Prospects and challenges of reducing emissions from deforestation and forest degradation in Central Kalimantan Province, Indonesia

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Abstract: Indonesia is rapidly progressing in terms of reducing emissions from deforestation and forest degradation (REDD plus) preparedness. We carried out a detailed feasibility study to develop and implement a new mechanism of the REDD plus for Central Kalimantan, a REDD pilot province of Indonesia. Several REDD plus activities were implemented in Paduran Mulia Village of Central Kalimantan. Remote sensing data was used to detect land use changes in the study area and was complemented by ground inventory to assess the actual carbon stock of the forest. The study found that land cover and uses have significantly been changed since last 30 years. Considering 2008 as a base year, we estimated that the total emission reduction would be 9,344 Gg CO_2 in the next 20 years (about 450 Gg CO_2/year). The results indicated the optimistic scenario with significant emission reduction if the proposed REDD plus activities were implemented successfully.

Keywords: deforestation; forest degradation; peat land; REDD plus; Central Kalimantan; Indonesia.

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1 Introduction

Reducing emissions from deforestation and forest degradation (REDD) plus has a greater significance in Indonesia having one of the largest tropical forests in the world with the second highest deforestation and emission rates from land use change (MoF, 2009; Houghton, 2009). About 2.5 Gt CO_2 per year emissions come from land use and land use changes and forestry (LULUCF) in Indonesia (Noordwijk et al., 2008) which is about 80% of total emission in the country (Verchot et al., 2012).

Forest is an important backbone of country's socio-economic system. The country has approximately 94 million hectares of natural planted forests, which is about 52% of its total land area (Jurgens et al., 2013). About 48 million people live in and around the forests and more than six million people directly dependent on forest for their livelihood

(MoF, 2009). Wood products have contributed significantly to economic growth with export value worth US$ 5 billion reported in 2005 (MoF, 2009). However, the country has been facing a serious deforestation problem since last few decades. The country lost approximately 1.7 million ha forest per year during the period of 1985–1997 with highest forest lost occurred during 1997–2000, reaching 2.8 million ha per year (MoF, 2009). Nevertheless, with increasing government interventions in forestry sector, the deforestation rate was decreased to about 1.2 million ha during the period of 2000–2005 (MoF, 2009). Forest statistics 2012 indicated that Indonesia lost only 0.48 million hectares of forests in 2009–2010, much lower than previous years (United Nations Development Programme, 2013).

Deforestation in Indonesia is largely driven by planned activities such as the conversion of forest lands into plantations particularly for oil palms and pulpwood trees. Similarly, coal mining has also become an important driver of deforestation as the coal production has increased significantly over the last ten years (Ministry of Energy and Mineral Resources, 2010; Pacheco et al., 2012). In addition, unplanned deforestation such as fire, illegal logging, slash and burn practices and forest encroachment also contribute significantly to deforestation in the country. With the growing projected population in the country, pressure on forests will continue for land reform and reallocation to support the increasing population. For example, with the anticipation of significant market demand for palm oil by 2025, the Indonesian government is planning to double its current palm oil production of 23 million tonnes over the next decade which would four million hectares additional oil palm plantation (Bahroeny, 2009; Kongsager and Reenberg, 2012). Concerns are mounting whether these new expansions will target the secondary forest zone, which is exempt from the forest conversion moratorium of 2010 on new forest concessions (Colchester and Chao, 2011).

Indonesia possesses immense areas, about 21 million ha or 84% of Southeast Asian peatlands (Murdiyarso et al., 2010), especially in Sumatra, Kalimantan and Papua. Peatland degradation accounts for about 65% of Indonesia's greenhouse gas (GHG) emissions (Murdiyarso et al., 2010). It is estimated that in the last 25 years, losses from the biomass amounted to 158 MgC per hectare while it was 270 Mg C per hectares from peatlands (Hergoualch and Verchot, 2011). Moreover, restoration of peatlands takes considerably longer time as the rate of C loss can be more than seven times higher than accumulation (Murdiyarso et al., 2010). However, a little attention has been given to manage or preserve these peatlands in national land use planning and allocation systems (Caldecott et al., 2011), since activities involving peat contributes less than 1% of GDP.

1.1 REDD plus momentum in Indonesia

Indonesia is one of the fastest moving countries in terms of REDD plus preparedness. The REDD plus process started with the establishment of National Council on Climate Change in June 2008 which was followed by Ministry of Forestry Regulation on REDD in December 2008 and Ministry of Forestry Decree on carbon sequestration in May 2009 (Gregorio et al., 2012).

Indonesia showed strong political commitment on REDD plus with the declaration of president Susilo Bambang Yudhoyono during G-20 meeting in 2009 stating that his government was "devising a policy that would cut the country's greenhouse gas (GHG) emissions by 26 percent by 2020 with significant portion contributing to this would come from reducing emissions from deforestation and forest degradation" (Ardiansyah and

Bayunanda, 2010). A presidential taskforce was formed in 2010 to coordinate all the REDD plus activities in the country that has finalised national strategy on REDD plus in 2012 (National REDD+ Taskforce, 2012). As proposed by the national REDD+ strategy, a high level national REDD+ agency was established in 2013 that replaced the functions of taskforce for overall coordination and implementation of REDD activities in the country.

The country was selected as one of UN-REDD pilot countries. Subsequently, the country signed 'letter of intent (LOI)' with the Government of Norway in May 2010, which came with USD one billion funding pledge to develop national strategies on REDD plus (Caldecott et al., 2011). Similarly, to show its commitment towards REDD plus, the country issued Presidential Instruction on moratorium of new licenses in May 2011, imposing two years suspension on all new concessions for the conversion of peat and natural forest, which was also one of the key elements of the LOI signed with the Government of Norway (Caldecott et al., 2011). Similarly, presidential decree on national plan to reduce GHGs was promulgated in September 2011. As a part of national commitment, Indonesia has also claimed to have spent more than US$1.5 billion on forest protection and the degraded land rehabilitation showing its commitment for combating deforestation and forest degradation (PWC, 2011). Similarly, the ministry of forestry has purposed several schemes as a climate mitigation effort to serve its REDD plus initiatives such as rehabilitation of 700,000 hectares of deforested land, restoration the ecosystem areas up to 7.4 million hectares (ha) etc.

In terms of institutional arrangement, presidential REDD plus task force is a central body in Indonesia, which has ten working teams to coordinate all the REDD plus activities in the country. Additionally, there have been a number of REDD and climate change related working groups established both at the national and provincial/district levels. Process towards establishment of national working group on REDD has been started since 2008, coordinated by the ministry of forestry as the leading institution in UNFCCC negotiation on forest related agendas including REDD.

There are currently more than 50 forest carbon projects operating in Indonesia including many of them in Kalimantan aiming for the reduction of deforestation and degradation, restoration, reforestation and forest management (Lin et al., 2012). Similarly, more than 200 national and international organisations are working in Indonesia to support the formulation of REDD plus policy and strategy (Gregorio et al., 2012).

1.2 REDD plus and safeguarding community right over resources in Indonesia

Safeguarding community right over forest resources is one of the major issues raised during the preparation of national strategy. Active participation and supports from local communities are indispensable for the successful implementation of REDD plus which requires strong motivation factors and incentives to the local communities. One of the ways to motivate local communities to participate the REDD plus activities would be to secure their right over resources by devolving certain level of resource ownership at the local level.

However, Indonesia's current forest policy mainly focuses on production and protection forests. According to Indonesia's readiness preparation proposal (R-PPs/MoF, 2009) the REDD strategy will mainly emphasise on developing more effective conservation and management tools for protection and production forests; exploring options for forest harvesting and management to supply the requirements of pulp and paper and oil palm industries and developing strategies for restoration of peatlands. Although safeguarding community rights over the forest resources have been mentioned in R-PPs, the proposed national strategy gives a little or no priority to community forestry approach, which is a major lacking in its Phase one activities.

Community forestry is in very early stage of development in Indonesia, which could be a cost-effective way of reducing emissions under REDD (Skutsch et al., 2007). The concept of community right in forestry emerged during 1990s, with the requirement of supporting local communities living in and around the estates by plantation owners and other concessionaires through community development activities. In 1995, government officially approved a social forestry program which would allow farmer groups and village-based institutions to lease government forests for 35 years. Although national REDD+ strategy has acknowledged the role of local communities in sustainable forest management, community-based management has not been the highlight, which could be one of the key approaches for the sustainable forest management, safeguarding community needs and right over forest resources and planning forest land use for management activities.

1.3 Developing REDD plus mechanism in central Kalimantan

Indonesia has decentralised all aspects of local development issues including land and natural resources management and revenue collection from central government to its provincial, district and municipal governments (Korhonen-Kurki et al., 2012). National REDD+ Taskforce (2012) clearly stated that provincial strategy and action plans will be developed with reference to the REDD+ national strategy. Accordingly, the much of the development and implementation of REDD plus activities are also decentralised to sub-national level including establishment of MRV system, capacity building and institutional strengthening and enhancing capacity of local people to engage in forest management through REDD plus activities. The country will develop sub-national level MRV initially and move towards country-wide system by the end of 2014 (National REDD+ Taskforce, 2012).

The president of Republic of Indonesia appointed Central Kalimantan as one of the pilot provinces for the implementation of REDD plus activities in December 2010. Central Kalimantan occupies three-quarters of lowland area with about 60% peatlands, covering approximately three million hectares (Governors' Climate and Forests Task Force, online). The province has about 12.6 million hectares of forest with about 150,000 hectares of deforestation and forest degradation annually, which is one of the highest deforestation rates among the Indonesian provinces (The Government of Central Kalimantan, 2012). The province is considered as a good choice for pilot projects since it contains a lot of issues which are typical to country as a whole, including boundary disputes between sub-districts, overlapping tenure systems and concession licenses, mining in forest estate areas, etc. (Caldecott et al., 2011).

With the aim to support the REDD plus pilot activities in Central Kalimantan, Mitsubishi UFJ Research & Consulting Co., Ltd has conducted a feasibility study in close collaboration with Waseda University, Ehime University, Palangkaraya University, MU Research and Consulting Indonesia and KOKUSAI KOGYO under the fund of the New Mechanism Feasibility Study 2011 by Global Environmental Center Foundation (GEC).

The main objective of the project was to develop new mechanism of the REDD plus for the Central Kalimantan with the specific objectives:

1 to design and implement REDD plus activities

2 to develop MRV and RL

3 to maintain livelihood of residents low carbon society.

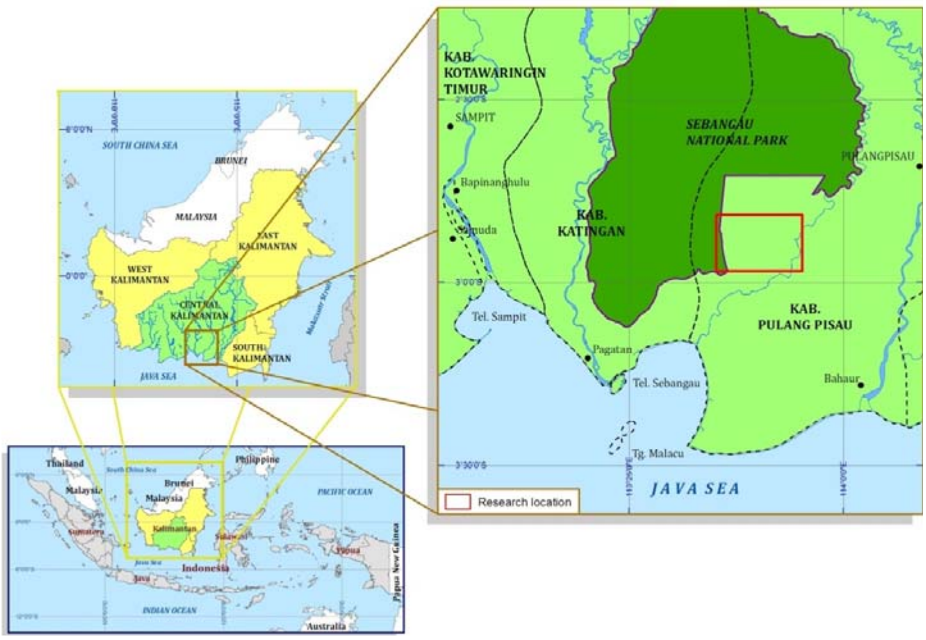
The project started in 2008 by the A-0901 project under Environmental Research and Technology Development Fund of the Ministry of the Environment, Japan and its total period is for four years. The main objective of the paper is to present the results of the project. The paper also highlights some of the issues and challenges to implement REDD plus activities in the project area.

2 Methods

2.1 Description of the project site

The study was carried out in Paduran Mulia Village of Central Kalimantan. The village is located next to Sebangau National Park and covers approximately37,500 ha land that includes about 387 ha residential and agricultural land uses (Figure 1).

Figure 1 Map of the study area (see online version for colours)



Currently the village has 103 households, which was reduced from 550 households initially settled as immigrants from Java in 1991. The livelihoods of the local people are based on agriculture and employment at oil pal, plantations. Peat swamp covers 17.3% of the landscape, which is characterised by acidic organic soil, making land less suitable for agriculture. Therefore, slash and burn has been a common agricultural practice as burning neutralises acidic soil making it more suitable for agriculture. However, majority of people are willing abandon slash and burn practice if they are provided with alternatives such as employment at oil palm estates. Additionally, their livelihood options are constraints by the lack of market system in the village making them unable to generate income from agricultural productions. Oil palm companies have contributed significantly to the local economy by providing employment opportunities to people and building public infrastructures in the village.

The village also suffered from a couple major disasters recently such as a forest fire outbreak in 2009 and a major flood in the summer of 2010, which displaced many residents out of village. Due to such disasters and lack of employment opportunities, villagers have been emigrating to nearby cities to look for a better opportunity. However, the local government has been encouraging people to remain in the village and has promised to increase palm oil plantations to improve their economy.

The forest in the study area consists of two main tree species; *Melaleuca leucadendron* in swampy areas and *Acacia spp* in dry areas. *Melaleuca leucadendron* is native to Central Kalimantan and is one of the fastest growing hardwood species that attains up to 30 m height and can be harvested in ten years rotational cycle. Being capable to grow in acidic soil and peatlands, this species is considered to be a suitable option for the rehabilitation of degraded peatlands and to provide economic opportunities to the local people. This species is currently being used as a fuel wood by the villagers.

2.2 Data collection and analysis

2.2.1 Socio-economic data collection

A social survey was conducted to collect socio-economic data in order to understand the social issues as well as local people's knowledge and interests towards REDD plus implementation Household survey was carried out in Paduran Mulia village in 2011. Twenty-seven households were randomly selected out of existing 103 households. Similarly, a three days long workshop was held in September 2011 to discuss and analyse problems and potential solutions related to socio-economic and forestry issues in the village. Thirty-six participants attended the workshop, which were from diverse background. According to the background and characteristic of the participants, they were categorised into six groups, which are presented in Table 1.

2.2.2 Resources inventory for developing measurement, reporting and verification (MRV) system

Measurement, reporting and verification (MRV) is a system for monitoring changes in forest carbon stocks and reporting those changes transparently and timely and verifying those estimates through an independent entity (Herold and Skutsch, 2009). Setting up a national reference level (RL) is always a challenging task. According to MRV strategy guideline of Indonesia, the national RL will be an aggregate of sub-national RLs. The methods for setting up the RLs and projecting future deforestation will be based on combining spatial remote sensing data with historical deforestation rates at sub-national units. RLs are proposed for two different forest landscapes: forests on mineral soils and peatlands.

Table 1 Characteristics of stakeholders

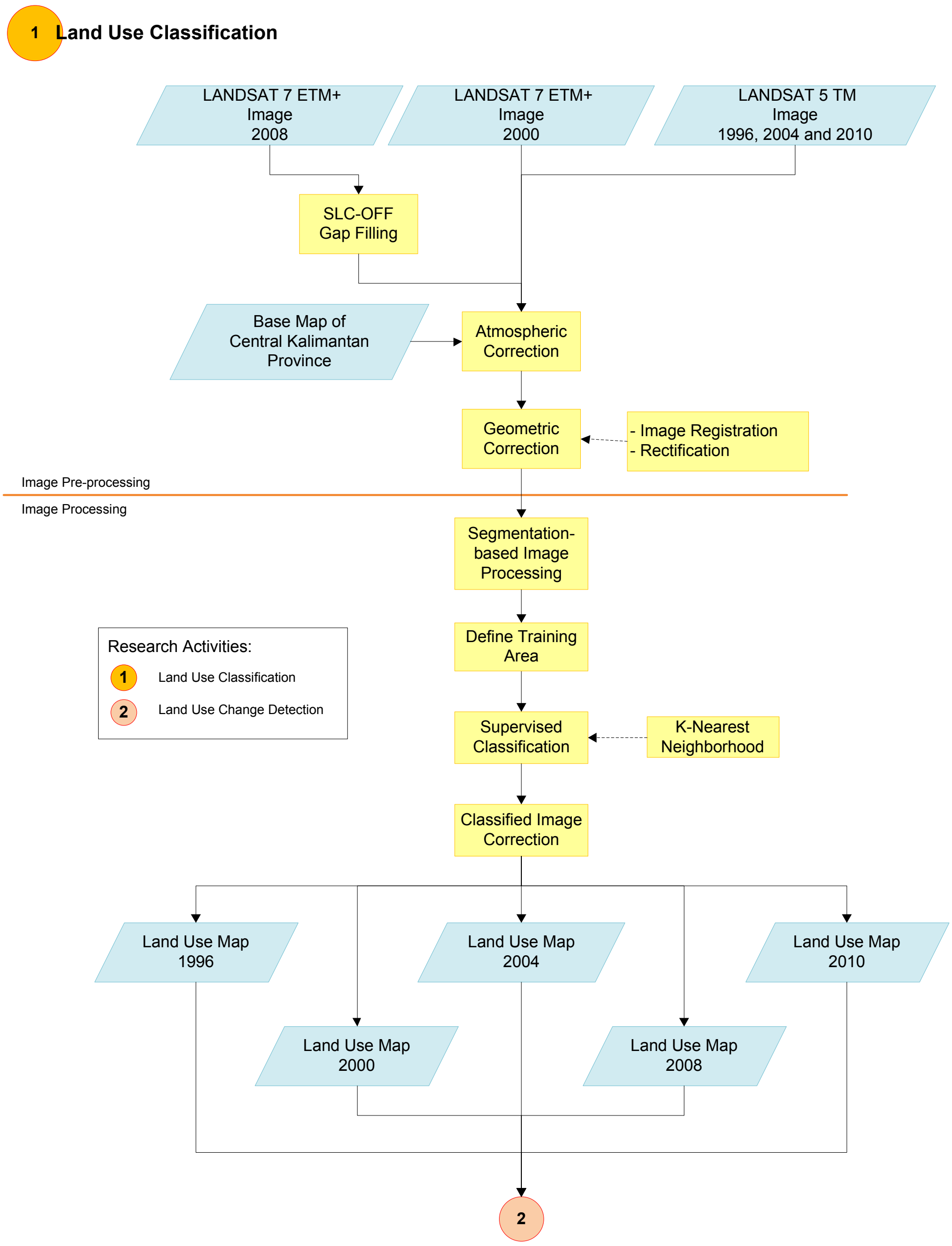
Type of stakeholders	*Participated number*	*Group characteristics and justification for their selection*
Village authority	Six members	They understand village's history on land uses and livelihoods. They are also working on the future development plan of the village.
Fire fighting team	Eight members	They are forest fire fighting team members and are concerned safety of people and agricultural production in the village.
Farmer group	Four members	Their livelihood mostly depend on agriculture and mostly practice agricultural practice in low productive lands.
Large landowners	Six members[1]	They are key land users for slash and burn rice production, cash crops and oil palm plantation.
Outsiders (members outside of the village)	Six members[2]	These people understand the difference of working conditions between inside and outside of the village. They also understand the effects of oil palm plantation.
Mother group	Six members[3]	They were expected to provide views regarding the future development of village thinking the future of their childern.

Notes: 1 = they own land area more than one ha,
2 = three out of six members were experienced in working for oil palm plantation,
3 = three members having children under six-years old and the other having children over seven-years old

We have adopted the methodology VM 0015 of VC (n.d.), to develop methodology for setting RLs, which focuses on methodology for avoided unplanned deforestation. We established RL by using last ten years historical trend of deforestation and forest degradation. The RL boundary was set with the total area of 386,685.74 ha in Paduran Mulia Village, Sebangau Kuala Sub-district, Pulang Pisau District, Central Kalimantan Province. However, VM0015 does not include methodology for peatlands.

Remote sensing techniques were used to estimate above ground biomass. Forests were classified and land use changes were detected by using Landsat TM satellite images from years 1985 to 2008. The land use classes were generated by Landsat images classification. Two kinds of processes were applied in image classification i.e., image pre-processing and image processing (Figure 2). As the changes in the landscape started in early 1990s with the inception of oil palm plantations, the temporal images from years 1985 to 2008 should give clear indication of deforestation to set a carbon emission level in study area. To complement the Landsat images, high quality aerial photos were also used to assess the crown coverage. Similarly, Laser altimetry or light detection and ranging (LiDAR) data was used for stand height estimation. LiDAR is an active remote sensing technology (Wehr and Lohr, 1999) and has been used to estimate individual tree height frequently (Suárez et al., 2005). The field data was then used to develop an allometric equation to estimate overall stand biomass based on crown coverage and stand heights.

Figure 2 Detailed flowchart of land use classification (see online version for colours)



Source: Onda et al. (2013)

Gain and loss method has frequently been recommended to estimate changes in carbon stock from peatland (Murdiyarso et al., 2010). This method requires knowledge of the main carbon inputs (carbon gains after littler fall etc.) and outputs (carbon losses after fire, soil respiration etc.). The balance between gains and losses before and after land use change are compared in order to assess emissions and removals (Verchot et al., 2012).

For an accurate assessment of soil carbon stock changes in peat soil following land use change, measurements are required over the full depth of the peat profile (Verchot et al., 2012). LiDAR technique will be useful for the purpose. A horizontal strip will be dug along the forest up to the depth of peatland. With the support of LiDAR, the changes in the depth of peatland will be monitored once in 10 years to estimate the total carbon stock gain or loss from the study area.

3 Results and discussions

3.1 Major sources of GHG emissions in project area

The study found that the conversion of primary peat forests into other land use practice was the primary source of GHG emissions from deforestation and forest degradation. The conversion of primary forests has led to drying of swamp lands causing higher decomposition of organic matters and thereby higher emission of CO_2. Beside land conversion, slash and burn is another important source of GHG, which has been a common agricultural practice as burning neutralises acidic soil-making it more suitable for agriculture. Such practice has also increased frequency and intensity of forest fire. Forest encroachment for agriculture land expansion is also a major driver of deforestation and forest degradation in the project area.

3.2 REDD plus activities for emission reductions

The study identified potential REDD plus activities to control the conversion of primary peat forests into other land use practices. In order to control forest conversion, alternative options to the economic incentives derived from oil palm plantation development need to be developed to motivate local villagers to participate actively in REDD plus mechanism. For the purpose, the project devised and implemented the following REDD plus activities (Figure 3).

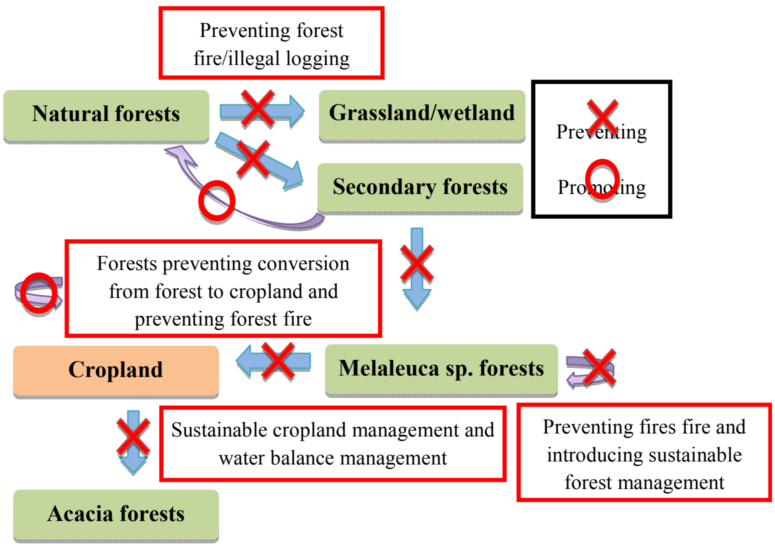
1. Discourage slash and burn agricultural practice: project emphasised to discourage the current slash and burn practice to avoid forest fires and to reduce the degradation of peatlands. We encouraged promoting the plantation of *Melaleuca leucadendron* in peatland areas to preserve and restore them and to prevent invasions from *Acacia spp* that contributes to drying of peatlands.
2. Provision of incentives for REDD plus activities: as an incentive to replace the development of oil palm plantations, *Melaleuca leucadendron* has been considered as an alternative option, which is widely available in the study area. However, additional efforts are deemed necessary to explore the timber market for this species so as to provide enough and continuous incentives to the villagers. Similarly, income from anticipated carbon trade from REDD plus activities would also be another major incentive for the villagers.
3. Establishment of fire fighting teams: to stop the unplanned emissions from forest fires, project established fire fighting teams and provided necessary training and required equipment.

4 Discourage expansion of farmland: as the expansion of farmland in the study area is primarily based on conversion of primary forests, the control of such practice is vital. Introduction of scientific agricultural practice to increase productivity from existing fallows and provision of alternative options for income are important to avoid further agricultural expansion. Again, cultivation, management and marketing of *Melaleuca leucadendron* would be an option.

5 Discourage the expansion of *Acacia* forest: acacia species tends to dry existing swampy lands causing large CO_2 emission from heterotrophic respiration as compared to oil-palm plantations (Murdiyarso et al., 2010). Therefore, we recommend discouraging conversion of waste land or primary forests to *Acacia* spp. plantation.

6 Capacity building: several training and capacity building activities will be carried out to build local capacity on forest management techniques, improved crop management techniques, forest fire control and various income generating activities. The project has already built local capacity on forest fire management and will discuss with stakeholders to design and implement activities to enhance alternative livelihood options for the local communities.

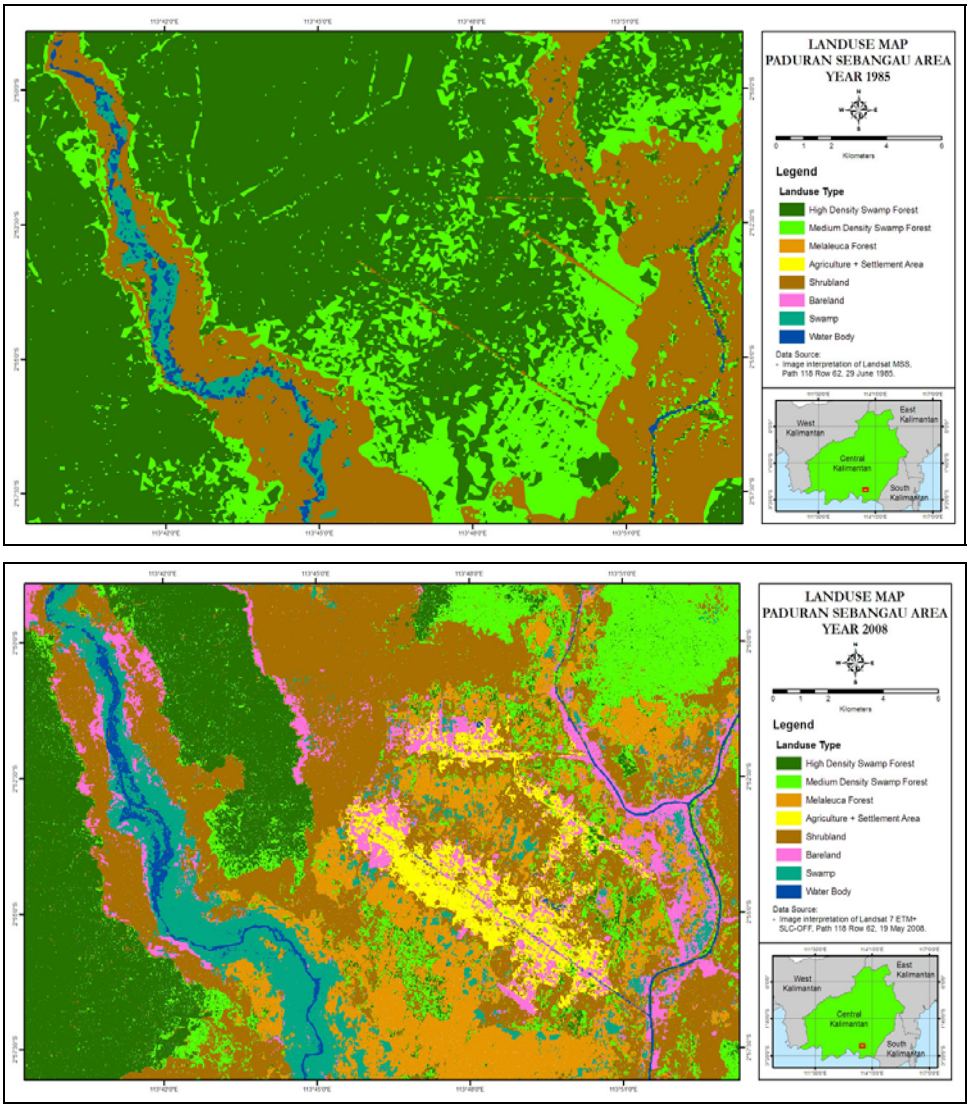
Figure 3 Proposed REDD plus activities in the study area (see online version for colours)



3.3 Establishment of RLs

For the purpose of carbon estimation, we considered project starting year 2008 a base year, as this is the year when National Working Group on REDD+ was started in Indonesia. According to VM 0015 (Section 1.2.3) we considered baseline periods to be ten years to establish RLs. As aforementioned, deforestation rate was very high during years from 1997 to 2000, which would overestimate the reference scenario, had we considered years before 2000. Therefore, we used land use changes from years 2000 to 2010 for the purpose as deforestation rate was already decreasing and would provide most realistic scenario for the future projection.

Figure 4 Classified Landsat images of year 1985 and 2008 showing land use changes in the study area (see online version for colours)



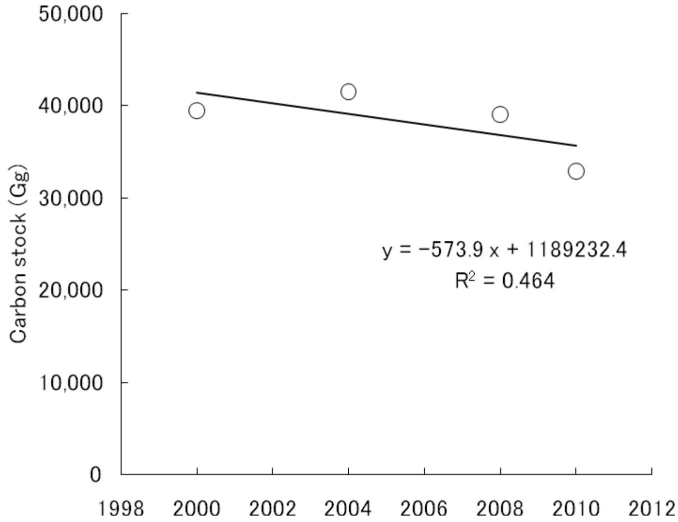
Note: The images indicate the significant changes in land use in the study area

Table 2 Land use changes from year 1985 to 2010 in the study area

ID	*Landuse type*	*Area (Ha)*						
		1985	*2000*	*2004*	*2008*	*2010*	*+/–*	*% of change (2000–2010)*
1	High density swamp forest	24,105.64	9,681.75	10,055.05	8,992.05	8,425.06	(1,256.69)	–12.98%
2	Medium density swamp forest	8,510.66	5,033.78	5,429.92	5,212.54	3,861.57	(1,172.21)	–23.29%
3	Melaleuca forest	N/A	5,631.44	5,976.27	6,553.71	4,408.33	(1,223.11)	–21.72%
4	Agriculture + settlement	N/A	2,165.00	2,365.87	1,969.29	4,100.76	1,935.76	89.41%
5	Shrubland	10,238.29	18,505.47	17,795.70	13,974.55	14,966.79	(3,538.67)	–19.12%
6	Bareand	N/A	1,755.29	1,490.70	3,059.83	1,832.80	77.52	4.42%
7	Swamp	785.39	599.18	258.38	3,609.94	5,776.58	5,177.41	864.09%
8	Waterbody	499.69	767.78	767.78	767.78	767.78	-	0.00%
Total (Ha)			44,139.68	44,139.68	44,139.68	44,139.68		

Remote sensing data classification showed that the areas under secondary forests are decreasing due to conversion into cropland (Figure 4). The values in Table 2 indicated both high and medium density swampy forests were decreased by 13 and 23.3% respectively from years 2000 to 2010. Similarly, *Melaleuca* forest and shrub land were also decreased approximately by 20%. However, the area under agriculture, settlement and swampy lands were increased significantly over the same period. Overall, average annual emissions from secondary and *Melaleuca* forests were 93.6 Mg-C/ha and 67.1 Mg-C/ha respectively. Similarly, the emissions from peat soils were 250 Mg-C/ha in secondary forest and 100 Mg-C/ha in *Melaleuca* forest (MURC, 2011). The higher emissions from peat soils under secondary forest has been attributed to the higher thickness, carbon contents and bulk density of peat soils under secondary forest compared to other type of forests. The thickness of peat soils varies from 40 cm to 590 cm in the region (Wahyunto et al., 2010). In central Kalimantan, more than 50% of 3 million hectares covered by peat soils have peat thickness more than 200 cm (Wahyunto et al., 2010).

Figure 5 Equation for RL based on land use changes from year 2000 to 2010



Note: The figure shows the trend of CO_2 without REDD+ scenarios

Source: MURC (2011)

Based on the changes in land uses and forest biomass from years 2000 to 2010, we calculated allometric equation (Figure 5) and projected the reference scenario until year 2030. The projection indicates that the total GHG emission reduction with REDD plus scenario would be approximately 9,000 Gg CO_2 for next 20 years with mean reduction about 450 Gg CO_2/year (Figure 5). The baseline scenario is based on the assumptions that in the absence of a REDD project, the current practices of conversion of primary forests into other land uses and slash and burn will continue, as they are the main sources of the livelihoods in the study area, contributing to degradation of peat soils and frequent forest fires. The project scenario has assumed that the proposed seven REDD activities outlined in previous section and in Figure 3, will significantly reduce the conversion of primary forests to other land uses and will discourage local communities practicing slash and burn by providing alternative livelihood options for local communities and building their capacity on forest management activities.

3.4 Addressing issues and challenges

Addressing socio-economic issues are essential for the effective implementation of REDD plus. The study found that the major income sources of people are agriculture and employment in oil palm plantation. However, due to recent disasters such as forest fire and floods in the area, many villagers are immigrating to the nearby cities in order to look for better employment opportunities, which has caused significant population decline in the village. The study also found that more than 50% were not happy with the current living condition, especially due to lack of economic opportunity in the area.

The opportunity cost of working with oil palm estate for the villagers is about $200 per month, which is much higher than expected income from marketing of *Melaleuca leucadendron* as there is no established market for this species yet. This would discourage villagers to participate in REDD plus activities. Similar situation applies to rest of the country as well. Oil palm plantation could generate between US$3,835–US$9,630 per ha whereas the same area would generate between US$614 – US$994 in carbon credits (Butler et al., 2009; Pacheco et al., 2012). Similarly, the local government may not want to lose its potential revenues and investments by industries that may bring by land conversion.

Similarly, as REDD plus activities aim to control water drainage from existing peatlands, it may increase the possibility of floods in the area and may significantly affect the local residents. The most importantly, the major challenge would be to set up a clear and transparent mechanism for benefit sharing among different stakeholders in the region, which would ultimately affect local people's interests on REDD plus activities.

The study also found that the phase I activities of REDD plus, which mainly focused on strengthening local capacities, benefited to local authorities and institutions only. However, local villagers should be the focus of such activities not only to motivate them for their active participation in REDD plus activities but also to strengthen their capacity to manage forest resources and enable them to generate income from alternative options.

In order to explore the potential solutions for aforementioned problems and to understand the motivation factors for local villagers to participate and support REDD plus activities, the project conducted a project planning workshop. Although the workshop suggested various strategies including alternative income sources and community development activities, it completely ignored the role of local communities in forest management including ownership and right over resources. This may ultimately lead to less participation and support from local people in forest management in the long run.

4 Conclusions

Central Kalimantan has been selected as a pilot province for the implementation of REDD plus activities. The province occupies three-quarters of lowland area with about 60% peatlands and has the highest deforestation rate among the Kalimantan provinces. The major drivers of deforestation and forest degradation in the Province were the conversion of primary forests into other land uses such as oil palm and agricultural lands.

The project devised and implemented several REDD plus activities to combat deforestation, discourage oil palm plantation and provide incentives to the local people.

We used VCS, VM 0015 methodology to develop MRV system. We found that the total emission reduction in biomass with REDD plus scenario would approximately 9,000 Gg CO_2 in the next 20 years.

However, there are several inherent challenges and difficulties to implement REDD plus in the region. The opportunity cost of developing peatlands to oil palm is much higher, which is the major source of local income. Strategies are needed to create alternative income opportunities for the local villagers to minimise differences with opportunity cost arise from oil palm plantation. A thorough study on value chain development of *Melaleuca leucadendron* is required to explore market opportunities from this species. In addition, other income generating activities need to be explored in the study area as a part of REDD plus activities. Similarly, construction of dam and improvements of water channels are required to prevent floods, which would also serve as a transportation channel for lumbers in the future. Finally, REDD plus policy development process should involve all the stakeholder through and should develop clear and equitable benefit sharing mechanism agreed by all the stakeholders.

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