Table 2. Emission reduction scenarios and implementation plans, Merangin district

Zone	Emissions reduction scenario	Cumulative reduction (tonne carbon dioxide equivalent per hectare per year)	Contribution to reducing emissions (%)	Activity
National park	Maintain primary forest	3.23	8.16	Control and protect forest inside the national park
	Maintain primary forest	6.79	17.13	Control and protect forest inside the national park
	Maintain primary and secondary forest. Conduct reforestation activities on grassland, bush fallow and abandoned areas to convert into secondary forest with low-density trees	6.88	17.36	Reforestation and rehabilitation of forest areas in the park. No further settlement development within the park. Compose regional development plan to support forest protection in the park. Strengthen law enforcement and institutions. Execute development activities that are based on land-use planning and that focus on strengthening the livelihoods of communities around the forest. Increase communities' capacity to prevent forest fire in the park
Village forests	Maintain primary forests, preventing conversion to other land uses and enforcing implementation of selective logging	2.99	7.55	Evaluate and improve village forest work plans proposed by village institutions and approved by the head of the district. Improve communities' capacity to manage village forests. Improve the capacity of communities to protect and control village forests by providing better working facilities. Increase communities' capacity to prevent and control forest fires

Policy implications and future activities

The target of reducing emissions in Merangin district can be achieved if the development strategy focuses on activities to reduce forest degradation. The main emitters are the national park, large private plantations, smallholders' plantations and village forests. The park contributed the most to regional emissions owing to large conversion of forests to coffee systems. Control of the park's boundary urgently needs to be strengthened, including enforcement of the law for those conducting illegal activities in the area (that is, providing permits to open land inside the national park).Reforestation of open land in the park could help increase carbon sequestration. Large private plantations should only be allowed in non-forested areas. However, in reality, this regulation may be difficult to implement as non-forested land is mostly owned by other stakeholders (that is, local communities).

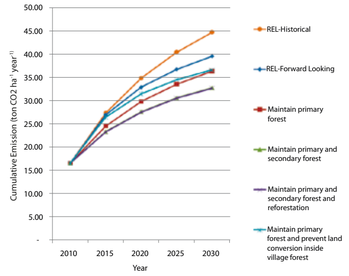

Figure 4. Reference Emission Level and estimated emission for each development scenarios

Another useful activity would be to increase the capacity of local communities in managing village forests. Local communities are allowed to harvest timber in these forests. It is important that they do so sustainably.

Finally, activities to reduce emissions require integrated coordination between local and central governments and, in particular, the Ministry of Forestry in issuing forest-related permits and managing forest land. For example, forest encroachment by migrants should be addressed by the local government and the Ministry of Forestry because it relates to different perceptions of forest boundaries.

A special working group with various local government agencies as members should be formed to coordinate and plan emissions reduction activities. The working group should also be responsible for evaluating if these activities have met the low-emissions development goals at regional and national levels.

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World Agroforestry Centre
TRANSFORMING LIVES AND LANDSCAPES

Planning for low-emissions development in Merangin district, Jambi province, Indonesia

Photo by Asep Ayat

Merangin district covers 7.679 km^2 or around 15% of Jambi province[1]. The level of emissions of carbon dioxide equivalent in Merangin has been high compared to other districts in the region, largely due to changes in land uses. During 2005–2010, the average annual emissions from Merangin was 16.62 tonne of carbon dioxide equivalent per hectare. The main source of emissions was forest degradation, owing to the conversion of primary forests to secondary forests and from high-density secondary forest to lower-density secondary forest and mixed rubber systems.

Merangin district is home to a large conservation area protected as Kerinci Seblat National Park. Thus, any land-use planning in the district needs to include the park. A land-use plan and associated management that optimally considers the function of the national park can be an opportunity for the district to balance

Main issues

- Mitigation of climate change through changes to agriculture, forestry and other land uses requires thorough consideration of the balance between economic and social benefits that can be gained from development and the environmental risks that arise with different types of land management.
- The Presidential Regulation no. 61 Year 2011 (National Action Plan to Reduce Greenhouse Gas Emissions), known as RAN-GRK, provides the detail of Indonesia's commitment to reduce emissions.
- Implementation of the plan at sub-national level needs practical and comprehensive tools to plan activities that will reduce emissions.
- Emissions reduction requires integrated cooperation, not only between local government agencies but also with all ministries responsible for forests and other land uses.
- Emissions are caused by different actors and factors. Discussions between all stakeholders are crucial.

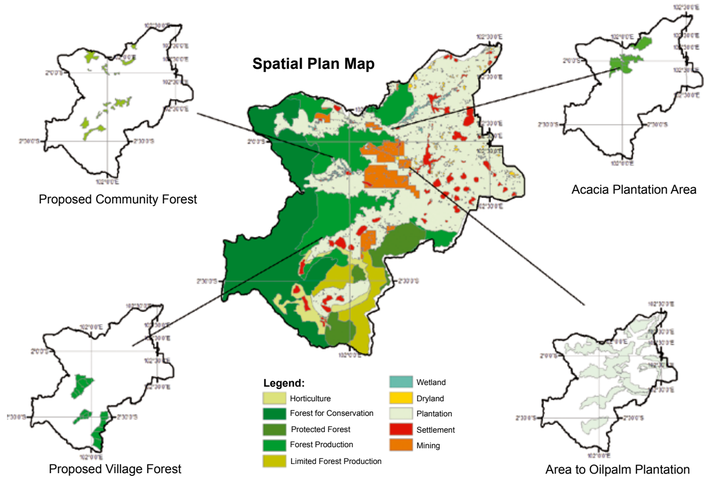

Figure 1. An integrated map of Land Use Allocation Plan and Regency Spatial Land Use Planning

the need for development and the need to maintain environmental functions that help mitigate climate change.

During 1990–2000, the main land conversions were from secondary forests to mixed rubber systems and from monoculture rubber plantations to mixed rubber systems and oil palm plantations. During 2000–2005, secondary forests were still being converted to mixed rubber systems, while the existing mixed rubber systems were converted to the more intensive systems of monoculture rubber and oil palm plantations. These data are a result of a spatial analysis conducted for the purpose of understanding historical land-use changes, with the objective of informing development pathways that could reduce future emissions. This project was a collaboration between Merangin district Regional Planning and Development Agency (Badan Perencanaan Pembangunan Daerah/Bappeda) and the World Agroforestry Centre to develop a low-emissions development strategy, a research method known as Land-Use Planning for Low-Emissions Development Strategy (LUWES).

Integrating the development plan with the regional land-use plan

We were able to estimate the future greenhouse gas emissions for the district by analysing the regional planning documents that represent future development pathways. The main documents required were the regional development plan and regional land-use maps, with various supporting documents.

In Merangin district, the documents related to the regional development plan were the Long-term Development Plan (Rencana Pembangunan Jangka Panjang/RPJP), Mid-term District Development Plan (Rencana Pembangunan Jangka Menengah Daerah/RPJMD), District Government Work Plan (Rencana Kerja Pemerintah Daerah/RKPD) and various working and location permits issued by the local government (for example, for forest and mining concessions and plantation estates). The Regional Land-use Plan (Rencana Tata Ruang Wilayah/RTRW) map provided the region's spatial plan. The result of integrating these documents was the identification of all interventions and activities planned for the region.

Table 1. Land-use allocations with associated development plans, Merangin district

No.	Allocation	Area (hectare)	Percentage	Development plan
1	Horticulture	9509	2.7	Highland vegetable farming. Coffee, rubber and oil palm systems restricted. Existing cinnamon systems will be converted to horticultural systems
2	Industrial Forest Plantations (HTI)	37 196	5.1	Harvesting is the main activity in HTI zone. Planting has not started yet but is planned
3	People's Forest Plantation (HTR)	26 030	3.6	Encourage communities to establish rubber systems in up to 80% of total area by 2030
4	Village forest (Hutan Desa)	45 769	6.3	Encourage communities to establish and manage non-timber forest products (for example, rattan, *jernang*, honey, candlenut). Timber harvesting permitted in village forests located within Production Forest following standard rules of use
5	Protected area	37 141	5.1	Maintain the size of the forest area by prohibiting conversion to other uses
6	Production forest	30 645	4.2	Moratorium on new HTI and HPH (Hak Pengelolaan Hutan/Forest Concession) permits and maintain existing areas with trees
7	Limited production forest	10 492	1.4	Maintain existing forest areas
8	Oil Palm Plantation (HGU)	151 303	20.7	Establish oil palm systems
9	Wetland/irrigated land	11 173	1.5	Rice production
10	Dryland Agriculture	4169	0.6	Convert abandoned land, grassland and bush fallow into dry land agricultural systems and/or pasture
11	Smallholder plantation	138 666	19	Establish and develop tree-based systems (for example, rubber, oil palm, coffee) while maintaining existing paddy systems area
12	Settlement	27 958	3.8	Settlement expansion is only permitted outside the forest zone. Existing settlements in the forest zone are prohibited to expand
13	Mining Concession	2951	4.5	Mining to be established in the area during the next 30 years and will adhere to land restoration policy
14	National park	157 479	21.6	Prohibit any form of development in the area, including expansion of existing settlements. Existing settlements to be categorised as 'enclaves'

Fourteen (14) allocation zones were identified in Merangin district (Table 1). The largest zones were Kerinci Seblat National Park, private plantations and smallholders' plantations, comprising 21.6%, 20.7% and 19%, respectively.

Classifying allocation zones is a way of identifying planned development activities, which enables a comprehensive analysis to estimate future land-use changes that might occur, including the associated emissions.

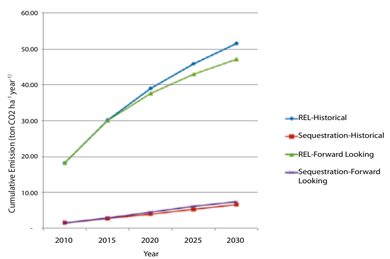

Figure 3. Reference Emission Level of Merangin Regency

Estimating future greenhouse gas emissions

We used the land-use allocation map, discussions with government agencies, land-cover maps and time-averaged carbon stocks for each land-cover type (based on surveys and measurements in the field) to estimate the future emissions from the district. We used a computer program called REDD Abacus SP that was specifically developed to estimate emissions from land-use changes, including their associated opportunity costs (economic gain or loss from the change). Figure 2 shows the projected emissions until the year 2030. Based on the current development plan, the projected cumulative emissions will be 47.22 tonne per hectare per year. This is lower than the projected cumulative emissions based on historical land-use changes, which was 51.62 tonne per hectare per year.

The estimated contribution of each land-use zone to the overall emissions level differed between the reference level based on historical land-use changes and the reference level based on the development plan. Based on historical land uses, the main contributors of emissions are the national park (17.14 tonne per hectare per year), large private plantations (6.55 tonne per hectare per year), smallholders' plantations (4.60 tonne per hectare per year) and village forests (3.32 tonne per hectare per year).

The estimated emissions based on the development plan for each zone were similar except for the national park and smallholders' plantations zones, which would have lower contributions, while large private plantations and HTI zones would have higher. The changes in emission patterns shows that development pathways are very influential in determining the level of emissions and can be used as a way to manage future emissions from the district.

Figure 3 presents the high contributions of the national park to Merangin's emissions. The park is an area with primary forests and high density of trees. Any activities that disturb or degrade this condition will produce high emissions. Therefore, sound management of the park is strategically important for a low-emissions development strategy in Merangin

Developing scenarios to reduce emissions

Developing various scenarios is important for determining development activities that can reduce emissions. When developing such scenarios, we

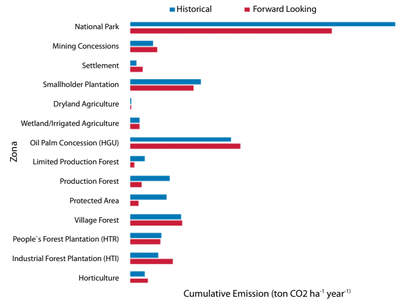

Figure 3. Cumulative emission level, estimated for each land use category in Merangin Regency

should pay careful attention to regional characteristics and conditions, in particular, economic factors.

Based on multi-stakeholder discussions and problem analyses, scenarios focussed on zones that significantly contributed to emissions, such as the national park. A step-by-step scenario was developed for the park, with activities ranging from prohibiting land conversion from primary forest and secondary forest through to reforestation activities on grassland, bush fallow and abandoned land.

Another scenario that was considered plausible was better management of village forests by maintaining existing forested areas and preventing forest conversion. For other land-use categories, their function could be adjusted to local needs. The scenarios chosen by the stakeholders in Merangin revealed their priority was to optimise the national park and village forests as areas for carbon storage, while other land-use categories were allocated to regional economic development.

The scenarios for the national park (Table 2) could potentially reduce emissions up to 17.36%, while the scenarios for the village forests could achieve a reduction up to 7.55%. Figure 5 depicts emissions at historical and development plan reference levels as well as the four emissions reduction scenarios. These data could help to identify the best scenarios to implement in Merangin district that take into account local biophysical, social and economic conditions and meet the reduction target.