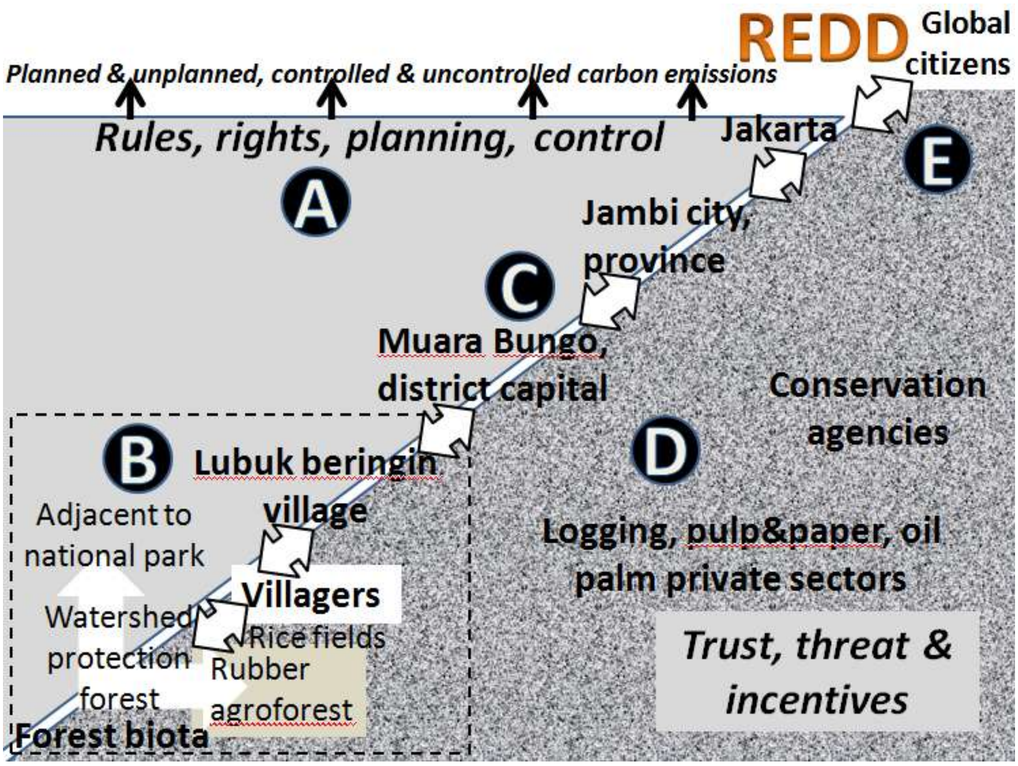


Figure 34. Schematic representation of the relations in a specific forest–village gradient, nested in a regency (district), province, country and global network of relations that can be understood in formal (rules, rights and planning: upper triangle) and informal senses (trust, threats and incentives: lower triangle). NB: Letters A to E are the sections of this paper

A. The policy context and conflicting rights

In Indonesia, as elsewhere, the right to use, manage and/or convert natural forest is, under the constitution, vested in the state for the benefit of the people. In practice, the perspectives of the state and local communities on how benefits could be achieved have differed and varied over time (Fay and Michon 2005). The historical basis of the state's claim over all natural resources varies within Indonesia, given the patchwork of governance arrangements and agreements with local rulers that the colonial government left behind (Galudra and Sirait 2009). Jambi province, Sumatra, was brought under colonial rule only in 1908 when nearly all land accessible by river, which was the major means of transport, was already used for agriculture. Only land in the mountains (which later would become the Kerinci Seblat, Bukit Tigapuluh and Bukit Duabelas national parks) and peat swamp/mangrove zones became firmly established protection forest zones. The remaining forests on the lowland peneplains, beyond reach of the villages at the time of colonial rule, were established as forest reserves. After Indonesia's independence, in the 1960s, road access was established and those forests were assigned to logging concessions.

In the early 1990s, the Kerinci Seblat National Park , the largest protected area in Sumatra, was the target of what was supposed to become an exemplary Integrated Conservation and Development

Project (ICDP)[14]. The project was closed in 2002, as evaluations suggested that its goals were not achieved. An impact study by Helmi and Yoariza (2002) compared villages that were involved in the project with those villages outside and concluded that the ICDP achieved the objectives on conservation awareness but failed to match the rate of development through alternative livelihood options. Ironically, the ICDP failed at its core by the lack of integration, contrary to its name, and because it remained a 'project'. The various service delivery sectors were not aligned; despite participatory mechanisms, there was no effective support for the villagers to guard the park when confronted with outsiders who intruded in the forest through their village, while conservation grant disbursement increased inequity and sparked jealousies. The failure of the ICDP does not stand alone, but shortcomings through 'projectisation' and implementation should not stop the search for real integration of conservation and development through other means (Pfundt et al. 2008). Local, national and global stakes in the outcome are clearly in need of effective reconciliation.

While a fully rights-based approach was difficult in pre-1998 Indonesia with its absence of a universally accepted baseline, agreements on the types of resource use and associated benefit-sharing could be negotiated. Elsewhere in Sumatra, substantive shifts towards tenure security were achieved and started to have positive effects for both livelihoods and environmental services, even though these fell short of clarifying all rights to mutual agreement (Suyanto et al. 2005, Kusters et al. 2007).

The 1998 political upheaval in Indonesia changed the playing field, though not necessarily the actors and stakes. The Indonesian Forestry Law No. 41 of 1999 contains a number of mechanisms, including privately owned forest (Hutan Hak), recognition of traditional rights (Hutan Adat), community-based forest management (Hutan KeMasyarakatan or HKM) and village forest management (Hutan Desa). These mechanisms could be applied to forests that have permanent watershed protection status (Hutan Lindung) and forests that could be subjected to sustainable logging practices or severely degraded areas for forest plantation development (including Hutan Tanaman Rakyat or HTR). However, between the legal opportunity and a fully functional implementation program, many intermediate steps needed to be taken to align forest governance agencies at district, province and national level. Until implementation rules had been established, no forest had been formally designated as Hutan Desa.

The 1999 forestry law was influenced by the decentralisation concepts of the 1998 Reformasi period. The mood in the forest sector rapidly swung back towards recentralisation in 2002. According to Djogo and Syaf (2003)...

> *the decentralisation of forest resource management authority to local governments has resulted in a situation in which district governments are neither accountable upward to the central government nor downward to the local people. The decentralization of authority without appropriate devolution processes or control mechanisms has resulted in the decentralisation of opportunistic behaviour that is in direct opposition to the development of good local forest governance. The delegation of authority has in fact resulted in the decentralisation of power to the private sector.*

Increasingly over the past decade, international concerns over the fate of tropical rainforests, driven by concerns for biodiversity as well as greenhouse gas emissions and climate change, focused on issues of governance and control of illegal logging. More direct involvement of local communities is widely seen as an important part of any solution. The discussion on REDD that started in Indonesia in 2007 re-emphasised the need to reduce conflict over forest boundaries and engage local communities in forest management (IFCA 2007, van Noordwijk et al. 2008). Jambi province was keen to be one of the pioneers in REDD programs and this provided support at provincial level for moving ahead with new initiatives for local forest governance.

[14] World Bank-sponsored project.

B. Lubuk Beringin: forest-village gradient and social capital

Lubuk Beringin, with a total area of 2800 ha (of which 84% is watershed protection forest), is one of the villages in the sub-district Bathin III Ulu, Bungo district, Jambi province. It was categorised as a poor village within the district, with below-average income levels. The village's main sources of food were its rice paddies and the main source of income was rubber and occasionally durian and other fruits obtained from the rubber agroforests that also provide such fruits and medicinal plants. While technically feasible, the intensification of rubber gardens involved risk of failure and required credit sources at reduced discount rates, which were not locally available (Williams et al 2001, Joshi et al. 2003).

In 1997 the village became part of the ICDP-TNKS program, which aimed to develop an agreement of village rules on environmental preservation. The agreement included maintaining forest areas, not opening land with more than 80° slope and planting bamboo along the riverside to protect the slope from erosion and landslides.

Lubuk Beringin is part of the Rantaupandan valley. Here, the Rewarding Upland Poor for Environmental Services (RUPES)[15] project of the World Agroforestry Centre explored rewards for environmental services in Bungo district after the closure of the ICDP. It included Lubuk Beringin as one of the focal villages, building on some of the social capital that had been achieved in the ICDP days, but relying on local initiative. As the rubber agroforests of Lubuk Beringin border on, and are partly classified as, watershed protection forest (Hutan Lindung), the key issues for the village were their lack of tenure security and options to deal with external disturbance to the forest upstream. As one of the RUPES sites, it had been successful in supporting and up-scaling the use of the Community-Based Forest Management (HKM) procedures of the forest law and a similar approach seemed appropriate for Lubuk Beringin. At central government level, however, the HKM option was seen as losing control, partly because relations between the community and formal government was not clear, even at the lowest level.

RUPES-Bungo activities focused on options for' jungle rubber' or biodiversity-friendly rubber agroforestry management (Kuncoro et al. 2006). These activities raised local awareness of the trade-offs involved in rubber intensification, that is, while rubber yields increase, the locally public goods and services of the agroforest decline. The village discussed the relevance of protecting their existing rubber agroforestry systems. Rubber agroforests also serve as habitat of fauna and flora and can preserve watershed functions. Since the village was not yet connected to the electricity grid, the idea came up to use the local river as a source of hydropower. The RUPES project supported the idea, as a direct reward for environmental services and a way to increase local incentives to protect the watershed. The local government later stepped in and provided further support when the first pilot case succeeded and the village had shown the ability to organise themselves. The village's efforts were recognised by receiving second place in the prestigious national Kalpataru award in 2006 at provincial level and as the top candidate in 2007. With these nominations, the visibility of the village was amplified and its commitment to combine conservation and livelihood improvement was strengthened.

The Lubuk Beringin villagers committed themselves to maintaining the Rantau Bayur protected forest area because the forest provides the water they need to generate electricity for their village, irrigate their rice fields and for drinking. A village rule (PERDUS) guides their efforts to manage the water and utilise the forest both for timber and non-timber purposes. They forbid land clearing and campaign for this by providing information in the mosque. The main threat to the forest, however, comes from the neighbouring villages and their development pathways. These neighbouring villages have agreement with private companies for oil palm development and implement local transmigration programs to increase their population size.

[15] RUPES is funded by the International Fund for Agricultural Development.

C1. Formal rules for Hutan Desa

Government Rule No. 6 of 2007 and No. 3 of 2008 indicated that forest management needed to be based on empowering society, developing local capacity and providing access in order to increase the prosperity of people living in and around the forest. The village forest or Hutan Desa option was clarified along with Community-Based Forest Management (HKM).

Hutan Desa areas are parts of the national forest estate managed by a village community through a local village organisation that plans, manages and allocates benefits derived from the forest. The management is not only focused on utilisation of forest resources but includes responsibilities to preserve the life-supporting functions of the forest. The procedure for assigning rights to any village in Indonesia involves approval at district, provincial and national levels (Figure 35). The designation of Hutan Desa became operational under the decree from the Minister of Forestry No. P.49/Menhut-II/2008 of 25 August, 2008.

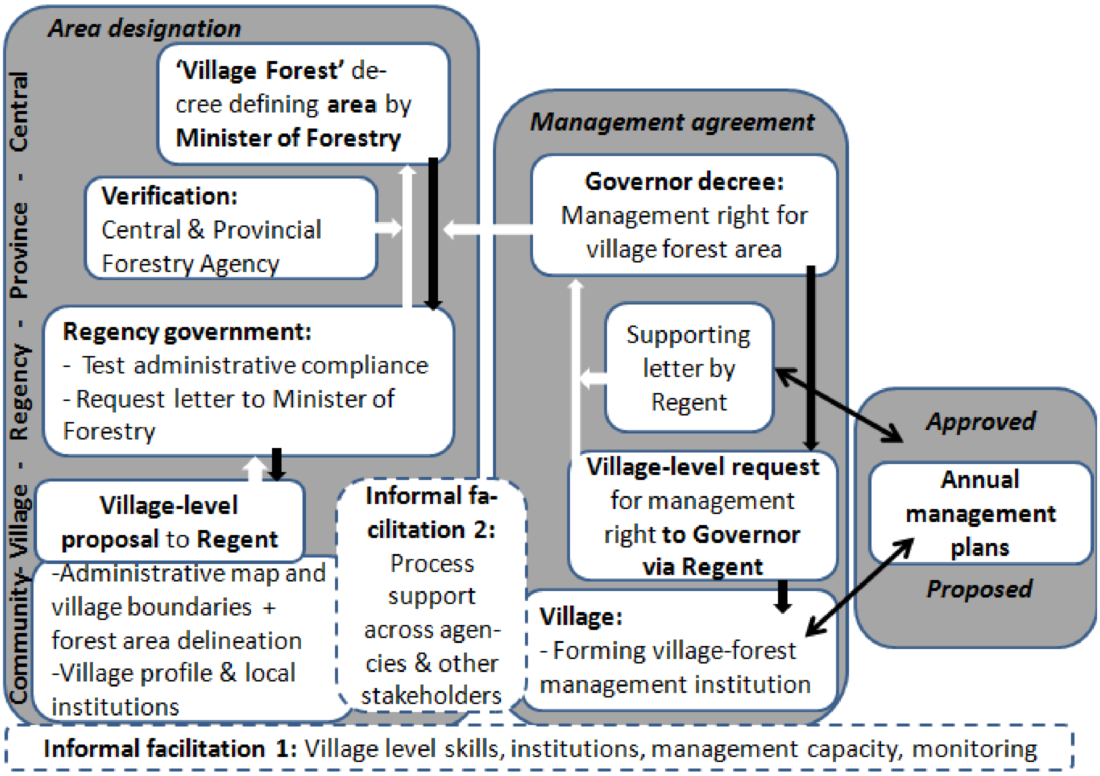


Figure 35. The process for proposing area designation, management rights and annual management plans for a village forest

The area which can become under Hutan Desa has to be administratively part of the village and can include watershed protection forest and production forest (as long as there are no existing concession rights). The Hutan Desa agreement is valid for 35 years, renewable for another 35 years, subject to approval of annual work plans. Detailed information about rights and obligations, work plans and other duties within the Hutan Desa scheme can be seen in the working paper (Akiefnawati et al. 2010).

The application for a Hutan Desa permit for Lubuk Beringin was supported by KKI-WARSI (an NGO) which was involved in the ICDP project in 1992 and researchers from the World Agroforestry Centre studying biodiversity in the area since 1998 along with rubber agroforest management and intensification options through the RUPES project. The application also gained the attention and support of the government in Bungo district, through the multi-stakeholder forum known as the Forest Governance Learning Group . The members of this forum, including individuals working at various agencies but not formally representing them, were responsible for formulating the development vision for Bungo district, which is free from partisan interests, politics or institutional agendas.

C2. Obtaining Hutan Desa recognition for Lubuk Beringin

Lubuk Beringin's Hutan Desa application process started on 20 November, 2008, when the Directorate General of Land Rehabilitation and Social Forestry in the forestry department clarified Regulation No. P.49/Menhut-II/2008 on 'village forest' during a meeting with the village representatives at the government planning (BAPPEDA) office in Bungo. Then, the village representatives officially proposed their intention to manage all the watershed protection forest (known as the Bukit Panjang-Rantau Bayur forest) within the administrative bounds of their village.

KKI-WARSI helped in completing the administrative requirements, such as maps and inventory of the natural resources within the village administrative boundaries. The proposal was completed within four months. The formal application letter from the village to the head of the district refers to support in proposal development provided by KKI-WARSI and the World Agroforestry Centre.

In early January, 2009, a verification team from the forestry department visited Lubuk Beringin for a feasibility study. Then, during a ceremony attended by 2000 people on 30 March, 2009, the Minister of Forestry officially awarded the Hutan Desa management rights to Lubuk Beringin. The village became the first in Indonesia to obtain such rights. The head of Bungo district received the decree from the Minister on behalf of the village. The forestry and plantation office has been designated to guide the village in implementing their Hutan Desa work plan. The village community is responsible for reporting illegal logging activities in the area to the relevant authorities.

The process of initiating, supporting and acquiring the Hutan Desa permit is a form of Action Research (Bargal 2006) in the sense that researchers were actively involved together with the village and used opportunities as they arose throughout the process. Researcher-supported local action typically proceeds stepwise, with phases of reflection alternating with phases of action and 'learning loops'.

D. Discussion: understanding trust, threat and incentives

Community coherence and connectedness

Are there specific factors in the condition or history of Lubuk Beringin that pre-disposed the village to be the pioneer of a new deal between forest authorities and village communities in Indonesia?

For more than a decade, Lubuk Beringin had been interacting with KKI-WARSI in the TNKS protection program. Although the ICDP as a whole may have failed, the process it started can be followed to Lubuk Beringin's Hutan Desa outcome. Although Suparman (1999) noted that the empowerment programs of the ICDP only reached rural elites, in the case of Lubuk Beringin, at least the final discussions ultimately involved all. The time pressure of projects may not match reality and success or failure may be judged too early.

The RUPES program on biodiversity and environmental services reward options also employed participatory, collaborative and co-learning approaches. It operated on the basic assumption that effective management of natural resources, including biodiversity conservation, occurs whenever there is synergy among human, natural and social capitals (Van Noordwijk et al. 2004). Social capital in the village was developed using an interactive co-learning approach, which allowed dialogue among as many relevant stakeholders as possible to share knowledge, define problems and find solutions. The community was considered as a collaborator having an active role in designing priorities, with the outsiders having the responsibility in actualising the process of conservation and development. Reaffirming the hypothesis of Ostrom (1990) that self-organization defines a community, the following principles were applied.

1. The boundary was clearly defined in the Lubuk Beringin landscape, taking account of the historical facts.
2. The community affected by the rules participated in modifying the rules.

Win-win-win solution?

Analysis of the benefits that the district, provincial and central government agencies derived from the Hutan Desa designation suggests that the public discussion of conflicts as deterrent of REDD investment in Indonesia as a whole and in Jambi province specifically have played a role. Although the REDD context is not reflected in the formal decisions (as it may give the impression of undue external pressure), it was expressed in informal interviews with those involved in the approval. The watershed protection forest status does not allow extraction rents while the costs of protecting the area are a drain on district resources that is supposedly balanced by gains in more regular flow regimes and reduced risk of landslides that disturb road infrastructure or can lead to loss of lives. The public display by the Minister of Forestry in announcing the Hutan Desa agreement just before parliamentary elections suggests that a showcase was indeed welcome after years of promises that benefits from forests should be more widely shared.

Bungo's forest governance learning group served as a venue for open discussions among activists about reforming forest governance. This forum was informal and the topics of discussion depended on initiatives from the members. The members of the forum did not represent their institutions so the meetings provide a safe space for learning.

Table 9 presents an analysis of the relevance of the REDD debate for the emergence of Hutan Desa agreements, based on discussions with various stakeholders at the national, provincial, regency and local levels. Stakeholders' approval of such stewardship agreements was synthesised by a simple score of positive, neutral or negative impacts of their group multiplied by a 5-point ranking of the power to facilitate or delay the approval. Given the multilayer type of approval process and scarcity of opportunities to trade off across different issues between governance layers (as opposed to within each layer), it may be reasonable to expect that the net outcome has to be at least neutral at each layer of governance before agreement can be achieved. In the table, the situation with and without REDD expectations was reconstructed. Without (or before) REDD expectations, the national and provincial discussions may have tended towards blocking the proposal, as the influence groups that expect these proposals to hinder the allocation of forests to the forest industry had more influence than the social forestry group. The REDD debate may have tipped the balance at both central and provincial level as expectations of benefit flows were voiced. Interestingly, in this analysis the major interest groups opposed could not openly express opposition because it involves watershed protection forest that is out of reach of the forest industry (even though *de facto* use has been possible). Similarly, at village and *kabupaten* levels the groups currently benefitting from illegal logging could not openly express their position.