Enabling strategy, legal and policy environments for low-carbon emission development pathways and the promotion of profitable, diverse agroforestry and sustainable livelihoods

This project focused on two districts in Jambi province, Sumatra, exploring an integrated methodology that can be more widely applied in other parts of Indonesia.

Project Report

World Agroforestry Centre

Enabling strategy, legal and policy environments for low-carbon emission development pathways and the promotion of profitable, diverse agroforestry and sustainable livelihoods

Report for
Climate and Land-Use Alliance (CLUA)

WORLD AGROFORESTRY CENTRE (ICRAF)

Correct citation

Galudra G, Agung P, Suyanto, van Noordwijk M, Pradhan U. 2011. *Enabling strategy, legal and policy environments for low-carbon emission development pathways and the promotion of profitable, diverse agroforestry and sustainable livelihoods.* Climate and Land-Use Alliance (CLUA) Final Report. Bogor, Indonesia: World Agroforestry Centre (ICRAF) Southeast Asia Regional Program.

2011

World Agroforestry Centre (ICRAF)
Southeast Asia Regional Program
Jl. CIFOR, Situ Gede, Sindang Barang, Bogor 16115
[PO BOX 161, Bogor 16001]
Indonesia
Tel: +62 251 8625415; Fax: +62 251 8625416
Email: icraf-indonesia@cgiar.org
Website: www.worldagroforestry.org/sea

Cover photos: Putra Agung

FINAL REPORT

Enabling strategy, legal and policy environments for low-carbon emission development pathways and the promotion of profitable, diverse agroforestry and sustainable livelihoods

Gamma Galudra, Putra Agung, Suyanto, Meine van Noordwijk and Ujjwal Pradhan

Acknowledgements

This document has been developed from the execution of activities, data analyses, discussions and papers prepared for the CLUA project , 'Enabling strategy, legal and policy environments for low-carbon emission development pathways and the promotion of profitable, diverse agroforestry and sustainable livelihoods', with contributions from the following people and organizations.

World Agroforestry Centre
Andree Ekadinata, Atiek Widayati, Arif Rahmanulloh, Asep Ayat, Elok Mulyoutami, Feri Johana, Harti Ningsih, Janudianto, Jasnari, Muhammad Sofiyuddin, Muhammad Thoha Zulkarnain, Ni'matul Khasanah, Noviana Khususiyah, Rachmat Mulia, Ratna Akiefnawati, Subekti Rahayu, Sonya Dewi, Suyitno, Tonni Asmawan and Yana Buana

Partners
Dadang Suhendar and staff of Dinas Kehutanan Tanjung Jabung Barat, Fajarman and staff of Badan Perencanaan dan Pembangunan Daerah Merangin, Ahmad Palloge and staff of Badan Perencanaan dan Pembangunan Daerah Tanjung Jabung Barat, Asep Yunan Firdaus and Andiko of Perkumpulan untuk Pembaharuan Hukum Berbasis Masyarakat dan Ekologis (HuMA) and Bambang, Fajriyaz and Idris Sardi of the University of Jambi

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1. Project overview

Opportunities for reducing greenhouse gas emissions from Indonesia exist across all sectors of the economy and across a wide geographic arena, but emissions from forest and peat land conversion dominate the numbers as well as the public debate. With the advent of 'reducing emissions from deforestation and degradation plus conservation' (REDD+) and the potential for increased financial flows into carbon-rich landscapes, the question of how to relate national commitments to local contexts and implementation is more important than ever. Rather than focusing on short-term emissions reduction strategies, the debate has shifted to a new form of 'clean development' strategies that focus on the combination of maintaining high carbon stocks and low carbon flows and yet achieving development goals. Planning for such a development pathway requires combinations between evolving REDD+ institutions, implementation of a broader set of nationally appropriate mitigation actions (NAMAs), aspects of climate-change adaptation, and mainstream development planning of transport infrastructure, human migration flows, investments in processing capacity for primary industries and their downstream associates and research and investment in renewable energy. Such planning has to be multi-scale and interact with many stakeholders. At provincial level, important progress has been made, for example, with the *Creating low-carbon prosperity in Jambi* report of the Indonesian National Climate Change Board. At the district level, however, further analysis of options and consequences is needed, with a more detailed analysis of the land-use patterns in and around forest margins. The 'Enabling strategy, legal and policy environments for low-carbon emission development pathways and the promotion of profitable, diverse agroforestry and sustainable livelihoods' project focused on two districts in Jambi province, Sumatra, exploring an integrated methodology that can be more widely applied in other parts of Indonesia.

The World Agroforestry Centre continues to conduct research into, and promotes, reducing emissions from all land uses (REALU)**,** rather than REDD+, to support NAMAs. In this project, we carried out research and negotiation, focusing on both the development of low-carbon emissions pathways and para-legal support to define and implement rights as included in district spatial planning. The Rapid Tenure Assessment method (RaTA) developed by the Centre, that has already been used in many of the REDD pilot areas, was deployed and refined to determine proprietary rights over carbon-rich landscapes. The Rapid Carbon Stock Appraisal (RaCSA), a carbon-stock measurement method also developed by the Centre and currently used together with the Agency for Forestry Planning, Department of Forestry, measured carbon emissions and stocks for each land-use change. We also analysed tree-based land-use systems, including rubber and mixed fruit tree agroforests in Jambi, and identified new options for investment, for example, in further domestication of *jelutung* (*Dyera costulata*) in swamp forests and valuable forest commodities such as dragonblood resin from *rotan* fruits.

Rapid assessment of current local initiatives in innovative agroforestry management were complemented by opportunity cost and abatement cost analyses to assess the economic value of different land uses. For example, the profitability of multi-crop and biodiverse agroforestry systems was compared with mono-cropping of oil palm, rubber or fastwood for the pulp and paper industry. An important trend noted in Sumatra was the emergence of a smallholding oil palm production system that shares some of the environmental concerns of large-scale oil palm but differs in its social and economic aspects.

Research carried out by the Centre and partners contributed directly to improving the quality of negotiations in the multi-stakeholder settings that define these political and biophysical landscapes. The Centre and partners worked closely with the new leadership at the district governments in Jambi province that resulted from the convening of new spatial and development planning that

addresses low-carbon emission development pathways as well as determining proprietary rights over the provision of environmental services, particularly reductions of carbon emissions.

2. Objectives

The purpose of this project was to develop and establish effective low-carbon development strategy planning and mechanisms at sub-national levels to reduce land-use emissions and increase carbon stocks.

2.1 Specific objectives

1. Develop and enhance multi-stakeholder policy dialogues and networking about carbon emissions reductions through spatial planning and mid-term regional development planning.
2. Legal and paralegal support for securing the rights of local communities, especially for carbon rights.
3. Develop new tools and enhance existing tools that explore land-use options to achieve high carbon stock (and low carbon flux) development. These tools help to refine and develop better multi-stakeholder policy dialogues at sub-national levels through realistic assessments of forest, agroforestry and agricultural options from economic, environmental and rights perspectives.
4. Assess the benefits and costs of REDD+ for livelihoods from local to provincial levels (REDD+ rent versus opportunity and transaction costs).
5. Develop a socio-economic baseline at community level. This baseline was to be used for impact assessment of REDD+.

3. Develop tools to be shared and used for capacity building at sub-national and national levels

3.1 Land-Use Planning for Low Emission Development Strategy tool

For climate-change mitigation through agriculture, forestry and other land uses at local levels, analyses are imperative, for both land managers and wider society, of the trade-offs and policy and development scenarios that take into account potential emissions levels and the financial and economic benefits or losses.

The Government of Indonesia has begun to establish a NAMA through its Rencana Aksi Nasional Penurunan Emisi Gas Rumah Kaca (National Action Plan to Reduce Greenhouse Gas Emissions/RAN-GRK) (Presiden Republik Indonesia 2011), which requires all local governments to come up with their 'nested baseline' and a plan for reducing emissions (Rencana Aksi Daerah Penurunan Emisi Gas Rumah Kaca/RAD-GRK).

As part of our technical support to the Government of Indonesia's effort to meet the ambitious targets set under recent bilateral agreements with the Government of Norway, we developed a new tool (or methodology) called Land-Use Planning for Low Emissions Development Strategy (LUWES). The LUWES method supports multiple stakeholder decision-making and land-use planning for sustainable development that can reduce greenhouse gas emissions from land-based activity while simultaneously maintaining economic growth. It also takes into account the impact on tenure and livelihoods of land-use allocation policies.

LUWES is a set of principles, steps and tools (including Java-based software called Abacus SP) that helps multiple stakeholders negotiate the development of land-use plans. Scenarios devised through LUWES can take the form of land-use restrictions, plantation development targets, land swaps, improved forest management, or any other type of land-use policy and strategy, either within a particular zone or the entire landscape at a particular period of time in the future. 'Business as usual' scenarios and projected emissions, such as the reference emissions level, can also be simulated to compare their likely performance.

LUWES is implemented through six main steps.

1. Compilation of existing land-based development and spatial plans into a single plan; identification of zones relevant to the strategies and policies of the plan; and intervention with regard to land-use changes, economic gains, carbon stocks and potential emissions.
2. Development of baseline scenarios and estimation of projected reference emissions levels (REL) and reference levels (RL)[1]. Baseline scenarios can be based on a linear projection of historical land-use changes, the modelling of drivers of land-use changes, forward plans through the adoption of an existing plan, and the projection of emissions from the baseline scenarios as the basis of setting the REL/RL. However, REL/RL will eventually have to be negotiated at higher levels such as nationally.
3. Calculation of opportunity costs as the trade-off of financial gains and emissions from land-use changes based on the baseline scenarios. The trade-off analysis should ideally include employment and economic gains.

[1] The reference emissions level (REL) is the amount of gross emissions from a geographical area estimated within a reference time period. The reference level (RL) is the amount of net emissions (gross emissions minus removals or carbon storage) from a geographical area estimated within a reference time period.

4. Development of scenarios to reduce emissions, simulation of these scenarios to estimate the actual reduction of emissions, estimation of the opportunity costs of the reductions, and selection of the most efficient scenarios.
5. Identification of who bears the costs in the selected reduction scenario and analysis of the relationship between the cost bearers and the subsector; and prioritization of development across the landscape at the smallest administrative level based on gaps and inequality. This involves direct stakeholder negotiations and results in revised scenarios. Most of step 4 usually then needs to be repeated.
6. Implementation of the agreed scenario starting with identification of policy interventions to support local action plans for reductions.

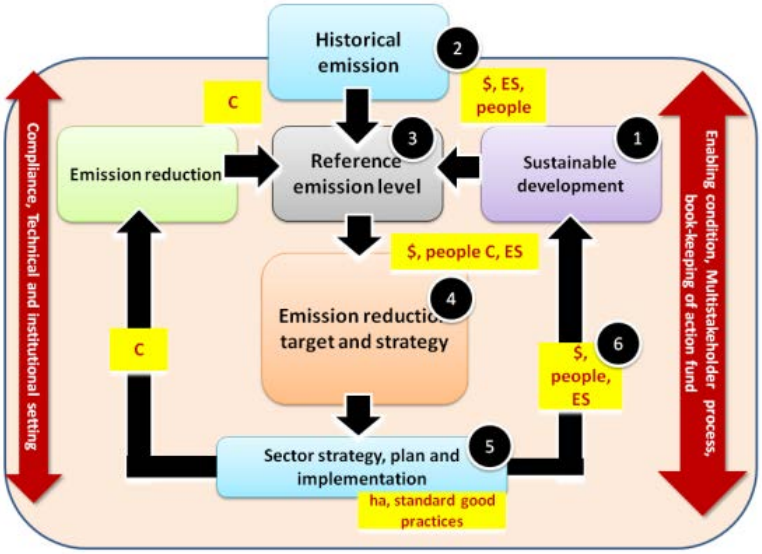

Figure 1. Steps in implementing 'Land-use planning for low-emissions development strategy' (LUWES)

The booklet of LUWES tools has been published (Dewi et al. 2011) and was launched at a national workshop held at the Manggala Wanabakti complex of the Ministry of Forestry in Jakarta on 24 November 2011.

Figure 2. National workshop on LUWES and the lessons learned from its development in Indonesia

Badan Perencanaan dan Pembangunan Nasional (National Planning and Development Agency/Bappenas) is considering using LUWES for RAD-GRKs. We have been invited to demonstrate the tool to Bappenas in March 2012 and we expect LUWES will be used in several districts and provinces this year.

4. Empowering local stakeholders to establish a land-use plan for a low emissions development strategy

The Government of Indonesia's ambitious commitment to reduce carbon emissions by 26% below the 2020 'business as usual' scenario and by another 15% with international assistance has raised the question how this will not hamper economic growth, which is targeted to be 7% per year.

The answer to this question is likely to be found at the level of local planning (locally appropriate adaptation and mitigation actions/LAAMA). As part of our technical assistance to the Government, we have identified several problems related to land-use planning: 1) lack of integration of mid- and long-term development plans (Rencana Pembangunan Jangka Menengah/Panjang/RPJM, RPJP) with land-use plans (Rencana Tata Ruang Wilayah/RTRW); 2) issues with the political economy of forest governance and land-use planning; and 3) trade-offs between mitigating climate change from agriculture, forestry and other land uses and economic gain.

With support from CLUA, we collaborated with Badan Perencanaan dan Pembangunan Daerah (Provincial Planning and Development Agency/Bappeda) in Tanjung Jabung Barat and Merangin districts. We reviewed and redesigned local RTRW and RPJM based on low emissions development principles. This work supported the local RAN-GRK and provided an umbrella for the interaction of REDD+ and voluntary carbon market activities.

To address the issues mentioned above, we conducted three series of workshops that aimed to empower local stakeholders not only technically but also in the negotiation process for developing land-use plans for low emissions development. Below, we detail the process in two districts, Merangin and Tanjung Jabung Barat, in Jambi province.

4.1 Training workshop in developing a land-use plan for low emissions development

This workshop mainly focused on technical aspects that were related to low carbon development planning, such as 1) historical quantification technique; 2) method and techniques to determine reference emissions level; 3) method and techniques for low emissions development planning; and 4) technical discussions about emissions reduction strategies in various development sectors. Through this training workshop, we contributed to the development of spatial planning policy in Tanjung Jabung Barat and Merangin that was then underway. Specifically, we provided advice related to the RTRW and RPJM for 2011–2015 in both districts. The training was conducted 26–30 June 2011 at the Golden Harvest Hotel, Jambi.

4.1.2 Objectives of the workshop

1. To build a better understanding of the methods, data and technical estimations of emissions by using spatial and biophysical data.
2. To develop technical skills for using emissions data to determine reference emissions levels in Tanjung Jabung Barat and Merangin districts.
3. To develop basic skills in planning for reducing emissions and estimating the consequences of this on development.

Twenty-six people attended the workshop, with most coming from local government agencies involved in district spatial and development planning, such as Bappeda and the forestry, estate crop, agriculture, mining and district land agencies.

4.2 Policy dialogue 1: compilation of existing development and spatial plans and identification of zones

Following on from the technical workshop, we conducted the first policy dialogue during 5–15 September with several local government agencies which had an interest in land in the two districts. The dialogues were conducted in Kuala Tungkal, Tanjung Jabung Barat, 5–7 September, and in Merangin town, Merangin district, 13–15 September 2011. Both dialogues involved local government agencies that were also included in the workshops: Bappeda and the forestry, estate crop, agriculture, mining and district land agencies.

The dialogues aimed to understand the existing spatial plan and local development strategy, focusing on land, in particular, and natural resources, in general. This step used inventories and compilations of land-based development and spatial plans from the various government agencies at local and national levels. Group discussions were conducted, through which it was revealed that many permits issued by the local agencies overlapped and caused a conflict of authority and confusion over land permit allocations. Together with Bappeda we tried to solve the problems during the discussions.

4.3 Policy dialogue 2: selecting the reference emissions level and analysing scenarios to reduce emissions in the two districts

We conducted the second policy dialogue during 17–21 October 2011. We invited staff of Bappeda in Merangin and Tanjung Jabung Barat to our office in Bogor. Those selected understood the district's policies and development strategies because the purpose of the dialogue was to review and redesign the RTRW and RPJM. Before the dialogue, Bappeda staff in both districts selected the reference emissions level and analyzed the possible scenarios that could contribute to reductions. In the policy dialogue we also discussed how the governments would implement the selected strategy.

4.4 Stakeholders' meetings: negotiations for selecting optimum low emissions development and local action plans

The stakeholders' meetings were intended as a step toward a consensus on low emissions development pathways that could be established through spatial and mid-term development planning. A list of zone-specific scenarios to reduce emissions were presented for which participants chose the best policies and local action plans.

In Merangin, we conducted the meeting on 27 December 2011. The local Bappeda office acted as the host and the meeting was opened by the district head (bupati). Participants were not only from local government agencies but also from the private sector, such as oil palm and mining companies, local NGOs and research and education institutions.

The meeting agreed that there were three local action plans that should be established as part of low carbon development: 1) protecting the remaining forest in the national park from encroachment and rehabilitating degraded areas; 2) promoting 'village forest' agreements to establish sustainable

livelihoods and enhance biodiversity; and 3) promoting community-based forest management (CBFM) in production forests to deal with migrants' encroachment and deforestation.

Figure 3. Stakeholders' meeting in Merangin, hosted by Bappeda and opened by the bupati

We also conducted a similar stakeholders' meeting with the same purpose in Tanjung Jabung Barat on 6 February 2012. The meeting was also opened by the local bupati and attended by the deputy bupati, district secretary (Secretariat Daerah/Sekda), two district assistants for environmental and legal issues (ASDA 1 and 2), the heads of sub-districts (camat), representatives of local government agencies and staff from private companies, especially the pulp and paper plantation company PT Wira Karya Sakti. Because much of the emissions from the 1990s through to 2010 came from such companies' operations, the main focus during the discussion was how to reduce emissions from this operational area. The meeting agreed that there were three activities that could be undertaken: 1) stop conversion of primary forests to acacia plantations; 2) maintain existing smallholders' tree-based systems; and 3) expedite planting acacia in bush fallow and grassland areas within the concession zone (± 21 000 ha). All of these activities will be included in the plantation company's land-use plan (Tata Ruang Hutan Taman Industri/TRHTI), which is endorsed and controlled under the Ministry of Forestry regulation no. 70/1995.

Figure 4. Stakeholders' meeting in Tanjung Jabung Barat, hosted by Bappeda and opened by the bupati

5. Impacts and pathways to local and national action plans under REDD+, RAD-GRK and RAN-GRK

We disseminated the results from LUWES and another tool that we had developed earlier (REDD/REALU Site-level Feasibility Appraisal/RESFA) to local governments to have an impact on national and local policy discourse and development.

Nationally, we have been actively involved in providing advice on policy related to tenure and establishing NAMAs (specifically, the RAN-GRKs), mainly through the Unit Kerja Presiden Bidang Pengawasan dan Pengendalian (Presidential Working Unit for Supervision and Management of Development/UKP4), and by providing technical advice to civil society organizations encouraging land-use policy changes through the Ministry of Forestry, National Land Agency and the Human Rights Commission.

At the district level, together with Bappeda in Merangin and Tanjung Jabung Barat, we used LUWES as the interface to integrate our research results into the development of the new RTRW and RPJM. We also helped improve the management of Kesatuan Pengelolaan Hutan XVI (Forest Management Unit 16) in Tanjung Jabung Barat by providing advice regarding the Unit's work plan, human resources and organizational structure.

Below, we set out the results of the work undertaken together with our partners to make an impact on forestry policy.

5.1 District action plans

5.1.2 Integration of LUWES and other research results into district spatial, mid-term development and low emissions development plans

Through our newly developed LUWES methodology, we were able to work together with Bappeda in Tanjung Jabung Barat and Merangin districts to design scenarios and strategies to reduce emissions from land-use changes and also establish the RL of both districts. The tool guided the two district governments in developing low emissions development strategies by taking into consideration improving local community livelihoods and protecting customary rights over land and trees (and carbon).

As described above, LUWES had been carried out through workshops, training, capacity building, multi-stakeholder policy dialogues and conflict resolution. The workshops were attended by key government officials, private sector representatives, NGO staff and academics from the two districts. At the time of writing, the process has been completed in both Tanjung Jabung Barat and Merangin.

The results, detailed below, were not only integrated into the RTRW and RPJM in both districts, but also formed the first step for developing RAD-GRKs.

Merangin district

Merangin district covers 7679 km^2, which is approximately 15% of the area of Jambi province (BPS Merangin 2009).

During 2005–2010, the average annual emissions per hectare from Merangin was 16.62 Ton (or Megagram) of carbon dioxide equivalent (Mg CO_2eq). The main source of emissions was forest

degradation, that is, conversion from primary forest to secondary forest and from high density secondary forest to lower density secondary forest and mixed-rubber systems.

During 1990–2000, the main land conversions were from secondary forest to mixed-rubber systems and from monoculture rubber 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 more intensified systems of monoculture rubber and oil palm.

At the district level, we estimated the future greenhouse gas emissions by evaluating the regional planning documents that represented development pathways. The result of integrating these documents was that we were able to assess the impact of the various pathways on land uses, predict emissions and identify specific interventions and activities planned for the region.

We classified land-use allocation zones to identify specific development activities planned for each zone, which enabled a comprehensive synthesis and analysis for estimating future land-use changes and their associated emissions.

Fourteen allocation zones were identified in Merangin district. The largest zones were Kerinci Seblat National Park, companies' plantations and smallholders' plantations, comprising 21.6%, 20.7% and 19%, respectively.

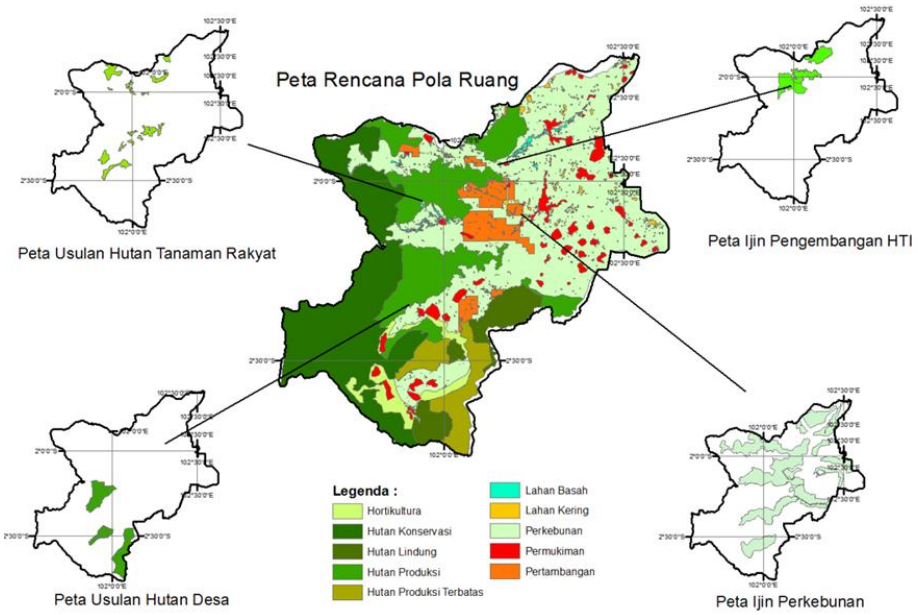

Figure 5. Integration of land allocation with Merangin district spatial planning

Based on the spatial allocation map and the results of the multi-stakeholder meetings, we estimated the future emissions of Merangin district. Additional information we needed were land-cover maps and time-averaged carbon stocks for each land-cover type present in the district (based on surveys and measurements in the field). To calculate future emissions, we used software called REDD Abacus SP that was specifically developed to estimate carbon dioxide emissions from land-use changes, including their associated opportunity costs (economic gain or loss), and projected emissions. The projected cumulative carbon dioxide emissions per hectare per year from Merangin (until 2030), based on the current development plan, was 47.22 Mg CO_2eq, which is lower than the estimated past emissions of 51.62 Mg CO_2eq.

The estimated contribution of each allocation zone to the overall emissions level differed between reference emissions based on historical land-use changes and reference emissions based on the development plan. Based on historical land uses, the main contributors of carbon dioxide were the national park (17.14 Mg CO_2eq per hectare per year), companies' plantations (6.55 Mg CO_2eq/ha/yr), smallholders' plantations (4.60 Mg CO_2eq/ha/yr) and village forests (3.32 Mg CO_2eq/ha/yr).

The national park has high density primary forest. Any activities that disturb and degrade this condition will produce high carbon dioxide emissions. Therefore, sound management of the park is critical to achieve low emissions development.

Developing reduction scenarios was important for determining plausible activities that could reduce regional greenhouse gas emissions. These scenarios should pay careful attention to regional conditions, in particular, economic factors.

Based on the multi-stakeholder discussions, reduction scenarios should focus on zones that significantly contribute to the district's emissions. A step-by-step scenario was developed for the national park zone with activities ranging from prohibiting conversion from primary and secondary forests through to reforestation activities on grassland, bush-fallow and abandoned land. Another scenario that was considered plausible to implement was better control and management of village forests by maintaining existing forested areas and preventing conversion, while for other land-use categories their function could be adjusted to local needs.

The emission reduction scenarios in the national park could potentially reduce emissions by up to 17.36% , while the village forests scenario could potentially reduce them by up to 7.55%. The figure below depicts emissions at historical and development plan (forward-looking) RLs as well as the four reduction scenarios. This can help to identify the best scenarios to implement in the district that take into account local biophysical, social and economic conditions and meet the reduction target.

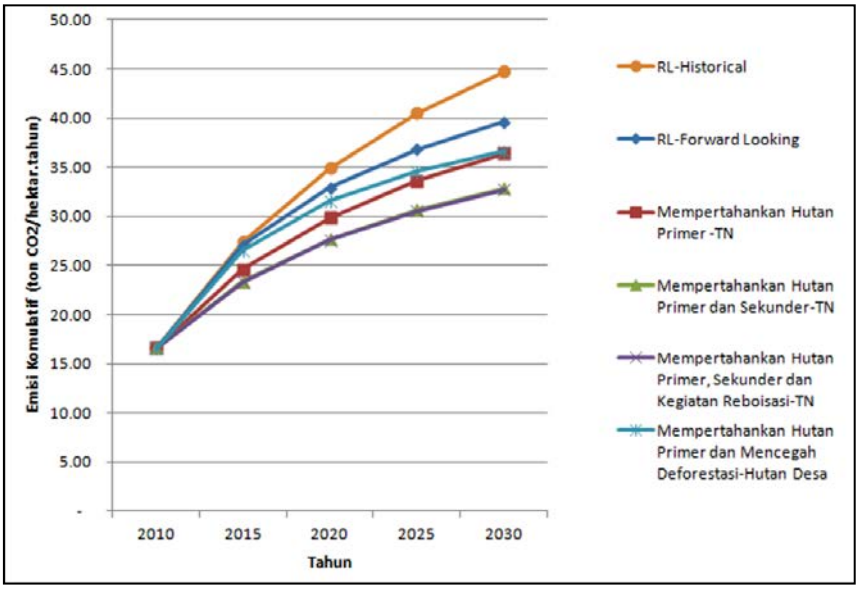

Figure 6. Reference levels (RL) and emission reduction scenarios in Merangin district

The target of reducing emissions in Merangin district can be achieved if the development strategy focuses on activities to mitigate forest degradation. The main zones of greenhouse gas emitters are the national park, companies' and smallholders' plantations and village forests. Protection of the national park boundary is urgently needed to be strengthened, including enforcement of the law for

those conducting illegal activities in the area (that is, providing permits to clear forests inside the national park). Reforestation of open land in the park could help to increase carbon sequestration. Company plantations should only be allowed in non-forested areas. However, this regulation may be difficult to implement as non-forested land is mostly owned by others (for example, local communities).

Another useful activity is to increase the capacity of local communities to manage village forests. Local communities are allowed to harvest timber from village forests, so it is important for community members to carry out sustainable harvesting and forest management.

Finally, activities to mitigate emissions require coordination between local and central governments and, in particular, the Ministry of Forestry when issuing forest-related permits and managing the forest land. For example, issues related to forest encroachment by migrants should be addressed together with local government and the Ministry because they relate to different perceptions of the forests' boundaries.

A special working group with various local government agencies as members should be formed to coordinate and plan reduction activities. The working group should also be responsible for evaluating if these activities have met the low emissions development goal regionally and nationally.

Tanjung Jabung Barat district

In Jambi province, Tanjung Jabung Barat district has one of the highest rates of carbon emissions associated with land-use changes.

During 2005–2009, the average emission of carbon dioxide in the district reached 9.66 Mg CO_2eq/ha/yr. The main source of emissions was conversion of logged-over forests to rubber and oil palm plantations. National development policy to establish industrial tree plantations (Hutan Tanaman Industri/HTI) greatly influenced carbon emissions in the district. Currently, HTI is the dominant land-use system in Tanjung Jabung Barat.

The size of the forested area is 240 090.55 ha or 48% of the district's total area. Approximately 71% of the forested area is categorized as production forest. The results of a spatial analysis we conducted show that most of the production forest area is allocated for HTI (156 306 ha) and oil palm plantations (90 655 ha).

From discussion with local government agencies in the district we were able to obtain land-related development documents, such as maps of mining, oil palm and HTI concessions and maps of agricultural commodity zones. These maps were then combined with the RTRW to derive a map of land-use allocation zones that was integrated with the development plan.

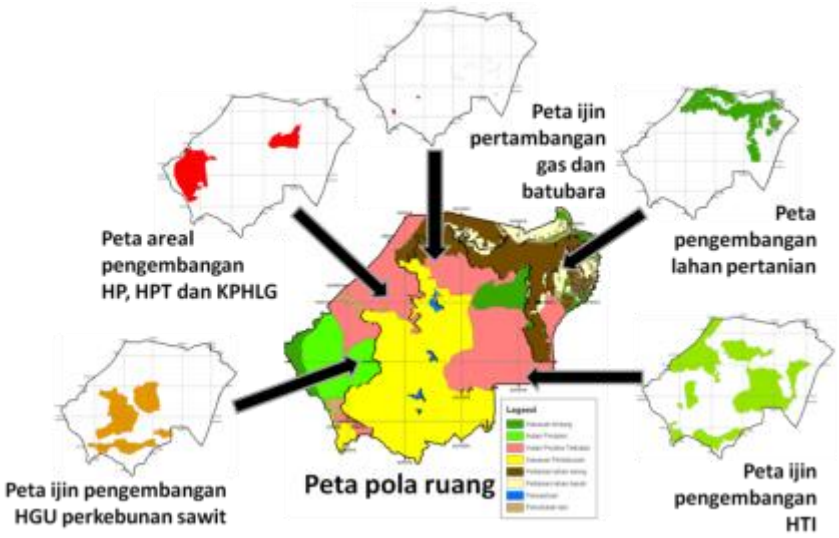

Figure 7. Integration of land allocations and Tanjung Jabung Barat district spatial planning

Based on the land-use allocation map, there were 12 allocation zones, comprising mining, production forests, peatland forests (under the Kesatuan Pengelolaan Hutan Lahan Gambut/Peatland Protected Forest Management Unit/KPHLG), industrial tree plantations and oil palm plantations. A large proportion of land was allocated for industrial tree (156 306 ha) and oil palm (90 655 ha) plantations, which in total amounted to 53% of the district's area.

With more than half of the district's area allocated to large private companies, land allocation requires careful planning because of the vulnerability to conflict between communities, companies and governments. A sound RTRW plays a significant role in ensuring a fair distribution of natural resources and forest benefits. In the context of the national RAN-GRK, RTRW are important for developing local RAD-GRKs.

Based on the land-use allocation map and the results of the multi-stakeholder discussions, we calculated the future emissions from the district using the REDD Abacus SP software, which included the associated opportunity costs (economic gain or loss).

Based on the current development plan, projected cumulative emissions will be 36 Mg CO_2eq/ha/yr. This is lower than the cumulative emissions based on historical land-use changes (44 Mg CO_2eq/ha/yr). The highest emitting zones will be industrial tree plantations (10.1 Mg CO_2eq/ha/yr), oil palm plantations (2.9 Mg CO_2eq/ha/yr) and the peatland managed by the KPHLG (1.9 Mg CO_2eq/ha/yr). Overall, these zones were projected to contribute to 78% of Tanjung Jabung Barat's total emissions by 2020.

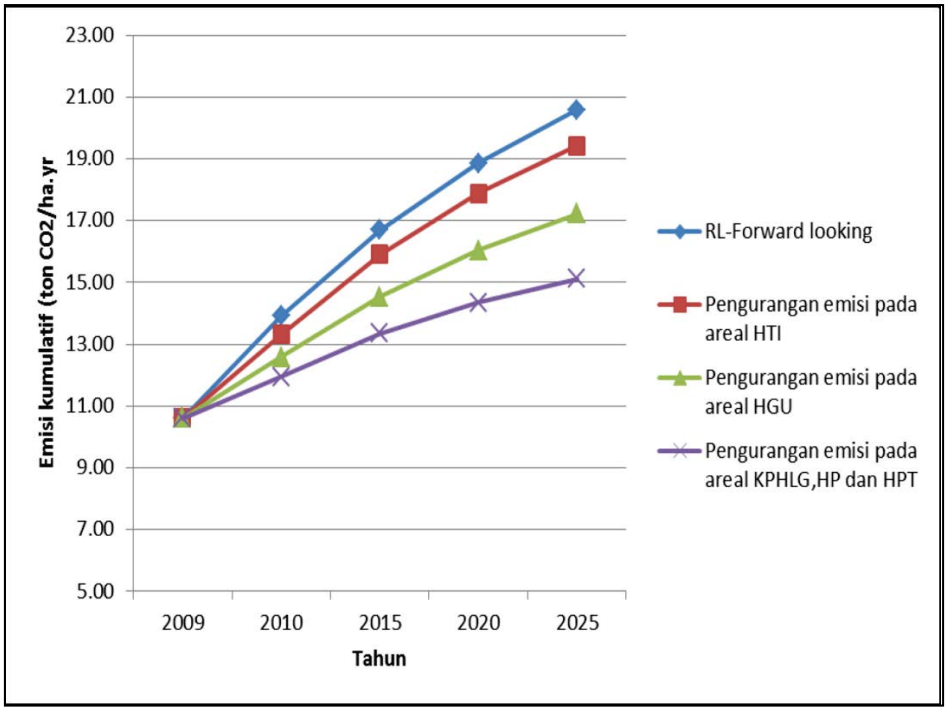

Figure 8. Reference levels (RL) and emissions reduction scenarios in Tanjung Jabung Barat district

Discussions about how to reduce emissions from industrial tree and oil palm plantations and the KPHLG area were held with the district government agencies. Various options were discussed carefully because existing activities provided a significant contribution to economic development in the district.

Implementing reduction activities in oil palm plantations (Use Right Title/Hak Guna Usaha/HGU) was projected to give the highest reductions. The activities identified in the scenarios were 1) prohibiting conversion of natural forests (with high carbon stocks) to oil palm plantations and prioritizing the establishment of oil palm on degraded or abandoned land with lower carbon stocks. In this way, carbon emissions can be minimized or even avoided and might even result in carbon sequestration. This scenario could reduce emissions by 2.2 Mg CO_2eq/ha/yr or 40% of the total possible reduction.

Another significant scenario was improving the management of the KPHLG area by planting *Dyera* sp. and enforcing the protection of peatland. This scenario could reduce emissions by 1.48 Mg CO_2eq/ha/yr, an amount equal to 27% of the total possible reduction.

Low emissions development can take place in Tanjung Jabung Barat if all stakeholders—local governments, communities and private companies—are committed to their tasks and responsibilities. For example, reducing emissions from the oil palm sector requires commitment from concession holders to optimize the use of abandoned and degraded land rather than opening land with high carbon stock. Similarly, reducing emissions from the HTI zone implies the commitment of pulp and paper industries to use raw materials from their planted trees and reduce (or even forgo) the use of wood (mixed tropical hardwood/MGH) from natural forests.

There will be challenges in implementing low emissions development in the field. For example, the use of abandoned land (with low carbon stock) by concession holders is regulated under the national Agrarian Law (and its derived regulations). However, in reality, various land claims by local communities create difficulties for concession holders to use the land. Therefore, concession holders

need tenure security over concession land if they are to successfully implement an emissions reduction strategy.

On a similar note, to reduce emissions in the KPHLG zone, the local government and communities must work together to restore the protection function of the KPHLG. Conversion of oil palm to *jelutung* systems could increase carbon stocks. However, such a commodity conversion needs careful consideration as it will have an impact on the income of smallholder farmers. Currently, oil palm systems contribute significantly to farmers' incomes. Besides *jelutung*, the local government should consider other trees that could also provide income to farmers in order to spread not only opportunities for improved income but also the risk of losses.

To provide communities around the KPHLG area with legal status and tenurial access to manage the land, the local government could consider provision of 'village forest' (Hutan Desa), 'community forest' (Hutan Kemasyarakat) or other forms of cooperative agreements that could strengthen collaboration between the government and communities.

A special working group with various local government agencies as members should be formed to coordinate and plan reduction activities. The working group should also be responsible for evaluating if these activities have met the low emissions development goal regionally and nationally.

Production Forest Management Unit 16 in Tanjung Jabung Barat district

Together with the Dinas Kehutanan (District Forest Agency) and the University of Jambi we worked with Production Forest Management Unit 16 (KPHP XVI) to assist with its contribution to the RAD-GRK. As mentioned above, during the policy dialogues with Bappeda, KPHP XVI was identified as playing an important role in any emissions reduction strategy. Accordingly, we supported this local initiative by ensuring it was included in the emissions reduction scenarios. Unlike any other KPHP, with KPHP XVI we worked together to address the issue of local people's rights and how these rights could be accommodated within KPHP XVI's jurisdiction.

Institutional setting of KPHP XVI

According to Minister of the Interior regulation no. 61/2010 (Menteri Dalam Negeri Republik Indonesia 2010), forest management units are described as local institutions (Satuan Kerja Perangkat Daerah/SKPD) under supervision of the bupati.

By considering various factors like the scope of the area, human resources, existing concessions, forest cover and existing programs from the national government (such as 'people's plantations'/Hutan Tanaman Rakyat/HTR), we proposed a new organizational structure for KPHP XVI (Figure 9).

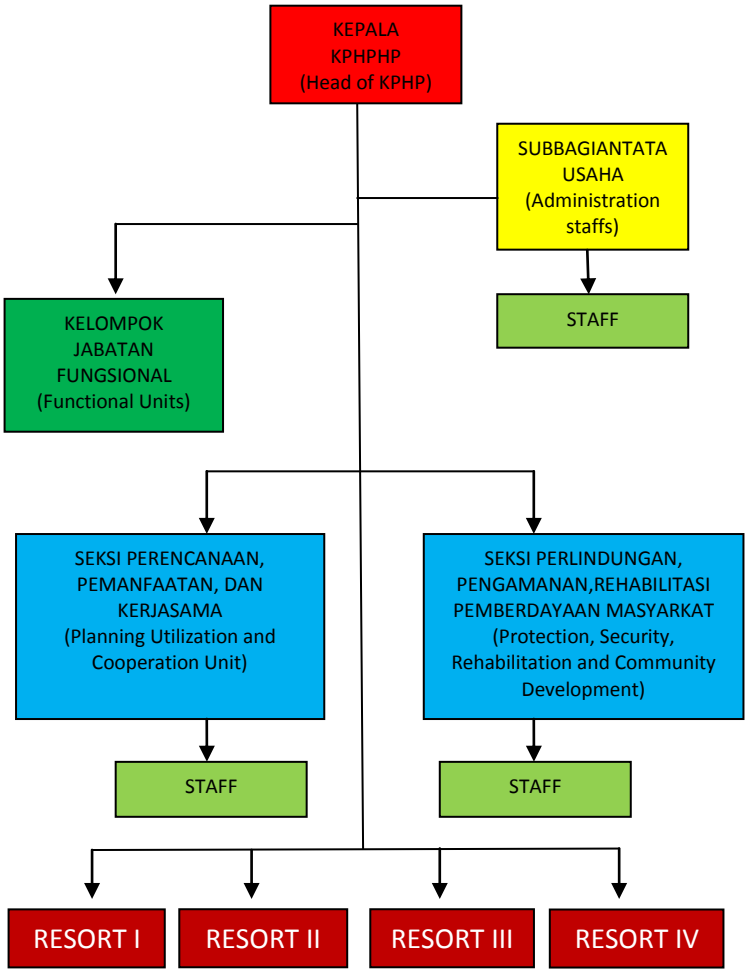

Figure 9. Proposed organizational structure of KPHP XVI

Forest management within KPHP XVI

Forest management within KPHP XVI will be divided into two: 1) areas within KPHP that have already been allocated to concession holders; and 2) 'open access areas'. Several approaches to forest management are planned in order to achieve sustainable forest management.

The existing concession holders within KPHP XVI are PT Wira Karya Sakti, PT Rimba Hutani Mas, PT Wana Teladan and also two HTR plantations designated by the Minister of Forestry. Most of the concession area is designated as HTI and covers more that 60% of KPHP XVI's total area. KPHP XVI will focus on monitoring concession holder's management of the forests.

Management of the open access areas is more challenging. Currently, these areas are being converted to oil palm plantations and are vulnerable to conflict over land tenure caused by counter-claims and encroachment. Because of this, clear, legal forest management is critical. We have provided recommendations on how to decrease the deforestation rate in these areas, specifically, that KPHP XVI should be divide the open access areas into three types for forest management: 1) ecosystem restoration area; 2) buffer zone for the national park; and 3) agroforestry area to increase community livelihoods.

5.2 National action plan

5.2.1 Prepare a national REDD+ strategy

Nationally, World Agroforestry Centre staff member Dr Sonya Dewi has been part of the special taskforce to prepare a national REDD+ strategy aligned with NAMA (RAN-GRK) and also advised on the design of an integrated national monitoring, reporting and validating system. This participation is 'boundary work' to ensure that our research findings are used in national policy design and reformulations. The RAN-GRK now requires all local governments to deliver a 'nested baseline' and local plans for reducing emissions (RAD-GRK). To this end, local data and spatial analyses have become crucial. We can provide much of the necessary data for many areas in the country.

Along with other colleagues from the Center for International Forestry Research, Institut Pertanian Bogor, University of Indonesia and the Indonesian Center for Environmental Law, Dr Dewi prepared the draft REDD+ national strategy (UKPB4 2011).

5.2.2 Tenure security: national legal study to support communities' rights and reduce conflicts

Together with Perkumpulan untuk Pembaharuan Hukum Berbasis Masyarakat dan Ekologis (Community and Ecology Law Reform Society/HuMA) and the University of Jambi we conducted a study on whether community-based forest management (CBFM) can provide tenure security for local communities, especially regarding carbon rights, and reduces conflict (Safitri et al. 2011). CBFM has been assumed to establish tenure security by reducing uncertainty regarding ownership and providing State enforcement in cases of infringement.

However, there has been debate about whether legal rights alone can establish tenure security. Some people have de facto tenure security despite their access and use not being regulated by the State. The de facto view of tenure security is based on the actual control of property, regardless of the legal status in which it is held. Another way to measure tenure security is dwellers' perceptions, which is simply an individual's understanding of his or her situation.

In this study, we set out to measure tenure security for 'village forest' agreements, a form of CBFM. The case study was located in Merangin district, where 17 village forest licences were being processed by the Ministry of Forestry. The study revealed several problems regarding tenure security.

1) Village forest agreements are considered as a way of resolving conflict between local communities and the Government over land use. Expectations of government agencies that there would be benefits from an anticipated REDD scheme led to the expansion of village forest agreements.
   However, there were problems with integrating communities' agroforests and the Government's regulations about village forests' management plans. Local communities' agroforestry practices mostly followed traditional customs and ecological knowledge passed down over centuries whereas the Government promoted other methods with varying objectives.
2) Market arrangements, such as the sale of land to migrants by village elites, can be a threat to existing village forest agreements as well as prevent their expansion. An earlier study that we conducted showed that migrants mostly sought land for coffee and oil palm plantations, which created land claims not only in the forest buffer zone and on village forest land but also in the national park itself. Migrants were attracted to forest frontiers if they perceived they could

obtain at least some security of tenure with an opportunity to make a living. Rarely was their tenurial security fully grounded in national legislation and its alignment with local traditional rules depended on informal intermediaries. Land tenure conflict between local communities and migrants was a constant threat.

To reduce the risk of conflict and to maintain village forests as buffer zones, local community institutions need to be strengthened. We envisage that instead of the current state of simmering conflict, increasing deforestation and land conversion there can be harmonious communities with clear, stable land tenure that allows local and indigenous communities to manage the land in a sustainable fashion for the benefit of their own livelihoods and the protection of biodiversity.

3) Deforestation and degradation are the result of a political economy that gave priority to economic development and powerful interest groups who benefited financially from depletion of resources. Land tenure conflicts have been mainly the result of land-use policies and allocations that favoured groups involved in forest conversion. The existing village forests are under threat and need to be integrated into land-use planning so that local communities' land rights, livelihoods and biodiversity in the buffer zones can be protected.

   To bolster existing agreements, more productive agroforestry systems should be established so that they are functioning economically as well as in the interests of biodiversity and the number of formal agreements should be extended.

6. Policy research and development

Policy research and development work was conducted from March to September 2011 in Merangin and Tanjung Jabung Barat districts. The aim was to create policy based on facts. Most of the research work was used to support local and national action plans.

Sections 6.1–6.6 below refer largely to Tanjung Jabung Barat whereas section 6.7 refers to Merangin.

6.1 Land-use policies, migration and the drivers of land-use changes

In principle, two major factors affect land-use decisions: migration and land-use policies. The notion that migration has a negative effect on land-use allocation, land dynamics, deforestation and climate change has been hotly discussed (McLeman and Smit 2006, Kartiki 2011). Meanwhile, land-use policies affect local land-use changes. Almost 50% of the district is categorized as State forest land, with forestry policies playing major roles in the allocation and/or re-allocation of land uses, including extraction of produce. Policies are constantly evolving in the national Government, with effects at the district level, for example, issuance of small-scale timber extraction and other concession permits. In this section, we analyze the role of land-use policies and migration as the main drivers of land-use changes in Tanjung Jabung Barat.

6.1.1 The political economy of land-use allocation policies and forest governance

The history of State forest governance began in the 1970s when forests were being logged by forestry companies. Customary forest governance by local communities was not recognised by the State at that time because of its unclear characteristics and elite domination of customary rules for

forest access and use. Along with the operations of logging companies, communities who previously had customary claims over an area joined in and opened natural forest searching for commercial timbers such as *ramin* (*Gonystylus bancanus kurst*).

Figure 30. Forest land-use allocation in Tanjung Jabung Barat

In Tanjung Jabung Barat, there were more than seven logging concessions issued from the 1970s until the 1990s. These concessions came to an end at the beginning of the decentralization era in the early 2000s, creating vulnerable conditions for State forest zones and forest cover. Former concession areas were abandoned and suffered from encroachment and illegal logging that caused more deforestation and degradation.

Another major land-use development within the forestry sector was driven by the ever-increasing demand by pulp and paper industries. Since 2004, as much as 70% of the forested areas in Tanjung Jabung Barat have been allocated for large-scale acacia and eucalyptus plantations. However, around 20 585 ha has been abandoned by forest plantation companies and is currently being occupied by locals and migrants for conversion to oil palm plantations. Ironically, around half of these forest areas are proposed for conversion to oil palm plantations by the rights holders.

Owing to this allocation, some areas are currently experiencing conflict between the companies, locals and migrants. About 8740 ha within the forest plantation concession area is claimed by local people. This conflict is mainly driven by the confusion surrounding overlapping land-use policies. The local community claim ownership of the 8740 ha based on the argument that the area was categorized as non-forest area (Areal Penggunaan Lain/APL) in the RTRWK of 1993, which is still being revised. However, the forest plantation concession perspective is that the area is a Conversion Production Forest based on the Forest Allotment Consensus (Tata Guna Hutan Kesepakatan/TGHK) of 1985.

Aside from forestry and land-use policies, development programs from the national Government also indirectly affect local forest governance and land-use changes. One such program is transmigration, which has largely been implemented in the major outer islands. Part of this program is closely related to the PIR-Trans program for oil palm development. For Tanjung Jabung Barat, since 1990, the major policy impact was the release of 36 087 ha of forest land to seven large-scale private oil palm plantation companies. The high demand for manpower for these plantations led companies to cooperate with the Department of Transmigration in order to bring in labourers from

outside the area (particularly from Java). Approximately 7396 transmigrants were settled in areas adjacent to oil palm plantations. This itself created great pressure on the remaining forest since these migrants searched for more land in order to accumulate capital over and above the land they received for planting oil palm. With unresolved land tenure issues resulting in open access to forest land, the increasing cash crop area is at the expense of forest. This is supported by the fact that in the peat areas, the largest 'landholding' for oil palm is on State forest land. To respond to this situation, the national Government launched the Kesatuan Pengelolaan Hutan (Forest Management Unit/KPH) scheme to manage the remaining forests (60 700 ha) that were not under the control of forest plantation concessions.

Both land-use policies, which lead to the issuance of concessions and release of forest land to large-scale plantations, are clearly for the benefit of the palm oil production and pulp and paper industries. Claims over land and subsequent conflicts have arisen not only as a result of these land-use allocation policies but also because of the de facto open access to forest land. The historic process of changing policies of land use and the lack of enforcement to protect resources by the State led to this situation, resulting in severe deforestation.

6.1.2 The history and patterns of migration

The population of the study area was about 266 952 in 2009, with a density of approximately 51/km^2. The density in the mineral soil area (35/km^2) was lower than in the peatland area (46.8/km^2). Villages in the mineral areas were established before the 1900s by inland people from western and northern Sumatra, while villages in the peatland area were established by ethnic Banjar people from Kalimantan in the 1930s, followed by ethnic Bugis and Javanese migrants in the 1940s. Most of the Bugis are now second generation and have already settled in other parts of Sumatra. In the mineral soil area, significant migration occurred in the 1980s and 1990s with the transmigration program that was associated with developing large-scale oil palm plantations and industrial forest estates. However, owing to the peatland area being strategically located near the main river that acts as a transportation route and also being on the coast, which is the core trading area in Tanjung Jabung Barat, the population is more dynamic than in upstream mineral soil areas.

In-migration to peatland areas has normally been driven by people wanting to improve their incomes through increasing their farming area for coconut and oil palm. On the mineral soils, landless people migrated to find off-farm livelihoods, as well as to find land on which to establish their own farms.

The local transmigration program operated by the local government lead to a high rate of out-migration from local communities on mineral soils, such as Rantau Benar and Lubuk Kambing, and also from the peatland migrant community of Teluk Nilau. The villagers, mostly newly married couples who did not inherit land from their parents, moved to the nearby transmigration areas and cultivated commercial commodities such as oil palm.

There were also fluxes of migration in the transmigration settlements, mostly owing to problems in adaptation to their new environment or to find better land. Some of these migrants ultimately returned to their original settlements, some ended up in neighbouring villages within or outside the district and some moved to areas outside Jambi province, such as to Riau. Some Javanese transmigrants from peatland areas migrated to Riau as coconut farmers. Their objective was to improve their income from farming.

6.1.3 Major drivers and the chain of factors

External drivers from the national Government

As mentioned earlier, almost 50% of the district is defined as State forest land, with forestry policies playing major roles in the allocation and/or re-allocation of land uses, including extraction of produce. During the Reformasi era of the late 1990s to 2000s, oil palm development was based on demand from both national and export markets. Despite different policy trends, the situation remains similar, marking the continuous victory of oil palm for rural land development in the outer islands. For Tanjung Jabung Barat, one of the clear signals was the release of State forest land for oil palm plantations.

Another major land-use development, in this instance within the forestry sector, has been driven by the ever-increasing demands of the pulp and paper industries. In Tanjung Jabung Barat, the trend can also be clearly seen in the large allocation of forest plantation areas. As much as 80% of the KPH in production forest areas are assigned to large-scale acacia plantation development.

Aside from forestry and land-use policies, the flux of migrants to districts like Tanjung Jabung Barat, along with other policies supporting land-use development, together created the major drivers of forest loss and the conversion of traditional systems into more profitable land uses.

Drivers at local level

Locally, aside from the top–down effects of national policies and programs, various development factors and local development dynamics had consequences for forest conversions and other land-use changes. Based on time series observations, 1990–2009, the decrease of forest cover and increase of tree-based land-use systems showed a strong correlation with increases in population density. This pattern is typically demonstrated by areas dominated by rural livelihoods where dependence on land for livelihoods is high.

The increasing population is strongly correlated with in-migration in Tanjung Jabung Barat. The national Government's transmigration program started in the 1980s and, owing to the agrarian backgrounds of the migrants, mostly in cash-crop farming, the increasing population inevitably led to seeking additional land for their farms. In the post-logging period, lands were occupied by local people through establishing coconut plantations for *kopra*[2] mixed with coffee. In some villages, in relatively small patches, smallholding oil palm plantations have also been developed in recent years (late 2000s) owing to higher profits from the crop. Oil palm has been extensively planted in the mineral soils area, especially in the transmigration settlements.

Land-based production is not only important for local livelihoods but also for district revenue. Although not as linear as the relationship with population, there is a relationship between the decrease of forest cover, increase of tree-based land-use systems and annual district revenue. Despite the varied scales, most of the tree-based systems in Tanjung Jabung Barat are cash crops with local, national and export industries and markets, for example, rubber, oil palm, coffee, coconut, betel nut and acacia.

Local incomes have improved over time, corresponding to the increasing use of land for more profitable products and the increasing loss of forest area.

[2]Copra (Eng.) is the dried meat, or kernel, of the coconut.

6.2 Migrants and land tenure security

This section is concerned with the social relationship between migration and deforestation and its impact on local tenure arrangements and State forest tenure insecurity. Migrants carry with them notions about property rights arrangements that are familiar and seek, or are compelled to pursue, new constructs in new locations. Thus, migration brings distinct tenure ideas and constructs into contact with those established in the host communities. Such a process comes about owing to pluralism, where no single authority (including the State) is seen as legitimate and able to implement rules regarding evidence of claim (Unruh 2008).

We examined the processes by which migrants gain access and change customary land tenure, as illustrated not only by the 'selling' of land, but also by the expansion and strengthening of customary territories within designated State forest land. On closer scrutiny, the relational concepts of land rights between migrants and locals, and customary land tenure changes by locals, are often mediated by expectations of benefits and costs, especially when claiming State forest land as customary land. These land transactions enable migrants to forge a social identity as part of a customary people and to engage in the process of strengthening their access rights to land. On the other hand, customary land tenure is often modified and adopts migrants' land tenure systems that are introduced not only to accommodate migrants' interests in land but also to expand and strengthen customary land tenure over State forest land.

6.3 The expectation of profits and livelihoods' transitions

We have argued that land-use policies and migrant influxes have had major effects on forest cover, specifically, more deforestation. Considerable land areas have been allocated for oil palm development and this, amongst others, has affected forest cover. Nevertheless, the question remains why local people are interested in planting oil palm and how this changes their livelihoods.

First, we compared the profitability of existing land uses in Tanjung Jabung Barat in order to understand the expectation of profits from each by local people. Then, we analyzed the changes in farming systems and livelihoods in five periods: 1) early years of the establishment of a village; 2) 1970s (logging concession period); 3) 1990s (transmigrant and oil palm period); 4) 2000s (reformation era); and 5) 2010 (time of study).

6.3.1 Profitability of land-use systems

The profitability analysis showed that all existing land uses on both mineral and peat soils are profitable. Large-scale, oil palm plantations on mineral soil are the most profitable. Large-scale logging also has high net present value but it is lower than oil palm. Although there are no more forest concessions in Tanjung Jabung Barat, large-scale conversion of natural forests and logged-over forests has taken place for the development of industrial tree and oil palm plantations.

This is the dilemma: high profitability from logging will cause people to deplete the forest resource; low profitability will also cause people to convert the forest to other land uses that are more profitable.

Acacia plantations also have a positive net present value but it is not as high as those of oil palm and logging. The development of industrial timber plantations became part of the strategy for national development, to satisfy the demand for raw material from the pulp and paper industry. The sector was targeted to develop 9 million ha in 2011 but only realised 45% of this in 2010. The low net present value for acacia plantations indicates that the business is not very attractive for investors

and farmers. Acacia plantations have a high establishment cost—building and maintaining roads and infrastructure—and high national and local government taxes.

Smallholding rubber plantations also showed positive profitability but oil palm was almost double in comparison. On mineral soil, many farmers changed their rubber systems to oil palm plantations. If we compare the smallholding oil palm systems on mineral soil and peat, we see that mineral soil is more profitable than peat. Management systems on peat are more complex: there are additional costs for the construction and maintenance of a drainage system. The costs are incurred throughout the year: maintenance to prevent submersion of plants and trees and acid poisoning from the water. Excess water causes plants to die of thirst[3]. For oil palm on peat, the difficulty of market access inspires low prices for fresh fruit bunches.

In the past, coconut plantations on peat were monocultural. However, since the 1990s, the price of coconut has declined. Thus, farmers started to intercrop with coffee and betel nut to increase profits. The profitability of mixed or agroforestry systems on peatland was high. The profitability of these mixed systems has a nearly equal value with oil palm plantations on peat. In other words, the competitiveness of these mixed systems with oil palm was high.

Another land-use system in Tanjung Jabung Barat that must be considered is *jelutung* (*Dyera* sp) monoculture. However, because *jelutung* has only recently been planted there was no farm budget data available.

6.3.2 Options for livelihoods' transitions

The economic wellbeing levels of different communities, as indicated by incomes and landholdings, were different. The average total income per year per household on the mineral soil area was higher than that in the peat area. In addition, the difference in income between transmigrants and local villagers was high: transmigrants' income was about three times the income of local villagers. Even the incomes of older and more recent migrants on peatland were similar. The composition of landholdings by land-use types were different across the sites. Most of the land belonging to transmigrants was planted with oil palm. The landholdings of local villagers on mineral soil showed differences but were dominated by rubber and oil palm. On peatland, the agroforestry or mixed garden system that consisted of mixed coconut with betel nut palm (*Areca catechu*) and coffee was an important land-use system for early migrants.

The equity of income was higher on peatland than on mineral soil, as indicated by a lower Gini ratio. Income inequity was very high between transmigrants and local villagers on mineral soil. Transmigrants often used surpluses from oil palm income to buy new land from local villagers for oil palm expansion, which further increased the income gap.

Designing interventions for reducing emissions without an understanding of local people's livelihoods' strategies can often lead to misinformed recommendations. From close attention to the situation in the field, we have been able to identify implications for both the national and provincial levels.

- A complete ban on oil palm development will have a negative impact on smallholders' livelihoods. Oil palm can still continue but it should be established on land that has lower carbon stock. We found that the average carbon stock of oil palm plantations was 40 tonne

[3] If soil becomes waterlogged the roots of plants are unable to absorb enough oxygen nor take up water and they stop growing and may die.

of carbon per hectare, a benchmark that can be used as the basis for land-use policies for new oil palm establishment.

- Policy development in favour of local villagers should be prioritised in order to reduce income inequity.
- Rehabilitation of degraded peatland areas with agroforestry systems such as coffee, coconut, betel nut and *jelutung* should be more seriously explored.
- Restriction of large-scale development programs on peatland should be considered in order to avoid the environmental and socio-economic impacts from major demographic shifts.

6.4 Population dynamics, education and gender

Demography and population were influential on land-use changes in the study area. Therefore, it was crucial to understand the population and migration patterns that influenced deforestation and land use, how gender influenced livelihoods' strategies, who controlled natural resources and what knowledge of the environment existed. This was baseline information for formulating interventions in district development that relate to land-use management to cope with climate changes.

In Merangin, in-migration owing to coffee farmers' land expansion was the central issue in some heavy conflict with the national park over tenure. However, coffee production by migrants within this area is substantial and boosts village and district economies. A better integration policy for migrants entering villages and districts could prevent massive in-migration and unmanageable migrant communities. Issues causing out-migration from the source area should also be investigated and policies established to prevent unmanageable migration.

Though still less than men, the role of women in natural resources management was quite prominent. Women were important in some farming activities that were not too heavy and located close to the house. In terms of education, there were no significant differences between men and women.

6.5 Carbon stocks, forest loss, land-use changes and historical emissions

6.5.1 Carbon stocks and historical emissions

The total aboveground carbon stock in Tanjung Jabung Barat gradually decreased during the last 20 or so years. For the first decade (1990–2000), stock decreased as much as 12 million tonne or 19% of carbon stock was lost, while for the second decade (2000–2009) the decrease was about 15 million tonne or about 31% of carbon stock lost. For State forest land over the entire time series, the stable aboveground stock was in Bukit Tiga Puluh National Park and the annual rate of loss was almost none. The largest carbon loss in the area was inevitably in the production forest and non-forest land areas, amounting to 6 million tonne during 1990–2000, with the annual rates of carbon loss ranging between 1% and 6%. However, despite the small area and hence amount, it is interesting to note that for the most recent years of observation (2005–2009) the percentage of carbon loss in peat protection forest (5%/year) was as high as that in production forest and non-forest lands. This shows the increasing conversion activity during the last few years despite the area's status as peat protection forest.

Tracing back the major contributing land-use trajectories of the emissions, the largest shares of emissions during 1990–2000 and 2000–2005 came from conversion of logged-over swamp forest to oil palm plantations (11% and 13%). For 2005–2009, all land-use changes that took place shared less

than 10% of emissions but, rather similarly to the preceding periods, the highest was conversion from logged-over forest to oil palm (7%).

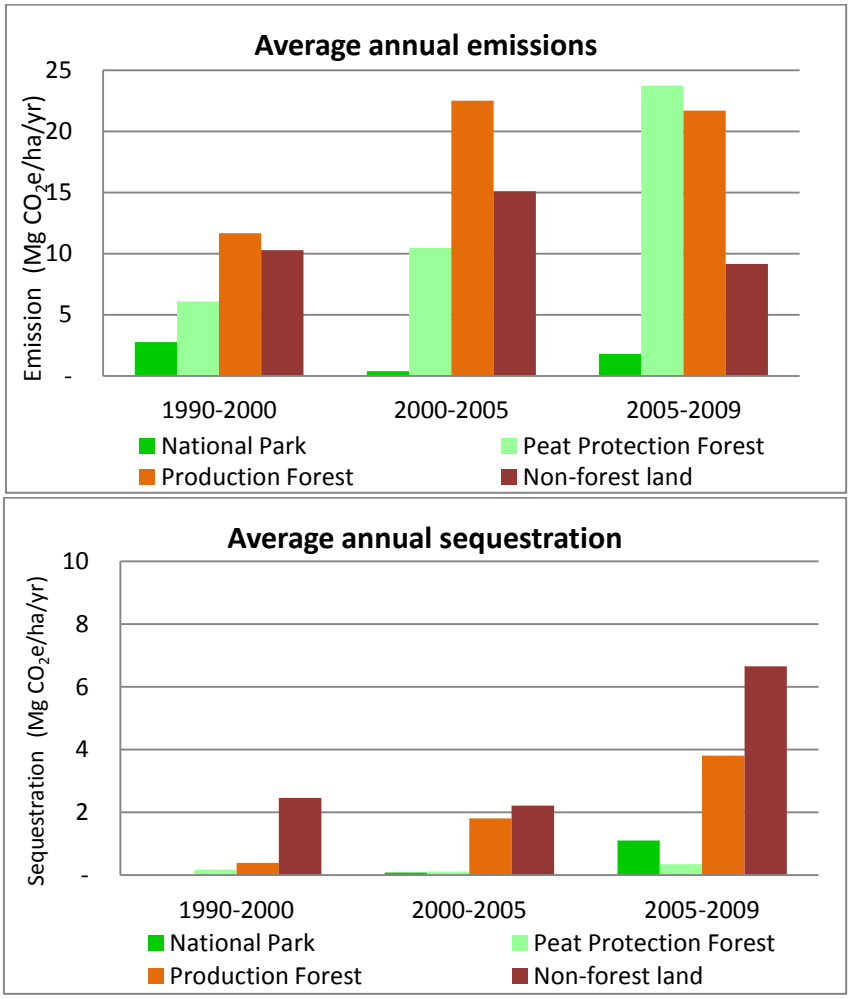

Figure 41. Land-based carbon emissions (top) and sequestration (bottom)

Figure 11 shows the significance of forest land for emissions and sequestration contributions, showing that for 1990–2000 and 2000–2005, production forest areas contributed the highest average annual emissions. An interesting phenomenon was observed in the 2005–2009 period, where emissions from peat protection forest exceeded those in other forest zones and in non-forest land and was the highest throughout the three observation periods. This phenomenon can be explained by the dynamics of land uses in peat protection forest (Hutan Lindung Gambut/HLG) areas, in which oil palm and coffee-based systems were planted.

Regarding the removal of carbon dioxide equivalent, or carbon sequestration, in the different forest land categories, non-forest land was consistently the highest for the entire period of observation. The highest amount of sequestration took place for 2005–2009, amounting to 6.66 t CO_2e/ha/yr. The highest contributions to carbon sequestration were identified as the changes of different tree-based systems (rubber monoculture, oil palm plantation and rubber agroforest) into the disturbed forest class. This indicates the large increase of canopy cover in the respective farms or plantations. Such an increase of trees and other plants might be owing to deliberate agroforestation through intercropping of fruit or timber trees or to abandonment of the land.

We can form preliminary conclusions that Tanjung Jabung Barat has now depleted its natural carbon-stock resources. The district is currently undergoing a phase where a highly commercial, low carbon-stock, land-use system dominates the area. Evidence also shows increasing carbon stock in some land-use systems. The latter may indicate that Tanjung Jabung Barat is embarking on the later stage of the forest transition gradient where vegetation, and hence carbon, increases, although the chances are that it will experience a prolonged medium stage in forest transition where low carbon-stock land-use systems dominate.

6.5.2 Forest loss and land-use changes

Analyses of land-use and land-cover changes are crucial for further identification of drivers of forest loss and other land-use conversions and also to analyse the consequences on land-use-based emissions. The quantified land-use changes and their trajectories provide evidence of magnitude and direction. In combination with the carbon data set, such information also helps determine the consequences of land-based human activities on carbon emissions or sequestration. Relating them to other data of the factors that are assumed to cause changes of emission sources provides a strong base for the design of interventions to reduce emissions in the area.

Four time-series data sets based on Landsat TM imageries were used in our study: 1990, 2000, 2005 and 2009. Decades were used as the time frames (1990–2000 and 2000–2009) because they also related well to different secondary sources.

In Tanjung Jabung Barat, land-use and land-cover changes showed a general pattern of persistent forest loss from 1990 to 2009. Oil palm plantations emerged in the 1990s and are extensive up to the present. Oil palm was booming in the 1990s, supported by the Government's transmigration program. Large plantations flourished, followed by extensive development of independent smallholding oil palm plantations lured by high profit, with easy market infrastruture. Industrial plantations (mostly acacia) appeared to be a new system emerging in the 2000s but, unlike oil palm, HTI appeared in moderate sizes and the area increase was not as sharp as oil palm. Traditional farming systems that were important for local livelihoods were rubber, coffee and coconut systems. Coffee- and coconut-based systems seem to be more persistent, shown by the relatively constant area, despite slight shifts. Rubber was relatively constant until 2005 and has experienced a decrease only in the past four-to-five years.

When dissecting the areas based on typical soil characteristics, that is, peat and mineral soils, the patterns of land-use and land-cover changes are different between the two. New monoculture systems, both oil palm and HTI, appeared earlier on mineral soil, that is, in the 1990s, than on peat soils (late 2000s). Areas for oil palm were always larger, on both peat and mineral soils, compared to HTI. Rubber appeared to be the largest traditional land-use system on mineral soils and the area was relatively constant throughout the two decades. Area changes in the two rubber systems (rubber plantations and rubber agroforests) were internal system dynamics that reflected increases in plant densities and replanting/pruning. For the peat soil, the largest traditional land-uses were coffee- and coconut-based systems, and these areas were also relatively constant throughout the two decades.

The category of State forest land tends to serve as the basis for land-use policies, partly because forest land status marks large parts within administrative boundaries such as a district. HTI concessions are only issued for the production forest zone, hence the emergence of this land-use type in this forest zone. The concessions started to appear a little in the 1990s, with a substantial increase in the 2000s. In some areas, oil palm was also established in production forest in the 2000s. This is very likely smallholding oil palm as, by law, large-scale oil palm concessions were issued only for private land (APL) and not in any forest zones. The establishment of oil palm in production forest

zones was likely related to the 'encroachments' on the leftover logged areas considered as open access.

In peat protection forests, cultivation and farming systems are not allowed, however, it was shown that both oil palm and coffee systems were established in these areas starting in the 2000s. As with the case above, prior to the formal issuance of peat protection forest status, the logged peat forest had been considered as open access by local people. And through a long history of cultivation, including land trading, the establishment of a forest reserve did not halt conversion, owing to lack of awareness or negligence regarding the new law.

6.6 Multiple environmental services: biodiversity and watershed protection as REDD+ co-benefits in Merangin district

Merangin district has low to mountainous topography consisting of various land-cover systems, such as undisturbed forests in the boundary areas of Kerinci Seblat National Park, remnant forests that are being promoted as 'village forests', 'customary' forest at Guguk village (690 ha), agroforestry systems and monoculture systems of rubber, coffee–rubber, cinnamon–rubber, smallholding plantations of oil palm and annual vegetable crops. Remnant forests, the customary forest and agroforestry are important land-use systems because of their higher levels of carbon stock and biodiversity. However, land-use conversion has tended to increase in these areas and has caused rapid carbon and biodiversity loss. Forest conversion changes or simplifies an ecosystem and species' composition.

6.6.1 Biodiversity and watershed protection as co-benefits of REDD

REDD was initiated in Bali at the United Nations Framework Convention on Climate Change's Thirteenth Conference of Parties to mitigate climate change and establish co-benefits that could have positive outcomes additional to any mitigation scheme. In the Bali Action Plan, biodiversity was considered a co-benefit and the value of forests with high levels of biodiversity could be significantly greater than the value of the carbon stored in them. Hence, exploring the impact on biodiversity of land-use and land-cover changes is an important focus.

In some areas, biodiversity conservation and watershed protection have already been elaborated in national plans and other programs, in which case a REDD scheme could utilize the existing plans, for example, through promoting 'village forests' (Hutan Desa).

A REDD mechanism in developing countries is expected to have significant positive impacts on biodiversity conservation since deforestation and degradation implies habitat destruction and thus biodiversity loss. To achieve biodiversity benefits and watershed protection, we need to identify potential synergies and trade-offs.

6.6.2 Tree-diversity composition as a biodiversity value

If biodiversity is to be included in a REDD scheme as a co-benefit, we must quantify it to know how much it changes when land uses and covers change.

Biodiversity is comprised of the number and range of types of plants and animals (as well as microbiology). For this study, we focused on plants, specifically tree species, because of the close relationship with carbon stock. To quantify the diversity of tree species, we used biodiversity indices, such as the Shannon diversity, species' richness and Sorensen similarity indices.

Based on our survey, we were able to conclude three major points.

1. Species' composition is dependent on the land-use system. On managed land, a dominance of species, particularly domesticated species, was apparent. By contrast, unmanaged land had no dominant species at sapling, pole or tree stages.
2. Species' richness and diversity in rubber agroforests was comparable with disturbed and undisturbed forests at all growth stages.
3. Compared to other land uses, rubber agroforests have a high similarity of species with undisturbed forests. Forest species can regenerate in rubber agroforestry systems, which apply low-intensity management.

6.6.3 Hydrology co-benefits

Two approaches were used to study the hydrological conditions of Batang Merangin sub-watershed. First, we articulated local perspectives on water resources, gathered through both structured and in-depth interviews in the upstream, middle stream and downstream areas. Second, we analyzed river discharge using the Flow Persistence model. This model provides an indicator of watershed health through the analysis of persistence of river discharge, which reflects the buffering capacity of a watershed.

Some hydrological problems were indentified, such as lack of water during the dry season, turbid water after heavy rainfall, and foul-smelling and contaminated water. Loss of forest cover, domestic and industrial waste (from the rubber and oil palm industries) and discharges from illegal gold mining are the causes. The local communities use the rivers for their daily needs such as sanitation and drinking water. Other uses of rivers are for fishing, transportation, irrigation, stone mining and mini-hydropower projects. Other sources of water are wells, springs and rainwater.

Prior to 1993, the flow persistence values tended to be constant over time. A decreasing pattern started after that period. This is very much linked to the loss of forest cover that dramatically increased in the 1990–2010 period and is associated with high flow during wet seasons and low flow during dry seasons, reflected by low values of flow persistence (average value 0.67). This result confirmed local people's observations of the hydrological problems. Therefore, preserving forest cover or increasing tree-based systems will sustain and perhaps restore the hydrological functions of the watershed.

7. Delivery of outputs

7.1 Consensus on low-carbon development pathways that can be accessed through spatial and mid-term development planning

Through the newly developed LUWES methodology, the World Agroforestry Centre and Bappeda Tanjung Jabung Barat and Merangin were able to design participatory scenarios and strategies to reduce emissions from land-use changes and also set the RLs for the two districts. These scenarios and strategies were integrated into the new spatial and mid-term development plans. We recently published with Bappeda Tanjung Jabung Barat and Merangin a report about our work on developing RAD-GRKs and the integration with the developing RTRW and RPJM (Ekadinata et al. 2012, Johana et al. 2012).

7.2 Drafts of local regulations on customary rights and emission reduction efforts

The emission reduction efforts, through LUWES, have been integrated with the RTRW and RPJM. Both plans now acknowledge local communities' rights. In Tanjung Jabung Barat, the RTRW and RPJM forbid pulp and paper concessions to convert local communities' agroforests into acacia plantations. They also state that any conflicts between local communities and concession holders over land boundaries must be settled through negotiations, mediated by the District Forest Agency. In Merangin, the RTRW and RPJM support and protect village forests from being claimed by companies and migrants. Village forests are now also part of the district's RAD-GRK.

7.3 Several reports on carbon rights, carbon stock, opportunity costs and baseline socio-economic data

Several reports have been finalized and some of them have been submitted to national and international journals. Moreover, some of these reports were made together with local and national partners as part of capacity building and dissemination of knowledge.

- *Livelihood options, poverty and equity in the peat and mineral lands of Jambi: case study in Tanjung Jabung Barat district*.
- *Forest governance and its legality in Tanjung Jabung Barat.*
- *Migrants, land market and forest tenure insecurity: an example of deforestation in Tanjung Jabung Barat, Jambi province, Indonesia.*
- *Drivers of forest conversion and land-use changes in the peatland of Jambi: historical analyses towards intervention for emissions reduction.*
- *Migration and gendered land-use perspectives in the peatlands of Jambi.*
- *Above- and belowground carbon stock in the peatland of Jambi.*
- *Historical emissions as consequences of land-use changes in the peatland of Jambi.*
- *Profitability of land-use systems in the peatland of Jambi.*
- *Opportunity costs of emissions caused by land-use changes in the peatland of Jambi.*
- *Land-use scenarios that reduce emissions across all land uses in a peatland district in Sumatra: case study of Tanjung Jabung Barat with the FALLOW model.*

- *Population dynamics, education and gender in Merangin district.*
- *Aboveground carbon stock of Merangin district, Jambi province.*
- *Tree-diversity composition of Merangin district, Jambi province.*
- *Hydrology co-benefits in Merangin district, Jambi province.*
- *Profitability of land-use systems in Merangin district, Jambi province.*
- *Livelihoods' options and poverty in Merangin district, Jambi province*
- *Management planning assessment on KPHP XVI in Tanjung Jabung Barat district, Jambi province.*

7.4 Profitability analysis of mono-culture and biodiverse agroforestry

A profitability analysis of the different land-uses in Tanjung Jabung Barat has been submitted to a national journal. The article is entitled, 'Profitability of land-use assessment in Tanjung Jabung Barat' and the key findings are as follows.

1. Large-scale oil palm plantations were the most profitable land-use system.
2. Of the smallholders' systems, oil palm was also the most profitable. Smallholders' oil palm on peat had lower profitability than that on mineral soils because of the higher cost of establishing drainage systems and because of lower productivity.
3. The competitiveness of rubber was lower compared to oil palm on mineral soils. The profitability of smallholders' oil palm was almost three times that of rubber.
4. The competitiveness of mixed agroforestry systems was high compared to oil palm on peat. The profitability of these systems was almost the same as oil palm.
5. The threat of converting other land uses to oil palm was higher on mineral soils than on peat.

7.5 Raised awareness about carbon rights, policy on tenure and the challenges from REDD on rights

Land tenure and communities' rights are almost entirely neglected at any level of the REDD debate. During this project, we set out to raise awareness regarding these issues. Through LUWES we have been able to integrate land tenure, forest boundaries and communities' rights issues into the RTRW, RPJM and RAD-GRK in Merangin and Tanjung Jabung Barat districts. At the national level, our study of tenure security of CBFM is has been included as part of the Roadmap of Tenure and we have been involved actively in campaign and advocacy for tenure issues.

8. The way forward

The RAN-GRK and its requirement of locally developed RAD-GRKs has created a huge demand for the type of process that we tested in Merangin and Tanjung Jabung Barat.

It is important to rapidly expand the use of the tools while continuing to develop innovations.

8.1 Rapidly expand the use of the tools

We would like to explore some issues regarding the expanded use of LUWES and other tools.

1. How can we interact with the network of CLUA grantees to have our methods fully tested and used more widely?
2. Working together with Bappenas, UKP4 and other stakeholders in integrating RAD-GRKs and REDD into the district-level planning process could be an effective impact pathway for low emissions development in Indonesia.
   This should help to find synergies in mitigation efforts with multiple modalities and also between mitigation and adaptation. The same work should also applied at the provincial level with Bappeda and other local government agencies.

8.2 Working to develop further innovations

We will remain focused on policy dialogues and negotiations at the district level but expand the process to the provincial level. There are a number of issues we would like to explore regarding this.

1. Strategies for low emissions development have been established in both districts and in the next step is to implement them. The activities to reduce emissions have been discussed and analyzed to clarify how they will achieve their goals. Negotiations are almost complete and it is time now for action.
2. For the next step, we will operate at three levels of engagement:
   - 2.1. Government
     - 2.1.1. Developing commitment through negotiations with local government agencies about activities to reduce emissions.
     - 2.1.2. Working more with Bappeda on how the strategies can be elaborated in detail through the legislative process of the Rencana Detail Tata Ruang (Detailed Spatial Plan/RDTR).
     - 2.1.3. Expanding our strategies on low emissions development to the provincial level.
   - 2.2. Private companies
     - 2.2.1. Working together with Dinas Kehutanan and pulp and paper concession holders on conflict resolution and protection of local rights. Some areas of community land with high carbon stocks and sustainable livelihoods are in the concession areas, creating the potential for conflict to occur.
     - 2.2.2. We will work together with Dinas Perkebunan and oil palm concession holders on how to protect high carbon stock areas without reducing profits.

2.3. Communities
    2.3.1. Developing KPH based on a local approach by promoting *jelutung* and developing its market as an alternative for rural development and community livelihoods, which will put further-pressure on oil palm development at the local level.
    2.3.2. We will also develop local institutions at community level that can help reduce deforestation and forest tenure insecurity as well as promoting sustainable livelihoods. This local institution, for example, village forest agreements, will reduce the influence of land market institutions that currently operate informally in land management at community level.

3. Further integration with other aspects of environmental services is needed, adding a climate-change adaptation and reduced vulnerability lens to the one on mitigation. New ways of quantifying the buffering of river flow have been developed and initial data for Merangin show exciting results. A further development of LUWES to incorporate multiple environmental services has the working title 'Land use for multiple environmental services (LUMENS). LUMENS is intended to help quantify the 'co-benefits' for local livelihoods and the vulnerability of land use scenarios, including food security, that maintain species-rich (agro)forests in strategic landscape positions, contributing to CLUA's Indonesia goal 1.
4. To disseminate the findings from our participatory research, we require the services of science writers who can assist local partners and government agencies to place their research findings into science policy papers, journals and digital and conference networks. Orientation and policy briefs should target policy makers, including those in the parliament and local legislatures.

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World Agroforestry Centre
TRANSFORMING LIVES AND LANDSCAPES

Climate and Land Use Alliance

Indonesia recently committed itself to implementing a national strategy to reduce emissions from deforestation and forest degradation and include conservation (REDD+), creating a new REDD+ agency and an independent monitoring, reporting and validating institution. As this process develops, the World Agroforestry Centre is working closely with the Government of Indonesia to increase understanding of all opportunities for reducing greenhouse gas emissions from land use. A clear priority is needed on emissions from forest and peatland conversion. Recent data analysis suggests that the loss of woody vegetation (and the associated increase of emissions) is, on a per hectare basis, as large outside as it is inside the Government-designated forest domain that has so far been the focus of REDD+ discussions.

With the advent of REDD+ and the potential for increased financial flows into carbon-rich landscapes, the question of how to relate national commitments to the local context and implementation is more important than ever. Rather than focusing on short-term emissions reduction strategies, the debate has shifted to new forms of 'clean development' strategies that focus on maintaining high carbon stocks and low carbon flows and yet also achieving development goals.