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APPLIED WORK

# Ex-ante GHG Appraisal of Forest Management Units (FMU) as main policy implementing tool in Indonesia (2015-2035)

## Targeting Climate Change Mitigation as main co-benefit in Forestry policies with the EX-Ante Carbon Balance Tool (EX-ACT)

**About EX-ACT:** The *Ex Ante* Appraisal Carbon-balance Tool aims at providing *ex-ante* estimations of the impact of agriculture and forestry development projects on GHG emissions and carbon sequestration, indicating its effects on the carbon balance.

See EX-ACT website: ***www.fao.org/tc/exact***

### Related resources

- EX-ANTE Carbon-Balance Tool (EX-ACT): (i) User Guidelines; (ii) Tool; (iii) Flyer
- See all EX-ACT resources in EASYPol under the Resource package, Investment Planning for Rural Development, EX-Ante Carbon-Balance Appraisal of Investment Projects

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# Ex-ante GHG Appraisal of Forest Management Units (FMU) as main policy implementing tool in Indonesia (2015-2035)

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# Table of Abbreviations

| | |
|---|---|
| AFOLU | Agriculture, Forestry and Other Land Use |
| CC | Climate Change |
| CEA | Country Environment Analysis |
| CDM | Clean Development Mechanism |
| $CH_4$ | Methane |
| $CO_2$ | Carbon Dioxide |
| DM | Dry Matter |
| EX-ACT | EX-Ante Carbon-balance Tool |
| FAO | Food and Agriculture Organisation of the United Nations |
| FIP | Forest Investment Programme |
| FMU | Forest Management Unit (KPH) |
| ELMRL | Environment Land Management and Rehabilitation of Livelihood Project |
| GHG | Greenhouse Gas |
| GWP | Global Warming Potential |
| HAC | High Activity Clay |
| IPCC | Intergovernmental Panel on Climate Change |
| LAC | Low Activity Clay |
| MOEF | Ministry of Environment and Forestry |
| MRV | Monitoring, Reporting and Verification |
| Mt | Million metric tonnes |
| NPV | Net Present Value |
| SVC | Social Value of Carbon |
| Mt | Million metric tonnes |
| $N_2O$ | Nitrous Oxide |
| PIU | Project Implementation Unit |
| PPLMP | Pasture and Livestock Management plans (PPLMP) |
| $tCO_2$-e | Tonnes of $CO_2$ equivalents |
| UNFCCC | United Nations Framework Convention on Climate Change |

# 1. Background

## 1.1 Study Framework: Forest Investment Programme support to Ministry of Environment and Forestry

This report is prepared to provide an ex-ante carbon balance appraisal of a set of selected Forest Management Units (FMU) considered within the target of FIP programme. The FMU are at the heart of Forest Management Mechanism.. The present work was targeted on a selection of advanced FMUs to be appraised in term of carbon-balance (2015-2035) in order to (i) test the relevance of the tool in such process, (ii) to provide to MOEF an appropriate appraisal tool whose use will be upscaled to all FMUs created (final target 600 FMUs) and (iii) to provide a basis GHG carbon balance for analysing the FIP. This appraisal also provides GHG impact of scenarios of upscaling and economic analysis of environment impact linked with GHG and other parts of Natural Capital

## 1.2 Current situation of Forestry in Indonesia

Indonesia holds the third-largest area of tropical forest after Brazil and the Democratic Republic of the Congo, with an estimated 94 million hectares of natural and planted forests, and is home to a rich store of biodiversity. Forests represent approximately 52% of Indonesia total land area.

Many of Indonesia's communities have longstanding, direct and multi-faceted relations with natural ecosystems (including cultural, social, political, and spiritual), beyond the economic importance of forests for subsistence, livelihood and economic development. By 2013, nearly 55 percent of the population remained dependent on land for their subsistence. There are about 32,000 villages within and surrounding the forest boundaries nationally. Approximately 50-60 million people dwell in state forest lands. On average, 20 percent of household income depends on natural resources.

Tropical rainforests provide a wide range of ecosystem services. Ecosystem goods and services are the benefits that humans derive, directly or indirectly, from ecosystem functions. Ecosystem services of tropical rainforests include climate regulation, water supply and regulation, maintenance of biodiversity, carbon storage, pollination and cultural values, among others (AEM, 2005). The loss of these ecosystem services due to deforestation and forest degradation is of global concern and of particular importance to rural populations that rely on natural resources for their livelihoods

## 1.3 Forestry in Indonesia as main GHG emission

Deforestation and forest degradation are expected to increase in Indonesia. The Food and Agriculture Organization (FAO) in 2010 estimated that Indonesia's forest cover was reduced by some 24.1 million hectares between 1990 and 2010 (from 118.5 million ha in 1990 to 94.4 million ha in 2010). About 77% of this area was primary tropical forest, the most biologically diverse and carbon-dense forest type. The expectation is that illegal logging will increase. 60 percent of such illegal logging is expected to occur in production forest areas.

Reducing deforestation in Indonesia can contribute to climate change mitigation at a globally significant scale. Estimates of annual greenhouse gas emissions from deforestation in Indonesia and the associated degradation of peat soils ranged from 0.32 to 1.91 GtCO2e during 2000–2010) relative to a global total of 40–49 GtCO2e from 2000 to 2010. Deforestation in Indonesia is largely driven by the expansion of profitable and legally sanctioned oil palm and timber plantations and logging operations. National and provincial governments zone areas of forest land to be logged or converted to plantation agriculture, and then district governments issue licenses to

individual companies for these purposes ("concessions"). Substantial deforestation occurs outside of legally sanctioned concession areas as well (Buscha, Ferretti-Gallona, & Engelmann, 2014)

## 1.4 Forest policies and Forest Management Units (KPH) as a main tool

The Indonesian forest and land-use sector represents a significant source of global greenhouse gas (GHG) emissions, a function of having one of the world's largest forest estates, coupled with high rates of deforestation, forest degradation and large areas of degraded peatlands. As such, the Government of Indonesia (GOI) has committed to reducing GHG emissions by up to 26% below 'business as usual' levels by 2020, and by up to 41% if international assistance is forthcoming. Up to 80% of these proposed reductions will be gained from changes to forest andpeatland management. Indonesian efforts are expected to be enhanced through access to international finance that will support policy, planning and on-site activities to reduce emissions from deforestation and forest degradation, and the role of conservation, sustainable management of forests and enhancement of forest carbon stocks, commonly known as REDD+ (Krisnawati, 2015).

The National Action Plan on Greenhouse Gases (GHGs), the National REDD+ Strategy, the Forest Management Unit (KPH) program and recent tenure reforms introduce far reaching programs that represent a potential transformation toward a forestry sector that is compatible with sustainable growth and equity. Progress in planning at the national level now needs to be translated to actions in the forest; however, a number of barriers to implementation at the local level remain. In this line, to reduce greenhouse gas emissions from deforestation, Indonesia instituted a nationwide moratorium on new license areas ("concessions") for oil palm plantations, timber plantations, and logging activity on primary forests and peat lands after May 2011.

In 2007, the urgency to strengthen the management of state forest areas resulted in the drafting of government regulations19 that prioritized KPHs and the safeguarding of the public function of forest areas. Legislation passed in 2007 resulted in the overlaying of 600 nominal KPHs over the whole forest estate. The plan is to have KPHs manage forests for their functional purpose (i.e., production, protection and conservation) while contributing to subnational growth and community wellbeing. There are 530 KPHs are primarily concerned with forest production and protection, with the remaining 70 are primarily concerned with conservation.

National Government and local government envision KPHs being the "owners" of forest resources pursuant to the mandate under the Law, whereby forest is controlled by the state and must be managed sustainably. The KPH undertakes day-to-day forest management, including supervising the permit holder's performance in forest management. KPHs play the role of forest management organizer at the site level and must ensure that forest management is in line with the forest's function and undertaken in a sustainable manner.

## 1.5 The Forest Investment Programme

The development objective of the Investment Plan is to reduce barriers to sub-national REDD+ implementation and to increase provincial and local capacity for REDD+ andsustainable forest management (SFM). Key entry points for the Investment Plan to addresssub-national barriers will be the national KPH system and ongoing tenure reform processes. Activities will focus on the following three inter-related themes:

• Institutional development for sustainable forest and natural resource management
• Investments in forest enterprises and community based forest management
• Community capacity building and livelihoods development

Institutional strengthening will be aimed at community-focused investments to enhance the enabling conditions for sustainable land use and REDD+ project implementation. Activities will support KPHs and other subnational institutions in improving local conditions for REDD+ implementation, in particular in relation to participatory planning, spatial planning, and community outreach and related management and business plan development.

Motivated forest enterprises will be selected from both forested and deforested regions, and where forest product demand remains high. Interventions with enterprises in communities adjacent to natural forests are intended to reduce degradation and associated emissions, while those in non-forested areas will enhance carbon stocks through planted forests. Interventions can address the need to develop viable forestry business models

Anticipated upstream interventions include: (i) community-based forest management enterprises and payments PES on degraded forest and grassland; (ii) plantation management on degraded forest and grassland; (iii) production forestry and sustainable forest management on natural forest; and (iv) ecosystem restoration and sustainable forest management. Interventions will also involve downstream forestry and enterprises in other related sectors linked to deforestation.

The program will support land use planning efforts at village level in selected communities, preferably in and around areas of priority KPHs. Micro spatial plans or land use plans will be integrated into community development plans as integrated spatial, development and livelihood plans. Support will also be provided to community livelihoods development and natural resource management, including activities implemented by the communities in priority areas targeting sustainable livelihood development, NTFP, forest management, fishery, and other sustainable economic activities in line with land-use plans. The investments will directly benefit communities, improve sustainable income, and reduce economic and subsistence pressures that drive some current activities.

The FIP Investment Plan and the National REDD+ Strategy are closely aligned. The Investment Plan will support the development of model KPHs that develop forest management plans that include bankable projects. Specific opportunities for such projects will be identified during project development. Functioning KPHs will support the implementation of national programs at the local level, including the REDD+ Strategy.

# 2. Methodology and tools used

## 2.1 EX-ACT tool

The Ex-Ante Carbon-balance Tool (EX-ACT) is an appraisal system developed by FAO providing ex-ante estimates of the impact of agriculture and forestry development projects, programmes and policies on the carbon-balance. The carbon-balance is defined as the net balance from all GHGs expressed in $CO_2$ equivalents that were emitted or sequestered due to project implementation as compared to a business-as-usual scenario.

EX-ACT is a land-based accounting system, estimating C stock changes (i.e. emissions or sinks of $CO_2$) as well as GHG emissions per unit of land, expressed in equivalent tonnes of $CO_2$ per hectare and year. The tool helps project designers to estimate and prioritize project activities with high benefits in economic and climate change mitigation terms. The amount of

GHG mitigation may also be used as part of economic analysis as well as for the application for funding additional project components.

EX-ACT has been developed using mostly the IPCC 2006 Guidelines for National Greenhouse Gas Inventories (IPCC, 2006) that furnishes EX-ACT with recognized default values for emission factors and carbon values, the so called Tier 1 level of precision. Besides, EX-ACT is based upon chapter 8 of the Fourth Assessment Report from working group III of the IPCC (Smith, et al., 2007) for specific mitigation options not covered in NGGI-IPCC-2006. Other required coefficients are from published reviews or international databases. For instance embodied GHG emissions for farm operations, transportation of inputs, and irrigation systems implementation come from Lal (Lal, 2004) and electricity emission factors are based on data from the International Energy Agency (IEA, 2013)

The EX-ACT appraisal process is interactive as well as participatory, and can strengthen the overall project design process, especially when a training and workshop element (for project teams, government counterparts, and other stakeholders) is integrated as part of the process. It may facilitate the discussion on ways to create incentives and institutional conditions that can promote their uptake (such as payments for environmental services).

### 2.2 Link with Policy support : strengthening KPH level planning

Positioning the Carbon balance appraisal at the level of KPH does allow to compare KPH level investment options, to simulate action scenarios, to move towards carbon and environment monitoring at KPH level . It is driving to a typology of KPH with different ranges of forest degradation and different strategies of forest rehabilitation and management of agriculture and plantation land.

Within landscape management approach, it could also help to integrate possibilities of pro-poor mitigation actions at decentralized level as Payment of Environment services for forest communities or support upgrading of Forest Non Wood Products value chains and micro entreprises.

## 3. Data used for the EX-ACT appraisal

While agricultural development projects usually implement a large set of complementary field actions, not necessary all project activities have impacts on GHG emissions and carbon sequestration. This section concisely summarizes the project activities that were considered for analysis by EX-ACT and also lists the taken assumptions on agro-ecological variables.

Ex-ante assessments are in parts necessarily based on assumptions and have to manage existing information gaps. The amount of missing information thereby decreases throughout the process of project design, while selected data can only adequately be collected as part of project monitoring and evaluation activities

### 3.1 Agro-ecological variables

The project area is characterized by a warm tropical climate with a wet moisture regime (over 2000 mm). The dominant soil type was specified as High Activity Clay Soils. Thereby the FMU plans will be implemented about a period of 10 years, EX-ACT will account in addition for a 10 year period of capitalization, which is needed in order to capture the full impact of introduced changes in land use and management of soil and biomass carbon stocks.

### 3.2 Data on deforestation, forest degradation and afforestation

The MOEF provided a geo-satellite derived information on deforested areas with differentiated land use after deforestation and on evolution of forest degradation for every FMU on the period 2000-2012. The table below does show the degree of detail of information provided by MOEF per KPH. It first provides the different kinds of forest type in the KPH and the evolution of these forests between 2000 and 2012 (col 3 and 4). There is then a distribution of areas in 4 categories , forest areas with no change (col 5), forest areas subject to deforestation (6) with use of such lands after deforestation, forest subject to degradation and total.

| KPH | Forest Type | Land Cover 2000 | Land Cover 2012 | No Change | Deforestation | Degradation | Plantation Forest | Grand Total | Planning Afforestation |
|---|---|---|---|---|---|---|---|---|---|
| KPH Boalemo | Primary Forest | Primary Land Forest | Primary Land Forest | 12,292 | | | | 12,292 | |
| | | | Secondary Land Forest | | | 6,713 | | 6,713 | |
| | | Primary Mangrove Forest | Primary Mangrove Forest | 236 | | | | 236 | |
| | | | Secondary Mangrove Forest | | | 538 | | 538 | |
| | Secondary Forest | Secondary Land Forest | Secondary Land Forest | 57,193 | | | | 57,193 | |
| | | | Grass | | 3,550 | | | 3,550 | 12,899 |
| | | | Settelment | | 8 | | | 8 | |
| | | | Bareland | | 3 | | | 3 | |
| | | | Dry land agriculture | | 194 | | | 194 | |
| | | | Dry land agriculture mix grass | | 1,763 | | | 1,763 | |
| | | Secondary Mangrove Forest | Secondary Mangrove Forest | 565 | | | | 565 | |
| | | | Dry land agriculture | | 2 | | | 2 | |
| | | | Fishpond | | 2 | | | 2 | |
| KPH Boalemo I Total | | | | 70,288 | 5,522 | 7,251 | | 83,061 | |

Data on planned afforestation per FMU were also available although they were considered as not yet confirmed (status of funding not cleared). Such data allowed at building a baseline scenario for next 10 years based on past trend (2000-2012) of forest degradation and deforestation. First impact of KPH is considered to be to stop forest degradation and deforestation (first scenario)

The potential of slight process of upgrading in protected forest areas was also considered in a scenario of the analysis (second scenario). Tier 2 information per type of forest was easily found in different publications referring to Indonesian Forest (see bibliography)

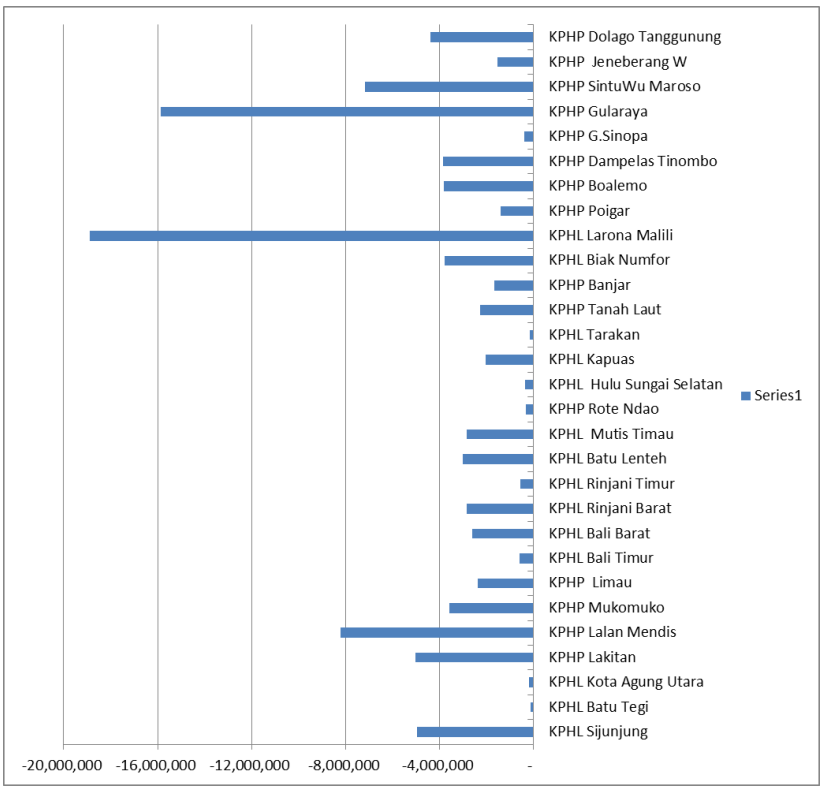
## 4. EX-ACT appraisal results

### 4.1 Comparing results per KPHL with MOEF scenario 1

Assumptions include: inclusion of unchanged forest areas, no assumption of protection-linked improvement on unchanged forest areas, 100% of deforestation stopped, 100% of degradation process stopped.

Such scenario was appraise on a set of 10 KPH and rediscussed with MOEF. Finally the scenario was applied on the 29 KPH considered as possibly supported by FIP Programme. The whole aggregated results for this scenario is a carbon balance of 82.6 Million TCO2 mitigated between 2015 and 2035, with an average of 40 TCo2 per ha. Such a result is equivalent to 2 TCo2/ ha / year of mitigation impact. It seems low since all unchanged forest areas have been considered in the computation.

| No | Regional | Nama KPH | Propinsi/ Kabupaten | Bentuk Organisasi | Total Ha | Carbon Balance Total CB 000 Tco2 | Scenario 1 CB /ha $TCO_2$/ha |
|---|---|---|---|---|---|---|---|
| 1 | I | KPHL Sijunjung | Kabupaten Sijunjung (Sumbar) | UPTD | 85,708 | - 4,275,064 | - 50 |
| 2 | I | KPHL Batu Tegi | Propinsi Lampung | UPTD | 9,316 | - 38,740 | - 4 |
| 3 | I | KPHL Kota Agung Utara | Kabupaten Tanggamus (Lampung) | SKPD | 7,101 | - 116,488 | - 16 |
| 4 | I | KPHP Lakitan | Kabupaten Musi Rawas (Sumsel) | UPTD | 75,177 | - 5,036,826 | - 67 |
| 5 | I | KPHP Lalan Mendis | Kabupaten Musi Banyuasin (Sumsel) | SKPD | 128,192 | - 7,355,266 | - 57 |
| 6 | I | KPHP Mukomuko | Propinsi Bengkulu | SKPD | 55,013 | - 3,084,385 | - 56 |
| 7 | I | KPHP Limau | Kabupaten Sarolangun (Jambi) | UPTD | 98,507 | - 611,284 | - 6 |
| 8 | II | KPHL Bali Timur | Provinsi Bali | UPTD | 8,253 | - 511,884 | - 62 |
| 9 | II | KPHL Bali Barat | Propinsi Bali | UPTD | 54,939 | - 1,559,216 | - 28 |
| 10 | II | KPHL Rinjani Barat | Provinsi NTB | UPTD | 34,726 | - 2,812,807 | - 81 |
| 11 | II | KPHL Rinjani Timur | Kabupaten Lombok Timur (NTB) | UPTD | 27,326 | - 113,459 | - 4 |
| 12 | II | KPHL Batu Lenteh | Kabupaten Sumbawa (NTB) | SKPD | 75,177 | - 2,775,700 | - 134 |
| 13 | II | KPHL Mutis Timau | Provinsi NTT | SKPD | 98,409 | - 1,946,687 | - 20 |
| 14 | II | KPHP Rote Ndao | Kabupaten Rote Ndao (NTT) | SKPD | 13,833 | - 153,166 | - 11 |
| 15 | III | KPHL Hulu Sungai Selatan | Kabupaten HSS Kalsel | UPTD | 5,968 | - 285,198 | - 48 |
| 16 | III | KPHL Kapuas | Kabupaten Kapuas (Kalteng) | UPTD | 76,496 | - 1,376,933 | - 18 |
| 17 | III | KPHL Tarakan | KotaTarakan (Kaltim) | UPTD | 5,293 | - 103,954 | - 20 |
| 18 | III | KPHP Tanah Laut | Kabupaten Tanah Laut (Kalsel) | UPTD | 38,275 | - 1,952,006 | - 51 |
| 19 | III | KPHP Banjar | Kabupaten Banjar (Kalsel) | UPTD | 50,269 | - 1,267,641 | - 25 |
| 20 | IV | KPHL Biak Numfor | Kabupaten Biak (Papua) | SKPD | 162,276 | - 1,298,209 | - 8 |
| 21 | IV | KPHL Larona Malili | Kabupaten Lutim (Sulsel) | SKPD | 192,699 | - 17,143,936 | - 89 |
| 22 | IV | KPHP Poigar | Provinsi Sulawesi Utara | UPTD | 24,513 | - 1,097,734 | - 45 |
| 23 | IV | KPHP Boalemo | Kabupaten Boalemo (Gorontalo) | UPTD | 80,125 | - 3,036,423 | - 38 |
| 24 | IV | KPHP Dampelas Tinombo | Provinsi Sulawesi Tengah | UPTD | 95,196 | - 2,166,334 | - 23 |
| 25 | IV | KPHP G.Sinopa | Provinsi Maluku Utara | UPTD | 36,648 | - 70,141 | - 2 |
| 26 | IV | KPHP Gularaya | Provinsi Sulawesi Tenggara | UPTD | 72,354 | - 13,723,122 | - 190 |
| 27 | IV | KPHP SintuWu Maroso | Kab. Poso (Sulteng) | SKPD | 130,396 | - 5,203,760 | - 40 |
| 28 | IV | KPHP Jeneberang W | Propinsi Sulsel | UPTD | 41,916 | - 1,098,400 | - 26 |
| 29 | IV | KPHP Dolago Tanggunung | Propinsi Sulteng | UPTD | 116,435 | - 2,356,635 | - 20 |
| | | | | | **1,900,533** | **- 82,571,397** | **- 43** |




The results per KPH allows comparative analysis of performance and a possibility of selection of KPH with highest Carbon balance. Only 11 KPH on 29 have GHG balance over 2 million Tco2

However this scenario which does only consider stopping deforestation and degradation, seems incomplete. Effective forest protection should allow to progressively rehabilitate some forest, improving therefore the Above and below ground biomass of such forest. This second impact was considered in the second scenario described below.

## 4.2 Aggregated KPHL results on scenario 2

In this new scenario, assumptions include: inclusion of unchanged forest areas, no assumption of protection-linked improvement on unchanged forest areas, stopped deforestation at start, 100% of degradation process stopped, Forest protection allows unaffected forest areas to reduce their level of degradation from 20% to 18% . The last assumption is still very conservative.

| No | Regional | Nama KPH | Propinsi/ Kabupaten | Bentuk Organisasi | Total Ha | Carbon Balance Scenario 2 Total CB 000 $TCO_2$ | CB /ha $TCO_2$/ha |
|---|---|---|---|---|---|---|---|
| 1 | I | KPHL Sijunjung | Kabupaten Sijunjung (Sumbar) | UPTD | 85,708 | - 4,953,415 | - 58 |
| 2 | I | KPHL Batu Tegi | Propinsi Lampung | UPTD | 9,316 | - 117,975 | - 13 |
| 3 | I | KPHL Kota Agung Utara | Kabupaten Tanggamus (Lampung) | SKPD | 7,101 | - 177,104 | - 25 |
| 4 | I | KPHP Lakitan | Kabupaten Musi Rawas (Sumsel) | UPTD | 75,177 | - 5,036,826 | - 67 |
| 5 | I | KPHP Lalan Mendis | Kabupaten Musi Banyuasin (Sumsel) | SKPD | 128,192 | - 8,210,390 | - 64 |
| 6 | I | KPHP Mukomuko | Propinsi Bengkulu | SKPD | 55,013 | - 3,587,251 | - 65 |
| 7 | I | KPHP Limau | Kabupaten Sarolangun (Jambi) | UPTD | 98,507 | - 2,367,452 | - 24 |
| 8 | II | KPHL Bali Timur | Provinsi Bali | UPTD | 8,253 | - 590,896 | - 72 |
| 9 | II | KPHL Bali Barat | Propinsi Bali | UPTD | 54,939 | - 2,610,267 | - 48 |
| 10 | II | KPHL Rinjani Barat | Provinsi NTB | UPTD | 34,726 | - 2,851,003 | - 82 |
| 11 | II | KPHL Rinjani Timur | Kabupaten Lombok Timur (NTB) | UPTD | 27,326 | - 559,206 | - 20 |
| 12 | II | KPHL Batu Lenteh | Kabupaten Sumbawa (NTB) | SKPD | 75,177 | - 2,990,587 | - 144 |
| 13 | II | KPHL Mutis Timau | Provinsi NTT | SKPD | 98,409 | - 2,847,692 | - 29 |
| 14 | II | KPHP Rote Ndao | Kabupaten Rote Ndao (NTT) | SKPD | 13,833 | - 322,493 | - 23 |
| 15 | III | KPHL Hulu Sungai Selatan | Kabupaten HSS Kalsel | UPTD | 5,968 | - 349,642 | - 59 |
| 16 | III | KPHL Kapuas | Kabupaten Kapuas (Kalteng) | UPTD | 76,496 | - 2,036,635 | - 27 |
| 17 | III | KPHL Tarakan | KotaTarakan (Kaltim) | UPTD | 5,293 | - 145,006 | - 27 |
| 18 | III | KPHP Tanah Laut | Kabupaten Tanah Laut (Kalsel) | UPTD | 38,275 | - 2,282,296 | - 60 |
| 19 | III | KPHP Banjar | Kabupaten Banjar (Kalsel) | UPTD | 50,269 | - 1,657,766 | - 33 |
| 20 | IV | KPHL Biak Numfor | Kabupaten Biak (Papua) | SKPD | 162,276 | - 3,786,488 | - 24 |
| 21 | IV | KPHL Larona Malili | Kabupaten Lutim (Sulsel) | SKPD | 192,699 | - 18,877,440 | - 98 |
| 22 | IV | KPHP Poigar | Provinsi Sulawesi Utara | UPTD | 24,513 | - 1,387,610 | - 57 |
| 23 | IV | KPHP Boalemo | Kabupaten Boalemo (Gorontalo) | UPTD | 80,125 | - 3,815,126 | - 48 |
| 24 | IV | KPHP Dampelas Tinombo | Provinsi Sulawesi Tengah | UPTD | 95,196 | - 3,830,337 | - 40 |
| 25 | IV | KPHP G.Sinopa | Provinsi Maluku Utara | UPTD | 36,648 | - 383,741 | - 10 |
| 26 | IV | KPHP Gularaya | Provinsi Sulawesi Tenggara | UPTD | 72,354 | - 15,858,269 | - 219 |
| 27 | IV | KPHP SintuWu Maroso | Kab. Poso (Sulteng) | SKPD | 130,396 | - 7,156,283 | - 55 |
| 28 | IV | KPHP Jeneberang W | Propinsi Sulsel | UPTD | 41,916 | - 1,521,929 | - 36 |
| 29 | IV | KPHP Dolago Tanggunung | Propinsi Sulteng | UPTD | 116,435 | - 4,385,512 | - 38 |
| | | | | | **1,900,533** | **- 104,696,634** | **- 55** |

Such scenario represent a carbon balance of 104,5 million Tco2, equivalent to an increase of 27% of GHG performances. 18 KPH are performing over 2 million Tco2. The average Carbon- balance per ha of KPH is now around 55 TCO2/ ha or 2.8 Tco2/ ha/year

Extrapolating such results of scenario 2 to the whole range of 600 KPH planned by MOEF, using an average of forest area of 65 535 ha / KPH, drives to potential of GHG mitigation of 108.1 million TCo2 per year for the whole set of KPH. The aggregate carbon balance of the 600 KPH between 2015 and 2035 is estimated around 2.166 Billion Tco2.

## 5. Economic Analysis of FMUs

FIP's positive mitigation impacts at the project level (that include 29 KPH sites) were translated in monetary terms using a Social Value of Carbon (SVC) averaging US$30 per ton of $CO_2$-equivalent in 2015 in real terms (as per the World Bank Internal Note on "The Social Value of Carbon in Project Appraisal"). Assuming (i) a conservative SVC of US$ 30 remaining constant over 20 years, (ii) a 5 percent discount rate (see below) and, (iii) a total carbon balance of -104,5 million ton $CO_2$-equivalent per year, the net present value (NPV) of GHG mitigation averages US$ 872 million on a 20 years horizon.

These environmental co-benefits were added to those arising from KPH-level activities namely: (i) the community-based production of timber (mainly teak trees) and bamboo and, (ii) eco-tourism activities. Incremental net benefits (calculated through a comparison between with and without project scenario), net of project costs, transfers and duties, were calculated over a 20 years period.

As suggested above, a 5 percent social discount rate (SDR) was chosen for the economic analysis and the calculation of the project's NPV. While purely environmental projects often chose a 3 percent discount rate to treat more equally present and future flows[1], development projects, in turn, consider the SDR as the after-tax rate of return on government bonds and returns from other low-risk marketable securities (for example saving accounts and/or deposits) (IFAD, 2015). World Bank statistics for Indonesia[2] report that deposit interest rates varied from 5.9 percent to 8.8 percent over the 2010-2014 period. Since the FIP project generates benefits that are both productive and environmental, the economic analysis followed a mixed and conservative approach by considering a 5 percent SDR in order to avoid the risk of approving the project at the expense of efficiency.

Under the current assumptions, detailed in the Economic and Financial annex of the World Bank project appraisal document (PAD), economic IRR is in the order of 11.2 percent and the NPV is in the order of USD 50.1 million. These results remain robust against various changes in the SVC, SDR and cost increases as shown in the table below.

| **Sensitivity** | **EIRR** | **NPV (USD)** | **BCR*** |
|---|---|---|---|
| **Base case** | **11.2%** | **50,057,833** | **1.590** |
| **Scenario 1:** | | | |
| Carbon price USD 45/unit | 11.2% | 50,092,466 | 1.591 |
| Carbon price USD 15/unit | 11.2% | 50,023,200 | 1.590 |
| **Scenario 2:** | | | |
| Total cost increase by 10% | 9.1% | 41,577,733 | 1.446 |
| Total cost decrase by 10 % | 13.4% | 58.537.932 | 1.767 |
| **Scenario 3:** | | | |
| SDR 3% | 11.2% | 72,664,687 | 1.692 |
| SDR 7% | 11.2% | 33,794,800 | 1.486 |

** Benefit cost ratio*

[1] FAO, 2015. EX ACT User Manual.
[2] http://data.worldbank.org/indicator/FR.INR.DPST

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