# Identify Measures to Enhance the Sustainable Emissions Reductions and Enhancement of Carbon Stocks in Meru Betiri National Park

**By:**
**Yanto Rochmayanto**
**Nugroho Dri Atmojo**
**Ari Wibowo**
**Tian Partiani**

**Center for Climate Change and Policy Research and Development**
**Forestry Research and Development Agency**
**Ministry of Forestry, Indonesia**
**In Cooperation with**
**International Tropical Timber Organization (ITTO)**
**Bogor, 2013**

# Identify Measures to Enhance the Sustainable Emissions Reductions and Enhancement of Carbon Stocks in Meru Betiri National Park

ISBN:
Technical Report No 27, November 2013

By: YantoRochmayanto, NgrohoDriAtmojo, AriWibowo, TianPartiani

This Report of Activity Is a Part of Program ITTO PD 519/08 Rev.1 (F): Tropical Forest Conservation for Reducing Emissions From Deforestation and Forest Degradation and Enhancing Carbon Stocks in MeruBetiri National Park, Indonesia.

Collaboration Between:

- Center for Climate Change and Policy Research and Development (PusatPenelitiandanPengembanganPerubahanIklimdanKebijakan)
  Jl. GunungBatu No. 5 Bogor West Java Indonesia
  Phone: +62-251-8633944
  Fax: +62-251-8634924
  Email: itto_519@yahoo.co.id
  Website: www.puspijak.org
- LATIN – the Indonesian Tropical Institute
  Jl. Sutera No. 1 Situgede Bogor West Java Indonesia
  Phone: +62-251-8425522/8425523
  Fax: +62-251-8626593
  Email: latin@latin.or.id
  Website: www.latin.or.id
- MeruBetiri National Park, Ministry of Forestry
  JalanSiriwijaya 53, Jember, East Java, Indonesia
  Phone: +62-331-335535
  Fax: +62-331-335535
  Email: meru@telkom.net
  Website: www.merubetiri.com


Published by:
Center for Climate Change and Policy Research and Development- ITTO PD 519/08 Rev.1 (F).
Jl. GunungBatu No. 5 Bogor 16610
Phone/Fax: +62-251-8633944
Email: itto_519@yahoo.co.id
Web site: www.puspijak.org

# LIST OF CONTENT

# LIST OF TABLE



# LIST OF FIGURE

# SUMMARY

*Tropical Forest Conservation For Reducing Emissions From Deforestation And Forest Degradation And Enhancing Carbon Stocks In MeruBetiri National Park, Indonesia, is an ITTO funded activity number PD 519/08 Rev.1 (F). This activity has been applied in Indonesia since 2010 as a demonstration activity in conservation area to support readiness phase of REDD+. REDD+ is a performance based activity that the success of REDD+ is based on how much emission reduction and enhancement of carbon stock have been made. From the implementation of DA REDD+ in MBNP, project additionality is gained from avoiding deforestation rate which is only 28.2 ha/year or emission reduction by 295,036 t$CO_2$e during crediting period (30 years). Additionality from enhancement in rehabilitation zone during crediting period (30 years) is estimated to 1,020,966t$CO_2$-e for 160 trees/ha, 1,189,387t$CO_2$-e for 240 trees/ha and 1,610,441t$CO_2$-e for 300 trees/ha. There has been threat to the sustainability of the conservation areas due to community activities and growth. However, lesson learned from MBNP has shown that community eager to participate in REDD+ activities, providing long term assurance to access the MBNP (especially in rehabilitation), to have additional income for their daily needs. DA REDD+ in conservation areas has shown multiple benefits not only carbon but also community and biodiversity. Although carbon benefits cannot be high but incentives should be given to conservation areas that high carbon stock and biodiversity value. Incentive mechanism for conservation areas should be given with possible sources not only from compliance global mechanism but also from local incentives such as national bugdet allocation, national carbon market or other mechanism.*

*Keywords: DA REDD+, carbon stock enhancement, emission reduction, MeruBetiri National Park*

# 1. INTRODUCTION

REDD+ is a forest carbon mitigation of climate change to reduce the source by reducing greenhouse gas emissions through not only enhancing carbon sequestration, but also through reducing emission from deforestation and degradation, enhancing carbon stocks, conservation and sustainable management of forest. The on-going negotiations on REDD+ mechanism have yet to define what procedures and modalities for implementation. However, UNFCCC (2009) stated that to ensure effective and result-based mechanism, a REDD+ mechanism should be implemented in a successive phase and ensure additionality as compared to the business as usual level.

REDD+ is a performance based activity that the success of REDD+ is based on how much emission reduction and enhancement of carbon stock have been made. Tropical Forest Conservation For Reducing Emissions From Deforestation And Forest Degradation And Enhancing Carbon Stocks In MeruBetiri National Park, Indonesia, is an ITTO funded activity number PD 519/08 Rev.1 (F). This activity has been applied in Indonesia since 2010 as a demonstration activity (DA) in conservation area to support readiness phase of REDD+.

According to IPCC GPG (2003) and IPCC Guideline (2006), five carbon pools namely above ground biomass, below ground biomass, soil, litter and necromass should be considered in any mitigation activities including REDD+. This activityhas been conducted to identify various activities that directly or indirectly influence the reduction of GHG emissions, the increase GHG uptake and the increase of carbon stocks.

As conservation area that has been confirmed through Minister's Decree, probably source of emission from deforestation would not be high, however due to the increasing number of human population and their activities, there would be significant threat to the national park. As an important carbon pool, identification of sources of emission and removal of the park is necessary. Therefore, the objective of this study is to identify measures to enhance the sustainable emissions reductions and enhancement of carbon stocks in the MBNP.

## 2. METHODOLOGY

### 2.1. General Conditions of Meru Betiri National Park and Social Economy of Community

- Collection of related information of Meru Betiri National Park including location, area, flora, fauna and others.
- Information of social economy of community has been carried out through the methods of questionnaires and direct interview to community. Data collection has been conducted in the buffer villages of MBNP namely Curahnongko, Sanenrejo, Wonoasri,Kebonrejo and Kandangan. Interviews have been conducted directly by providing appropriate questions through the questionnaire that has been prepared. While the questionnaire method has been done in groups of 10-15 people, who were given questionnaires to fill out the form together.

### 2.2. Threat to MBNP as Source of Emission

Threat to MBNP as source of emissions has been analyzed through analysis of land use change since 1997. Landcover changes were analyzed for land remaining the same landcover category and land converted to a new landcover category, as described in the figure below.

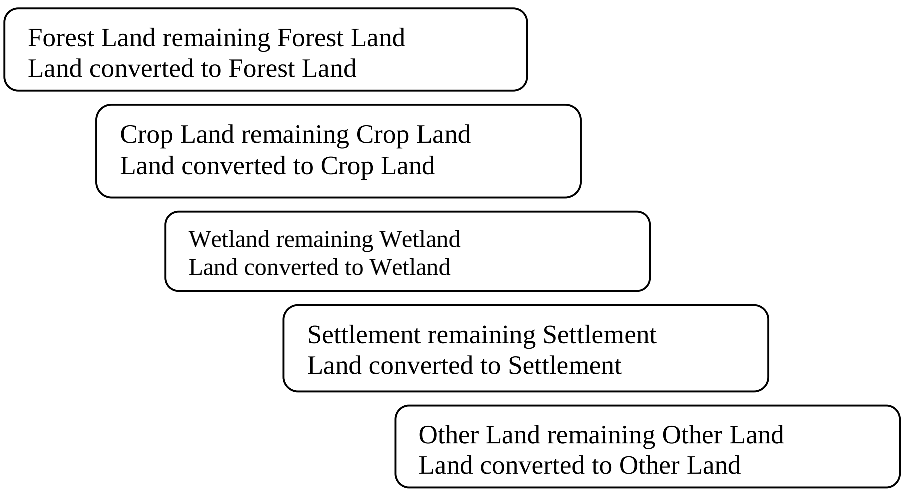


**Figure 1.** Landcover changes analysis.

### 2.3. Historical emission within MBNP

Histories of GHG emissions from MBNP were calculated by application of IPCC Guideline 2006. This method basically estimates the emission based on the analysis of landcover changes and the use of information of carbon stock to estimate emission.

### 2.4. Identification of measures to reduce emission and increase C stocks

In REDD+, some measures that have been identified to reduce emissions include avoiding deforestation, and avoiding degradation, meanwhile, measures to increase carbon stocks include, planting and growth of natural and plantation forests through the activities of conservation and sustainable forest management. Potential emission reduction and increase of carbon stock were identified from these measures.

### 2.5. Enabling conditions, barrier or issues in emission reduction and enhancement of C stock

Analysis has been made to identify potential barriers or issues that may be faced in efforts to reduce emission and to increase carbon stocks.

## 3. RESULTS AND DISCUSSION

### 3.1. General Conditions of Meru Betiri National Park

Meru Betiri National Park (MBNP) is geographically located at 113° 38' 38" – 113° 58' 30" E and 8° 20' 48" – 8° 33' 48" S, lies on Jember and Banyuwangi districts. The total area of this National Park is ± 52,681 ha[1] consisting of various vegetation types from mountainous, hilly areas, lowland areas, coastal to mangrove facing the Indian Ocean. MBNP has tropical rainforest ecosystem and rich in biodiversity (more than 500 identified plant species including rattan and bamboo) and various small to relatively large animals. MBNP is divided into five zones namely core zone, intact forest zone, utilization zone, rehabilitation zone, and buffer zones.

Each zone is managed specifically based on its specific function. Core zone with total area of 27.900 ha is strictly protected area and allowed only for research and education. Intact forest zone with total area of 22.622 ha is allowed for research and education, limited utilization for ecotourism. Utilization zone with total of 1.285 ha is for research and education, intensive but wise and sustainable utilization for highland and coastal ecotourism. Rehabilitation zone with total area of 4.023 ha is a zone where forest and land rehabilitation (agro-forestry cultivation) involving local community is taking place to strengthen and protect inner zone.


**Figure 2.** Map of Meru Betiri National Park in East Java Province

Rehabilitation activities are carried out in this area to restore forest cover from illegal conversion and illegal cultivation since early 1990s. Rehabilitation is carried out based on mutual benefit between the MBNP–Community by planting economically potential species in Agro-forestry plantation model for community benefits and protection-conservation for the MBNP. In this rehabilitation zone, six Agro-forestry models have been introduced by LATIN in cooperation with BogorAgriculturalUniversity.

MeruBetiri National Park represents mangrove forest, swamp forest, and lowland rain forest ecosystems.This Park is a natural habitat of the rafflesia flower (*Rafflesiazollingeriana*), and various other plants such as mangrove (*Rhizophora sp.*), api-api (*Avicenniasp.*), waru (*Hibiscus tiliaceus*), nyamplung (*Calophylluminophyllum*), rengas (*Glutarenghas*), bungur (*Lagerstroemia speciosa*), pulai (*Alstoniascholaris*), bendo (*Artocarpuselasticus*), and several medicinal plants.

This Park is also home to several protected animals, including 29 species of mammal and 180 species of bird. MeruBetiriNational Park is known as the last habitat of the Javan tiger (*Pantheratigrissondaica*) which is now a highly endangered and protected species. However, no traces of this tiger have been foundfor many years and it is feared to be extinct.MeruBetiri does have other distinct characteristics. SukamadeBeach is a habitat of the leatherback turtle, the hawksbill turtle, the common green turtle, and the Pacific ridley turtle. Several simple breeding facilities have been constructed at this beach to ensure that the turtles, too, do not become extinct

MBNP is surrounded by two districts and 11 villages with the total population of approximately 23.800 people. The majority of the community is living as land owning farmers (40%) and non-land owning farmers as labors (40%) and the rest are traders, construction labors and others. The average community income is quite low. Illegal logging/harvest in the National Park area for both timbers and other Non-Timber Forest Products including biological diversity is a potential threat to MBNP.

For social economic condition of community, based on data analysis, the number and distribution of the population in buffer villages of MBNP can be seen in the following table. The Table shows that the highest population density wasin Wonoasrivillage with 1,554 people/km$^2$, and the lowest was in Curahnongkovillage with 20 people/km$^2$.

**Table 1.** Number and distribution of population in villages around the MBNP

| No. | Village | Area (km$^2$) | Population | | Popula-tion | Density (people/km$^2$) |
|---|---|---|---|---|---|---|
| | | | Male | Female | | |
| | **Jember District** | | | | | |
| 1 | Curahnongko | 283,390 | 2.883 | 2.833 | 5.716 | 20,17 |
| 2 | Andongrejo | 262,790 | 2.683 | 2.826 | 5.509 | 20,96 |
| 3 | Wonoasri | 6,180 | 4.841 | 4.765 | 9.606 | 1554,37 |
| 4 | Curahtakir | 77,863 | 5.517 | 5.908 | 11.425 | 146,73 |
| 5 | Sanenrejo | 88,946 | 2.889 | 2.981 | 5.870 | 65,99 |
| | **Banyuwangi District** | | | | | |
| 6 | Sarongan | 27,001 | 2.892 | 2.978 | 5.870 | 217,40 |
| 7 | Kandangan | 18,064 | 4.423 | 4.205 | 8.628 | 477,64 |

For the level of education, from all total respondents of five villages namely Kebonrejo, Kandangan, Sanenrejo, Curahnongko and Wonoasri approximately 50% - 80% of respondents only had education up to primary school level . Some 12% - 38% did not even finish primary school. Some 5% -22% had education up to junior high school and 3% -13% had education level up to high school. Only less than 1% of population who could get to the level of diploma / bachelor degree.This means that the government program of nine years compulsary education simply did not work.
The following Table shows source of income of community living in surrounding villages of MBNP area.

**Table 2.** Source of income of community living in surrounding villages of MBNP area.

| Occupation | Percentage in Villages(%) | | | | |
|---|---|---|---|---|---|
| | Kebonrejo | Kandangan | Sanenrejo | Curahnongko | Wonoasri |
| Farmer | 11% | 18% | 36% | 56% | 35% |
| Farm labor | 16% | 10% | 43% | 19% | 42% |
| Estate worker | 24% | 5% | 0% | 3% | 10% |
| Merchant | 14% | 2% | 7% | 3% | 3% |
| Handyman | 0% | 1% | 3% | 3% | 2% |
| Estate labor | 5% | 32% | 0% | 2% | 4% |
| Freelance labor | 10% | 2% | 0% | 0% | 0% |
| Sugar makers | 0% | 3% | 0% | 0% | 0% |
| Private | 0% | 8% | 8% | 2% | 0% |
| Others | 21% | 17% | 5% | 12% | 5% |
| **Total respondents** | **263** | **262** | **200** | **318** | **209** |

Income of most people were quite low, with average income of Rp.505 601, - up to Rp. 1,215,093, - per capita per month (Table 3). This income was within the range of the Minimum Wage for Jember District which was Rp. 875.000,-/month

**Table 3.** Average income of community

| | Incomein villages (Rp) | | | | |
|---|---|---|---|---|---|
| | Kebonrejo | Kandangan | Sanenrejo | Curahnongko | Wonoasri |
| Income/capita/ year | 9.865.111 | 14.585.683 | 9.835.218 | 12.658.985 | 6.067.207 |
| Income/capita/ month | 822.093 | 1.215.474 | 819.601 | 1.054.915 | 505.601 |

In relation with land ownership, approximately 97% of respondents from the village Sanenrejohad farmland and 68% of them were in the form of yard area, with an area of 400-800 $m^2$. Residents who had their own farms generally cultivatedtheir land by planting rice, corn, soybeans, green beans and others.

In relation with community development and improvement of public welfare, the government has also began to provide aids to the community in around forest area. The most common type of assistance provided by the government was in the form of basic needs of groceries.

MeruBetiri National Park area has provided great benefits for communities in buffer villages. Lives of people depend on the area of the national park directly or indirectly. Directly, rural communities utilize forest products such as wood, bamboo, rattan, honey, and fruit. While indirectly, they get the benefits of clean air, clean water, soil and other natural conditions.

MBNP area consists of zones in its utilization. One of the zone is the rehabilitation zone. In the rehabilitation zone that cover an area of 4,023 hectares, rehabilitation activities can be done on areas that have been damaged by encroachment. Total land area that has been planned for rehabilitation is ± 2.500 ha. TNMB rehabilitation activities apply the patterns of collaborative/partnership involving the communities around the national park by through written mutual agreement that is mutually beneficial and is supported by various parties .

### 3.2. Threat to MBNP as Sources of Emissions

In general, emission from land change and forestry sector is from deforestation and degradation, as major threat to the national park. Deforestation is permanent change of land cover from areas categorized as forest land to other land categories. Degradation is defined as reduction of carbon stock in the same land category.

The National Park experienced loss or deforestation during political transition period in 1998. At the time, teak looting occurred in areas now as rehabilitation zone. The looting of teakwoods was conducted not only by local inhabitants but also outsiders. The loss has caused changes from formerly teak forest into now as agroforestryareas .

Combination of Landover changes in year 1997 to 2011 covers all changes in 14 years. The result of the changes represents what happened during that period in terms of community activities. The result of landcover changes on 1997-2011 is shown in Table 4.

**Table 4.** Landcover changes matrix 1997 to 2011

| **Landcover changes** | | **Hectare** |
|---|---|---|
| **Land Cover 1997** | **Land Cover 2011** | |
| Forestland | Cropland | 376 |
| | Agroforestry | 931 |
| | Grassland | 6 |
| **Forestland Total** | | **1,313** |
| Forestland/Teak | Cropland | 42 |
| | Agroforestry | 1,583 |
| **Forestland/Teak Total** | | **1,625** |
| **Grand Total** | | **2,938** |

Forest Land (primary) converted to non forest land (Cropland and Grassland) from 1997 to 2011 was about 382 ha. While plantation forest (teak forest) converted to cropland was about 42 ha. From the primary forest land and plantation forest converted into agroforestry, some 931 ha of agroforestry were from primary forest, while 1,583 ha were from plantation forest.

Analysisfor the past ten years was appliedfor the data of land cover from 2001 to 2011. The result of changes represented what happened during that period in terms of community activities. Forestland (Natural forest) converted to non forestland (Cropland and Grassland) from 2001 to 2011 was about 282 ha. The annual deforestation rate was about 28.2 ha/year.This figure shows that threat of the national park due to deforestation has been low, with average of 28.2 ha/year.

The MBNP has been confirmed as conservation area under the law, therefore there has been no planned deforestation occur. The unplanned deforestation occurred in 1998 during the reformation movement, which is under exceptional condition.

The MBNP as other forest areas also faced threats causing degradation and reducing the value of its ecosystem functions including its role in carbon sequestration and reducing greenhouse gas emission. The major causes of forest degradation were illegal logging and encroachment. The illegal harvest of timber and non-timber forest products from the national park were mostly due to poor law enforcement in the implementation of sustainable forest management, forest protection and conservation, lack of awareness on forest function and economic pressure caused by poverty and lack of sustainable source of income. This situation, directly or indirectly, contributed to degradation and deforestation of the Park area.

Examples of major threat for MBNP weredegradation caused by farmers who live in five villages (Wonoasri, Curah Nongko, Andongrejo, Sanenrejo and Curah Takir) along the national park border, where rehabilitation zone exists. A significant number of farmers (4,664 persons) cultivated a piece of land (in average of 0.25 ha/farmer) inside rehabilitation zone as agroforestry. They also collected forest products for sell to generate additional income. Other threats came from local villagers who take woods from MBNP for housing or firewood for household use and small industry.

### 3.3. Carbon Stock for Each Landcover Category and Historical Emission

Carbon stock assessment in the area within MBNP has been conducted according to a guideline or Standard Operational Procedure for field measurement from previous study. There were 40 plots distributed within the MBNP that were used for carbon stock assessment.These plots were used also as Permanent Sample Plot (PSP), which representforestland, cropland, agroforestry, and grassland landcover categories.

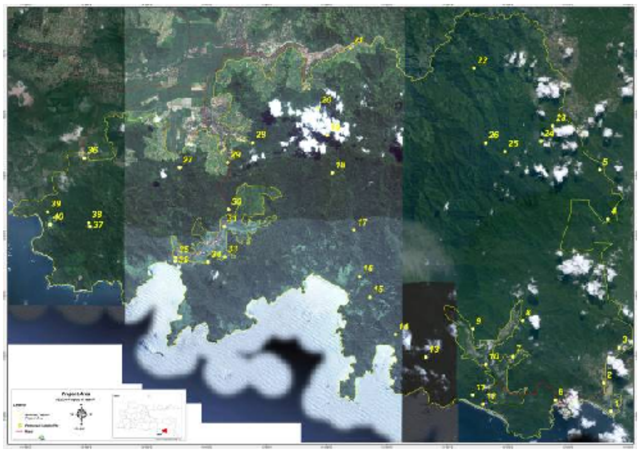

**Figure 3.** Permanent sample plots in MBNP

By following the selected guideline of carbon stock assessment, each landcover category within MBNP has carbon stock value. Based on the land use system in MBNP the carbon stock is estimated between 24.08 -166.63 Ton/ha (Table 5).

**Table 5.** Estimated above ground carbon stock at several land cover types in MBNP

| No | Land cover | Carbon stock (Ton/ha) |
|---|---|---|
| 1 | Primary forest | 135,02 |
| 2 | Secondary forest | 166,63 |
| 3 | Plantation | 98,8 |
| 4 | Bushes | 93,38 |
| 5 | Paddy fields | 28,7 |
| 6 | Shrub | 24,08 |

Secondary forest has the highest carbon stock of 166.63 Ton/ha. Primary forest has lower carbon stock than secondary forest, i.e. 166.63 Ton/ha. This is because the designation of the primary and secondary forest of MBNP is not based on vegetation density stratification. Secondary forest in MBNP landcover map is actually dense vegetation and has high diameters compared with the primary forest that contains bamboo forest. The highest carbon stock after the primary forest is found in forest plantation estate (98.8ton/ha), because it is dominated with old *Hevea braziliensis* trees. The lowest carbon stock is found in shrub and bushes (24.08 Ton/ha). Paddy fields in MBNP are intercropped with forest trees, so it provides 28.7 Ton/ha higher carbon stock than shrub and bushes.

The highest aboveground carbon stock in MBNP is classified as good (166.63 Ton/ha). Carbon stock in the tropical forests in Asia varies between 40-250 Ton/ha for vegetation and 50-120 Ton/ha for soil.

**Table 6.** Carbon stock each landcover category (t C/ha)

| Landcover | tC/ha |
|---|---|
| Forestland | 148.7 |
| Grassland | 7.2 |
| Cropland | 2.9 |
| Agroforestry (existing condition, not the optimum condition) | 28.7 |

### 3.4. Historical emission within the MBNP

Histories of GHG emissions were calculated from the landcover changes table matrix and the table of carbon stock for each landcovercategory. Stock difference method was used for GHG emission calculation. GHG emissions that can be claimed based on the selected methodology was only emissions from deforestation practices, while emissions from forest degradation cannot be claimed. Landcover changes that categorized as deforestation was only Forestland converted into non-forestland (cropland and grassland). The emissions histories analysis from 2001 to 2011 was presented in the following steps;

**Table 7.** Landcover changes matrix, 2001to 2011.

| Years/Landcover | | 2011 | | | | |
|---|---|---|---|---|---|---|
| | | Cropland | Agroforestry | Forestland | Grassland | Total |
| 2001 | Cropland | 403 | 0 | 0 | 0 | 403 |
| | Agroforestry | 0 | 2,018 | 0 | 0 | 2,018 |
| | Forestland | 276 | 517 | 47,637 | 6 | 48,436 |
| | Grassland | 0 | 0 | 124 | 1,700 | 1,824 |
| | Total | 679 | 2,535 | 47,761 | 1,706 | 52,681 |

Forestland (Natural forest) converted to Cropland and Grassland from 2001 to 2011 was about 282 ha, 276 ha converted into Cropland while 6 ha converted into Grassland. Annually, the rate of deforestation was about 28.2 ha/year.

In order to identify the GHG emissions from those landcover changes, the carbon stock of these landcover classes should be identified first. The carbon stock of each landcover class was as follow

Using the fundamental carbon emission calculation from deforestation and forest degradation published by REDD sourcebook (GOFC-GOLD, 2010).

$$\Delta C = \frac{(C_{t2} - C_{t1})}{(t_2 - t_1)}$$

Where:

ΔC = annual carbon stock change in pool (t C/yr)
Ct1 = carbon stock in pool in at time t1 (t C)
Ct2 = carbon stock in pool in at time t2 (t C)
Note: the carbon stock values for some pools may be in t C/ ha, in which case the difference in carbon stocks will need to be multiplied by an area.

GHG emissions (t C) =
[Deforestation area, forestland converted to cropland, ha (from 1997 to 2011) X carbon stock change, t C/ha, forestland >< cropland] + [Deforestation area, forestland converted to grassland, ha (from 1997 to 2011) X carbon stock change, t C/ha, forestland >< grassland]

Emission (t C) = 276 ha x (148.7 - 2.9)t C/ha + 6 ha x ( 148.7 – 7.2) t C/ha
= 40,240.8 t C + 849 t C
= 41,089.8 t C ≈ 150,662.6 t CO2e

Annual GHG emissions = 41,089.8 t C : 10 years= 4,108.98 tC/year=15,066.3 t CO2e/year. Total GHG emissions from deforestation practices in 2001 to 2011 within MBNP national park was about 150,662.6 t $CO_2$e or annually 15,066.3 $CO_2$e/ year.

### 3.4. Identification of Measures to reduce emission and increase C stocks

#### 3.4.1. Avoiding deforestation

In the project scenario, all the activities that lead to avoid the deforestation will be optimized, therefore the emissions from deforestation practices are expected to be zero. Total emissions that can be reduced by stoping deforestation practices during crediting period is about 295,036 t$CO_2$-e

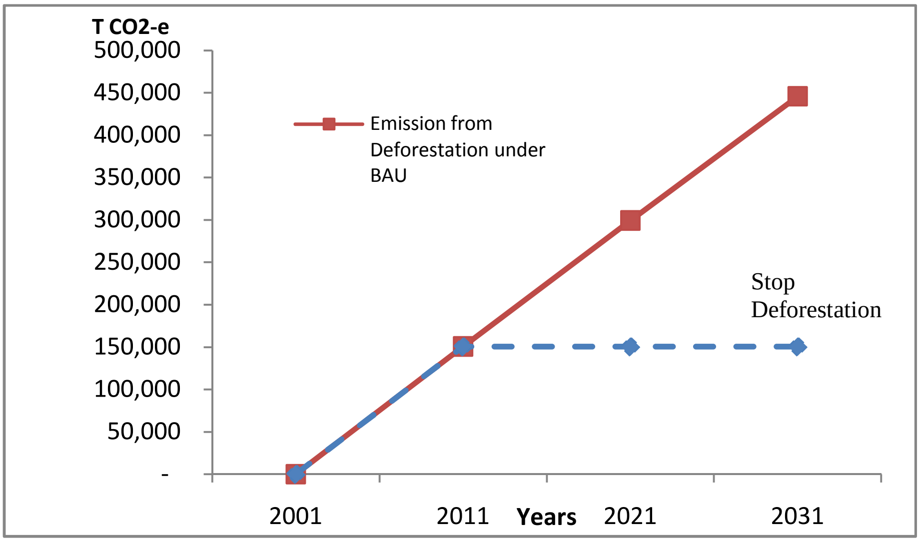


**Figure 4.** Project emissions

### 3.4.2. Avoiding degradation

Forest degradation is potential source of emission from LULUCF. From IPCC Guideline (2006), emissions from forest land remaining as forest land include logging (firewood, legal logging and illegal logging), forest fire, pest and disease. Estimationof emission from MBNP (Table 5 and 6) due tofires and illegal logging as threats to forest degradation.

**Table 8.** Estimation of emission from forest fires of MBNP in 2000 – 2012

| Year | Site | Area (Ha) | Type of area burned | Estimation of emission* (ton $CO_2$ e) |
|---|---|---|---|---|
| 2000 | Section II, Ambulu | 14.5 | Secondary Forest | 2.472,3 |
| 2001 | Section II, Ambulu | 3.2 | Secondary Forest | 545,6 |
| 2002 | Section II, Ambulu | 59.7 | Secondary Forest/shrubs | 7.661,5 |
| 2003 | Section II, Ambulu | 17.4 | Secondary Forest | 2.966,7 |
| 2004 | Section II, Ambulu | 12.5 | Secondary Forest | 2.131,3 |
| 2005 | - | - | - | |
| 2006 | Section I, Sarongan | 2.0 | Shrubs | 99,0 |
| | Section II, Ambulu | 2.5 | Bamboo forest | 426,3 |
| 2007 | Section II, Ambulu | 2.0 | Bamboo forest | 341,0 |
| 2008 | Section II, Ambulu | 1.0 | Bamboo forest | 170,5 |
| | Section III,Kalibaru | 0.2 | Bamboo forest | 34,1 |
| 2009 | Section II, Ambulu | 2.0 | Secondary Forest | 341,0 |
| 2010 | Section II, Ambulu | 1.0 | Secondary Forest | 170,5 |
| | Section III,Kalibaru | 1.2 | Shrubs | 59,4 |
| 2011 | Section II, Ambulu | 3.0 | Secondary Forest | 511,5 |

| Year | Site | Area (Ha) | Type of area burned | Estimation of emission* (ton $CO_2$ e) |
|---|---|---|---|---|
| 2012 | Section I, Sarongan | 5.0 | Shrubs | 852,5 |
| | | | | |

*) Based on data of average carbon stock of 93 ton C/ha, shrubs of 27 ton C/ha and mix forest and shrubs of 70 ton C/ha, with emission/combustion factor of 0,5

Based on data and estimation of emission from forest fires in MBNP, although fires almost occur every year, but total area burned is relativelly small. With average forest fire occurrence of only 8,5 ha/year, except the high wild fire in 2002. This is due to natural condition of forest cover that mostly green, and less activity of community in using fires for land preparation.

**Table 9.** Estimation of emission from illegal logging and encroachment in 1998 – 2012

| Year | Site | Species (Unit) | Loss | Estimation of emission* (ton $CO_2$ e) |
|---|---|---|---|---|
| 1998 | Section II, Ambulu | Teak ($m^3$) | 10,2 | 22,4 |
| 1999 | Section II, Ambulu | Teak ($m^3$) | 16,6 | 36,6 |
| | Section I, Sarongan | Mix woods ($m^3$) | 50,6 | 111,3 |
| 2000 | Section II, Ambulu | Mix woods ($m^3$) | 15,9 | 35,0 |
| | | Encroachment (ha) | 1,3 | 443,3 |
| | Section I, Sarongan | Teak ($m^3$) | 10,4 | 22,8 |
| 2001 | Section II, Ambulu | Mix woods ($m^3$) | 21,8 | 47,9 |
| | | Rattan ($m^3$) | 15,8 | 34,6 |
| | | Encroachment (ha) | 1,5 | 511,5 |
| | Section I, Sarongan | Mix woods ($m^3$) | 35,0 | 77,0 |
| | | Rattan ($m^3$) | 5,4 | 11,8 |
| 2002 | Section II, Ambulu | Mix woods ($m^3$) | 25,7 | 56,6 |
| | | Rattan ($m^3$) | 1,2 | 2,7 |
| | Section I, Sarongan | Mix woods ($m^3$) | 22,6 | 49,6 |
| | | Teak ($m^3$) | 0,1 | 0,1 |
| | | Rattan ($m^3$) | 60,0 | 131,4 |
| 2003 | Section II, Ambulu | Mix woods ($m^3$) | 52,9 | 116,4 |
| | | Teak ($m^3$) | 0,9 | 2,0 |
| | | Rattan ($m^3$) | 18,2 | 39,8 |
| | Section I, Sarongan | Mix woods ($m^3$) | 49,5 | 72,6 |
| | | Rattan ($m^3$) | 0,0 | 0,1 |
| 2004 | Section II, Ambulu | Mix woods ($m^3$) | 35,4 | 77,9 |
| | | Timber ($m^3$) | 0,2 | 0,5 |
| | | Rattan ($m^3$) | 7,1 | 15,6 |
| | Section I, Sarongan | Mix woods ($m^3$) | 41,4 | 91,1 |
| | | Rattan ($m^3$) | 29,9 | 65,4 |
| 2005 | Section II, Ambulu | Mix woods ($m^3$) | 32,0 | 70,5 |

| | | | | |
|---|---|---|---|---|
| | | Rattan ($m^3$) | 12,2 | 26,8 |
| | Section I, Sarongan | Mix woods ($m^3$) | 22,0 | 48,3 |
| | | Rattan ($m^3$) | 1,7 | 3,7 |
| 2006 | Section II, Ambulu | Mix woods ($m^3$) | 28,4 | 62,4 |
| | | Rattan ($m^3$) | 9,5 | 20,8 |
| | Section I, Sarongan | Mix woods ($m^3$) | 7,0 | 15,3 |
| 2007 | Section I, Sarongan | Mix woods ($m^3$) | 14,3 | 31,4 |
| | | Bamboo ($m^3$) | 15,0 | 33,0 |
| | | Encroachment ($m^3$) | 15,0 | 5115 |
| | Section II, Ambulu | Mix woods ($m^3$) | 21,5 | 47,3 |
| | | Bamboo ($m^3$) | 267,0 | 783,2 |
| | | Encroachment (ha) | 1,2 | 409,2 |
| 2008 | Section I, Sarongan | Mix woods ($m^3$) | 6,7 | 14,8 |
| | | Rattan ($m^3$) | 3,0 | 0,9 |
| | Section II, Ambulu | Mix woods ($m^3$) | 32,1 | 70,6 |
| | | Bamboo ($m^3$) | 216,0 | 475,2 |
| | | Mix woods ($m^3$) | 0,4 | 0,9 |
| | Section III, Kalibaru | Mix woods ($m^3$) | 29,5 | 64,8 |
| | | Rattan ($m^3$) | 0,3 | 0,1 |
| 2009 | Section II, Ambulu | Mix woods ($m^3$) | 32,9 | 72,5 |
| | | Rattan ($m^3$) | 12,0 | 3,5 |
| | Section I, Sarongan | Mix woods ($m^3$) | 19,0 | 27,8 |
| 2010 | Section I, Sarongan | Mix woods ($m^3$) | 14,3 | 31,4 |
| | | Bamboo ($m^3$) | 30,0 | 44,0 |
| | Section II, Ambulu | Mix woods ($m^3$) | 21,5 | 47,3 |
| | | Bamboo ($m^3$) | 285,0 | 627,0 |
| | | Encroachment (ha) | 1,2 | 409,2 |
| 2011 | Section I, Sarongan | Mix woods ($m^3$) | 24,1 | 53,1 |
| | | Rattan ($m^3$) | 3,0 | 0,9 |
| | Section II, Ambulu | Mix woods ($m^3$) | 26,1 | 57,4 |
| | | Bamboo ($m^3$) | 216,0 | 633,6 |
| | Section III, Kalibaru | Mix woods ($m^3$) | 31,8 | 70,0 |
| | | Rattan ($m^3$) | 7,5 | 16,4 |

*) Estimation of emission is based on assumption of 0,6 wood density, 93 ton C/ha for encroachment, average diameter of 5 cm for rattan and 10 cm for bamboos.

Data/estimation in Table 6 show that illegal logging and encroachment are still important issue in MBNP. With the community growth as well as their activities, threats especially from illegal logging remain high. However, socialization, awareness raising and patrol/repression activities are carried out regularly to reduce pressure by community.

Community empowerment is conducted in order to increase the performance of community institution, to anticipate and reduce the pressure to the forest. In order to reduce illegal logging in MBNP, improvement of community participation in MBNP management, has been carried out through establishment of Community-Forest Guards Partnership (Masyarakat Mitra Polhut – MMP). In buffer villages of MBNP in Wonoasri, Sanenrejo Kandangan, Sarongan, Kebonrejo, Curahnongko and Andongrejo, the Center forVillage Forestry Extension (Sentra Penyuluhan Kehutanan Pedesaan – SPKP), have been established. However there havee been difficulties related to resources (budget and human resources). In the future, this institution should be developed to increase community participation in concervation.

### 3.4.3. Conservation

Based on remote sensing analysis and field measurement, land cover in MBNP area and its associated carbon stock are shown in Table 7.

**Table 10.** Carbon stock in various land cover

| ***Land Cover*** | ***Area*** | ***Carbon stock (Ton/ha)*** | ***Total stock (ton)*** |
|---|---|---|---|
| Forest | 47,761 | 148.7 | 7,102,061 |
| Agroforestry | 2,535 | 28.7 | 72,755 |
| Cropland | 679 | 2.9 | 1,969 |
| Grassland | 1,706 | 7.2 | 12,283 |
| **Total** | | | **7,189,068** |

With assumption of natural growth of 0,25 t/ha/year (Team of Forda and DG of Forestry Planning, 2009), there will be an increase of carbon stock of 0,25 x 148,7 ton/ha/year = 37,175 ton/ha/year. For total forest area of MBNP, removal of carbon will be 47.771 x 37,175 = 1.775.515 ton C/year or 5.580.191 ton CO2 e/year.

The high figure of CO2 removal is mainly caused by assumption of natural growth forest by 0,25 ton/ha/year. Research is required to actually measure actual natural growth of tropical forest. However based on this estimation, it shows that MBNP has high stock carbon in its vegetation. Conservation effort is really required to protect or to prevent this carbon stock from deforestation and degradation. Its rich biodiversity also support that conservation effort in MBNP is required not only to reduce emission but also to conserve biodiversity as well as community's life.

### 3.4.4. Enhancing carbon stock

As conservation area, MBNP consists of zones in its utilization. One of the zone is the rehabilitation zone. In the rehabilitation zone that cover an area of 4,023 hectares, enhancement of carbon stock through rehabilitation activities can be done on areas that have been damaged by encroachment in 1998.

Total land area planned for rehabilitation is ± 2.500 ha. TNMB rehabilitation activities apply the patterns of agroforestry through collaborative/partnership involving the communities around the national park. This mutual agreement is mutually beneficial for both the community and the management of MBNP, and is supported by various parties .

For the baseline scenario, under current condition, the rehabilitation zone has tree density of 124 trees/ha or about 314,340 existing trees. This is the condition under government's intervention, the only intervention allowed by regulation in MBNP, given its status as national park.

There have been several government's replanting and species enrichment programs to overcome MBNP deforestation during 2002 to 2007. Local NGO KAIL also assisted some of the programs done in MBNP rehabilitation zone. The success rate of government program was only 32 %. There were several factors that cause low survival rate such as the schedule to distribute seedling from government aid thatearly behind planting season at the field due to rigid budgeting time, lack of field assistants and lackin capital to implement proper seedling maintenance.

With REDD+ activities, planting will be made to increase the stock of carbon by the selected trees within rehabilitation zone. There are three scenarios in implementing the REDD+ project in MBNP as presented in Table8.

**Table 11.** Project scenario in enhancing carbon stock

| **Scenario** | **Tree Density** | **Total Tree Population** | **Number of trees to be planted** |
|---|---|---|---|
| Realistic REDD+ | 160 trees/ha | 405,600 | 91,260 |
| Optimistic REDD+ | 200 trees/ha | 507,000 | 192,660 |
| Ideal REDD+ | 300 trees/ha | 760,500 | 446,160 |

Tree species that will be planted in the scenario is based on the inputs from the stakeholders and also considering the existing trees. Based on the discussions, it is suggested to plant *alpukat, melinjo, Durian* and others rather than *pete* and *nangka*, this is to prevent the over suply product of *petai* and *nangka*, since those tree species have existed alot.Another important discussion regarding tree species selection is: the tree selection for planting scenario in rehabilitation zone should be dominated with native forestry tree, since rehabilitation zone is an integrated area of national park.

Based on the review of Flora Database of MBNP, the selected species for REDD+ planting scheme namely Durian, Melinjo and Kemiri can be considered as native species, since they are listed in the database. Only avocado which can be considered as new species. However, based on the experience at the field level, it can be concluded that to make this REDD+ planting scenario success, local community involvement is a must. Therefore preference and request from community should be considered.

**Table 12.** Tree composition under baseline and project scenarios

| Species | 124 trees/ha (Baseline) | 160 trees/ha | 200 trees/ha | 300 trees/ha |
|---|---|---|---|---|
| Petai | 45% | 35% | 28% | 19% |
| Nangka | 5% | 4% | 3% | 2% |
| Alpukat | 2% | 7% | 11% | 15% |
| Melinjo | <1% | 6% | 10% | 15% |
| Durian | <1% | 6% | 10% | 15% |
| Others | 47% | 42% | 39% | 34% |

Based on above scenarios, using the same approach and equation from Kettering et.al (2001) in estimating GHG removal/sequestration under BAU case, GHG removals/sequestrations by trees under project scenarios within project boundary during crediting period are described in Table xx.

**Table 13**1. Gross GHG removal / sequestration under project scenario

| Year | GHG Removals of each scenarios (ton $CO_2$-e) | | |
|---|---|---|---|
| | 160 trees/ha | 200 trees/ha | 300 trees/ha |
| **2010** | 0 | 0 | 0 |
| **2011** | 11,815 | 11,815 | 11,817 |
| **2012** | 19,311 | 19,313 | 19,318 |
| **2013** | 29,350 | 29,355 | 29,367 |
| **2014** | 41,384 | 41,396 | 41,427 |
| **2015** | 54,192 | 54,223 | 54,299 |
| **2016** | 66,116 | 66,189 | 66,373 |
| **2017** | 75,458 | 75,630 | 76,060 |
| **2018** | 80,910 | 81,294 | 82,257 |
| **2019** | 81,914 | 82,729 | 84,766 |
| **2020** | 78,832 | 80,447 | 84,485 |
| **2021** | 72,809 | 75,784 | 83,221 |
| **2022** | 65,377 | 70,447 | 83,122 |
| **2023** | 57,979 | 65,968 | 85,940 |

| | | | |
|---|---|---|---|
| **2024** | 51,611 | 63,268 | 92,410 |
| **2025** | 46,679 | 62,466 | 101,934 |
| **2026** | 43,050 | 62,949 | 112,697 |
| **2027** | 40,242 | 63,653 | 122,182 |
| **2028** | 37,663 | 63,454 | 127,932 |
| **2029** | 34,822 | 61,514 | 128,246 |
| **2030** | 31,452 | 57,491 | 122,588 |
| **Total** | 1,020,966 | 1,189,387 | 1,610,441 |

Total Gross GHG removals by planting trees on scenario 160 trees/ha is 1,020,966 t $CO_2$-e, on scenario 200 trees/ha is about 1,189,387 t $CO_2$-e, and on scenario 300 trees/ha is about 1,610,441 t $CO_2$-e.

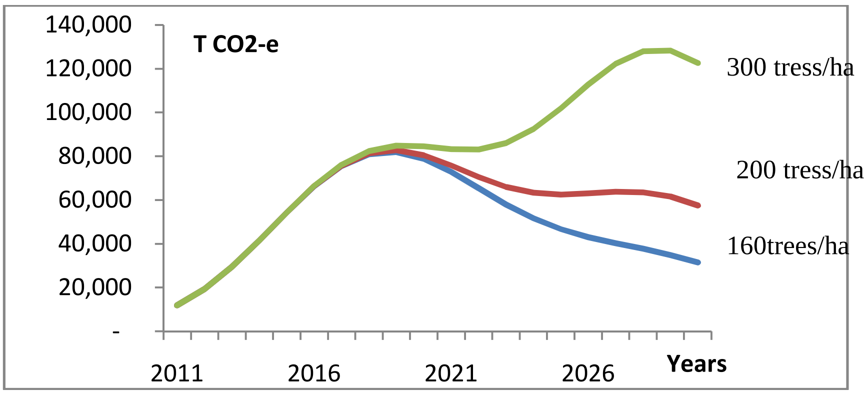


**Figure 5.** Gross GHG Removal by Scenarios

### 3.5. Enabling conditions, barrier or issues in emission reduction and enhancement of C stock

Conservation forests are ecosystems with high carbon stocks and rich in biodiversity. Protectionof these forests is a mitigation action to climate change and conservation to key biodiversity resources and other environmental goods and services that these forests provide.Moreover, the management of conservation forest needs to be understood in the context of the broader landscape. In the broader landscape, conservation forest is a mosaic of forest that has important role not only to biodiversity and community but also as a stock of carbon that grow and significantly determine the effectiveness of the area in reducing carbon emissions.

Meru Betiri National Park is an important conservation area in Java. It contributes to 32 % of annual income of two sub-districts (Pesanggaran and

Tempurejo). The MBNP is surrounded by two districts Jember and Banyuwangi with the total number of villages directly bordered with the Park area is 11-12 villages and total population of 23.800 people. Most community living in these villages are subsistence farmers and labors in the agriculture related activities. Some of the community members are working in the Park rehabilitation activities to get additional source of income. The population increase from year to year has been causing the dependency of community on the resources provided from the MBNP.

The threat by local community to the Park area includes illegal harvesting of biodiversity, unsustainable collection of firewood and hunting of wildlife species, and forest encroachment for planting agricultural crops. Poverty seems to be the strongest driver for illegal harvest of biodiversity and forest encroachment in this area. In term of climate change, threats from community activities that dependent on forest areas has important impact to the carbon stock of the area. These activities may result on forest degradation as the reduction of carbon stock in the national park.

Enabling conditions should be developed by improving community livelihood. This is based on the fact that current biomass, biodiversity loss and ecosystem degradation are mainly related to activities by local community. Approach to solve the problem is through the establishment of self-sufficient community, which has capability to improve prosperity without disturbing forest resources. Local NGOs, KAIL and LATIN, have facilitated initiatives to establish self-sufficient community model with several core activities.The NGO has also established other initiatives, especially those related to the community empowerment and prosperity promotion by domestication and cultivation of economically potential species, such as medicinal plants and ornamental plants.

In order to maintain and restore goods and services of forest ecosystem in the Park, including its function to store carbon and reduce emission, project intervention is critically important. The existing REDD+ activity is expected to prevent unplanned deforestation, improve community participation and income, as well as maintain biodiversity as co-benefit of the REDD+.By improving the park condition in all zones, it will make the MBNP provides its environmental good and services optimally.

# 4. CLOSURE

REDD+ is a performance based activity that the success of REDD+ is based on how much emission reduction and enhancement of carbon stock have been made. From the implementation of DA REDD+ in MBNP, project additionality is gained from avoiding deforestation rate which is only 28.2 ha/yearor emission reduction by295,036 $tCO_2e$ during crediting period (30 years).

As conservation area, MBNP consists of zones in its utilization. One of the zone is the rehabilitation zone. In the rehabilitation zone that cover an area of 4,023 hectares, enhancement of carbon stock through rehabilitation activities can be done on areas that have been damaged by encroachment in 1998.

Additionality from enhancement in rehabilitation zone during crediting period (30 years) is estimated to 1,020,966$tCO_2$-e for 160 trees/ha, 1,189,387$tCO_2$-e for 240 trees/ha and 1,610,441$tCO_2$-e for 300 trees/ha

However, there has been threat to the sustainability of the conservation areas due to community activities and growth. The success to achieve carbon benefits depend on community participation and involvement. They can be a source of emission/threat and can involve in activities to conservation and enhancement of C stock. Lesson learned from DA REDD+ in conservation areas of MBNP show that community eager to participate in REDD+ activities, however they need long term assurance to access the MBNP (especially in rehabilitation), to have additional income for their daily needs.

DA REDD+ in conservation areas has shown multiple benefits not only carbon but also community and biodiversity. Although carbon benefits cannot be high but incentives should be given to conservation areas that high carbon stock and biodiversity value. Incentive mechanism for conservation areas should be given with possible sources not only from compliance global mechanism but also from local incentives such as national bugdet allocation, national carbon market or other mechanism.

## REFERENCES


Aliadi, A, NurhadidanWibowo, A. 2013.Community Involvement to Support Enhancement of Carbon Stock in Rehabilitation Zone of MeruBetiri National Park.Technical Report No 24, ITTO PD 519/08 REV.1 (F) In Cooperation with Forestry Research and Development Agency Ministry of Forestry, Indonesia. Bogor.

Aliadi. A. 2012. Pengembanganalternatifpendapatanuntukmeningkatkantarafhidupmasyarakatlokal di sekitar Taman NasionalMeruBetiri.LaporanTeknis No 19, September 2012. ITTO PD 519/08 REV.1 (F) In Cooperation with Forestry Research and Development Agency Ministry of Forestry, Indonesia. Bogor.

Arifanti, VB, danMarthinus, D. 2013. Establishment of Project Boundaries of REDD+ and Landcover Re-classification in MeruBetiri National Park. Technical Report No 23.ITTO PD 519/08 REV.1 (F) In Cooperation with Forestry Research and Development Agency Ministry of Forestry, Indonesia. Bogor.

Balai Taman Nasional Meru Betiri. 1999-2012. Laporan Tahunan Balai Taman Nasional Meru Betiri.

Balai Taman Nasional Meru Betiri. 2011. Laporan Baseline Desa Penyangga. Balai Taman Nasional Meru Betiri.

Cerindo. 2013. Draft Project Document Avoiding Unplanned Deforestation, Verified Carbon Standard.

CIFOR. 2011. Standards and methods available for estimating project-level REDD+ carbon benefits Reference guide for project developers. Working Paper, No. 52. CIFOR, Indonesia.

IPCC. 2003. Good Practice Guidance for Land Use, Land-Use Change and Forestry. Intergovernmental Panel on Climate Change. IPCC National Greenhouse Gas Inventories Programme. IGES. Japan.

IPCC. 2006. IPCC Guidelines for National Greenhouse Gas Inventories. IPCC National Greenhouse Gas Inventories Programme. IGES, Japan.

Lugina, M, Zuhud, EA, danGinoga, KL. 2010. Review existing schemes and lessons learned from the surrounding areas. Technical Report No 1.ITTO

PD 519/08 REV.1 (F) In Cooperation with Forestry Research and Development Agency Ministry of Forestry, Indonesia. Bogor.

Marthinus, D, Wibowo, A, Boer, R dan Ok Ma, H. 2011. Review on Methodology for Application of REDD+ Project in Conservation Area of MBNP, East Java for Voluntary Carbon Mechanism. Technical Report No 9.ITTO PD 519/08 REV.1 (F) In Cooperation with Forestry Research and Development Agency Ministry of Forestry, Indonesia. Bogor.

Subarudi . 2011. PelatihanInventarisasiSumberDayaPetani. LaporanTeknis No 15, Desember 2011. ITTO PD 519/08 REV.1 (F) In Cooperation with Forestry Research and Development Agency Ministry of Forestry, Indonesia. Bogor.

Tim BadanLitbangKehutanandan Taman NasionalMeruBetiri. 2011. Review tentang illegal logging sebagaiancamanterhadapsumberdayahutandanimplementasikegiatanpengurangan emisidarideforestasidandegradasi (REDD+) di Indonesia. LaporanTeknis No 11. ITTO PD 519/08 REV.1 (F) In Cooperation with Forestry Research and Development Agency Ministry of Forestry, Indonesia. Bogor.

Tim Taman NasionalMeruBetiri. 2012. Meningkatkankelembagaandanpemberdayaanmasyarakatuntukmengatasimasalahpenebangan liar di Taman NasionalMeruBetiri. LaporanTeknis No 17, Januari 2012. ITTO PD 519/08 REV.1 (F) In Cooperation with Forestry Research and Development Agency Ministry of Forestry, Indonesia. Bogor.

Tim Taman NasionalMeruBetiri. 2012. Peningkatankesadaranmasyarakatdanparapihakuntukmendukung REDD+ dankelestarian Taman NasionalMeruBetiri. LaporanTeknis No 18, Agustus 2012 ITTO PD 519/08 REV.1 (F) In Cooperation with Forestry Research and Development Agency Ministry of Forestry, Indonesia. Bogor.

Tim Taman NasionalMeruBetiri. 2013. Pelatihanpembuatanbibitjamurtirambagimasyarakatdesapenyangga TamanNasionalMeruBetiri. LaporanTeknis No 26. ITTO PD 519/08 REV.1 (F) In Cooperation with Forestry Research and Development Agency Ministry of Forestry, Indonesia. Bogor.