# Comparison of Feasibility between Large Scale and Small Scale A/R CDM Cooperated with Local Peoples in East Java, Indonesia

(Summary)

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## 1. Preparation for Reception of CDM in Host Country

Government of Republic of Indonesia legislated Elucidation law of the republic of Indonesia Number 17 of 2004 concerning ratification of Kyoto Protocol to the United Nations Framework Convention on Climate Change, and ratified Kyoto Protocol in October 19, 2004. DNA will be established after the approval by several ministries and government offices as of February 24, 2005.

## 2. Outlines of the Project

Project site is Probolinggo District in East Java Province, Republic of Indonesia. Outlines of the project are shown in **Table-1**.

Irrigation system by deep wells will be introduced to improve the agriculture of this area as an incentive of participating farmers. The additionality of this project is establishment of irrigation system by deep wells. Irrigation system will improve the agricultural yield by more than two times harvest in a year, increase the possibility to chose the planting species both crops and trees and promote the growth of planted trees. Common business of plantation trees or forestation will not be implemented in this heavy drought area, because more fertile and unnecessary irrigation system area is widely spread in East Java Province. The aforestation/reforestation in this area will be implemented only under the A/R CDM system.


Figure-1 Project site in Probolinggo district, East Java, Indonesia

Table-1 Outlines of the Project

| Category | Items | Summary |
|---|---|---|
| Basic condition for the Project | Name of the Project | AR CDM Project in Probolinggo Distric, East Java Province |
| | Category of CDM | Sink |
| | Project type | Reforestation / Afforestation |
| | Objective of the Project | (1) Increase the CO2 sequestration<br>(2) Supply wood materials and reduce the felling pressure on the natural forest<br>(3) Improve the land productivities and prevent land degradation<br>(4) Contribution for the local economy and local peoples' life |
| | Object area and boundary of the project site | Four sub-districts in Probolinggo district, East Java, Indonesia<br>Sub-district / area(ha) / Plantation method:<br>Tongas / 500 / Combination of agro-forestry and industrial plantation<br>Lumbang / 500 / same with above<br>Wonomerto / 300 / same with above<br>Sumberasih / 200 / same with above<br>Total / 1,500 / |
| | Project period | 20 years |
| Project structure | Structure | Cooperated project by Sumitomo Forestry (SFC), KTI company, land owners/farmers, leader of farmers (president of university in Probolinggo) |
| | Roles of participants | SFC: Funding, technology transfer, Coordinate of CDM project, administration on CDM<br>KTI: Implementation of the Project, monitoring<br>Land owners: Participants of the project |
| Technology | Technology transfer | Transfer the Silviculture and Forest management technology including extreme technology |
| | Sustainable development | Irrigation system by wells promotes growth of crops and trees, increases the land productivities, and guarantee of buying wood materials by KTI stimulate the farmers' motivation for re-plantation |

<table>
<tr><td rowspan="4">Project design</td><td>Planting yea and area</td><td>Planting area (ha) in first three years<br><br>| Sub-district | 1st year | 2nd year | 3rd year | Total |<br>|---|---|---|---|---|<br>| Tongas | 167 | 167 | 166 | 500 |<br>| Lumbang | 167 | 166 | 167 | 500 |<br>| Wonomerto | 100 | 100 | 100 | 300 |<br>| Sumberasih | 66 | 67 | 67 | 200 |<br>| Total | 500 | 500 | 500 | 1,500 |</td></tr>
<tr><td>Planting species</td><td>Several species consists of mainly Gmelina (Gmelina arborea) and Waru(Hibiscus sp.)</td></tr>
<tr><td>Planting method</td><td>Agro-forestry system: Planting density is 1,000 pcs/ha, thinning to 400 pcs/ha by 7years old.<br>Yield age is 10 years old.<br>Planning the rotation of planting and harvesting in order not to decrease the standing volume in whole project area.</td></tr>
<tr><td>Usage of wood</td><td>Sawn timber, plywood, block-board and local use</td></tr>
<tr><td rowspan="3">Stakeholders</td><td>Local government's opinion</td><td>Nothing at present</td></tr>
<tr><td>Participant's opinion</td><td>Very aggressive</td></tr>
<tr><td>Interested party's opinion</td><td>Aggressive</td></tr>
<tr><td rowspan="8">CDM requirement</td><td>Credit period</td><td>20 years</td></tr>
<tr><td>CO2 sequestration</td><td>net anthropogenic GHGs removal by sinks = Actual net GHG - actual GHGs emission by project - Baseline net GHG - Leakage</td></tr>
<tr><td>Base line</td><td>Substitute the data of Pasuruan district in where the growth of fence trees on border of farms have been monitored continuously since last year.</td></tr>
<tr><td>Monitoring</td><td>Monitoring the biomass above ground, below ground and soil carbon as a carbon pool. Litter and dead wood will be evaluated zero (no stock) as default.</td></tr>
<tr><td>Indirect impact, leakage</td><td>Excrete CO2 on wood transportation by fuel of truck after the beginning the harvest</td></tr>
<tr><td>Environmental Impact</td><td>Environmental impact assessment (EIA) is not need in case of plantation of less than 10,000ha. EIA of irrigation wells have been done.</td></tr>
<tr><td>Risks</td><td>There will be noting</td></tr>
</table>

| | | |
|---|---|---|
| | Feasibility of the Project | Calculating the profit and loss of the project assuming the credit price between 0～20$/tonCO2. |
| Project planning | Planning | Planning the plantation project based on the Forestry planning method. |
| | Simulation | Studying and comparing IRR of large scale (1500ha) and small scale (500ha) AR CDM |

## 3. Baseline Methodology

3.1 Title

"Reforestation of Crop Land Using Tree-based Agroforestry System"

### 3.2 Project condition for implementation

(1) Agricultural area or abundant area for long time because of heavy drought

(2) Local peoples have produced their own food in their land

(3) There is no economical leeway to plant trees.

(4) There will be not feasible of tree plantation in the project site, and government also dose not encourage the planting trees.

(5) There will be rich labors/workers in and around the project site.

### 3.3 Carbon pool

Above-ground biomass, below-ground biomass and soil carbon

### 3.4 Baseline of the Project

Baseline is defined the change of the carbon pool except CDM project. Measurement of baseline will be proceeded on the following steps;

(1) Analyze the history of land use in the project area.

(2) Asses the dependency of community on their land in meeting their needs.

(3) Identify key barriers for the implementation of AR-CDM Projects

(4) Measure or estimate carbon stock in the carbon pools from lands being used for AR-CDM project

### 3.5 Baseline approach

The change of carbon stock in the project boundary at present

### 3.6 Considering the situations and policy of government or local government

The aim of this project is an improvement of food and wood material production using agro-forestry system, and the project lives up to the policy of central and local government. The step of process will be as follows;

(1) Identify regulations and/or decrees related to industrial timber development, particularly on source of raw material for wood industries.
(2) Analyze policies/plans of wood industrial company to get raw materials.
(3) Analyze economic viability of establishing tree-based agroforest in community land to assess whether in the absence of carbon incentive (without CDM) private company is still willing to establish tree-based agroforest in community land
(4) Provide additional data or documents that can confirm the result of analysis (if available).

### 3.7 Explanation of decision process on baseline scenario in the methodology

It is assumed that local peoples will not change the land use by themselves as long as no approach from outside. The change of carbon stock in the baseline scenario will be estimated with following steps;

(1) Identify land use cover within the project boundary before project is implemented.
(2) Project future land use change within the project boundary under the absence of the project taking into account land use history and government plan or policy.
(3) Estimate biomass carbon pools of each land use within the project boundary using best available biomass data before the project is implemented.
(4) Calculate the change in carbon stock using the result of land use projection describe in the step 2 above.

### 3.8 Verification of additionality in the project

Additionality will be proved by the following steps;

(1) Provide legal/official documents that the project is not part of government laws and regulations and other activities similar to the project (activities that produce outputs or services comparable with the proposed CDM project) are not widespread.
(2) Perform analysis to show that the project is economically and financially less attractive than the other similar activities (excluding revenue from sale of CERs) through investment and sensitivity analysis. The sensitivity analysis is to show that the result of the investment analysis is robust to reasonable variations in critical assumptions. If the investment analysis shows that the CDM project is economically and financially attractive (excluding revenue from sale of CERs) then go to step (3)
(3) Show that there are barriers that may prevent the projects from occurring such as low of survival rate due to climate condition. The project should show how the barriers are removed and their associated cost. If the associated cost is

included (excluding revenue from sale of CERs) the project is becoming economically and financially less attractive.

### 3.9 Measurement of Baseline vegetation

The Diameters at Breast Height (DBHs) and heights of fence trees as border of land in a plot established in December 2003 in Grati sub-district, Pasuruan district, were measured. The growth in dry weights of trees on each border line of land in one ha for one year was estimated as follows;

**Table-2 Changes of estimated dry weights of trees on borders of land and estimated CO2 weight in trees**

| border line | Dry weight (kg) in 2003/12/24 | Dry weight (kg) in 2005/1/13 | Growth (kg) |
|---|---|---|---|
| A | 5,142.82 | 6,051.47 | 908.65 |
| B | 2,511.32 | 1,987.91 | -523.41 |
| C | 664.34 | 738.05 | 73.71 |
| D | 4,173.73 | 3,762.21 | -411.52 |
| E | 322.63 | 280.26 | -42.37 |
| F | 2,873.05 | 3,485.25 | 612.20 |
| Total | 15,687.89 | 16,305.15 | 617.26 |
| Estimated $CO_2$ weight in trees(kg) | | | 1,131.64 |

The growth of trees in a year was estimated 617kg/ha/year or 1.131ton/ha/year of CO2 weight. These trees and branches are used for feed of farmers' domestic animals or fuel woods. Therefore the growth of trees is estimated to be stable in long term. The baseline of tree growth on borders is defined as Zero.

### 3.10 Emission and Leakage

Estimated emission and leakage of $CO_2$ on the implementation of the project are shown on Table-3.

Table-3 Estimated emission and leakage

| Item | Analyzed factor | Calculation | Result |
|---|---|---|---|
| Fuel consumption in household | Car and energy for house-work | Neglected because the cause and effect is unclear | 0 |
| Emission from transportation of seedlings | Distance of transportation | Planting seedlings 20 years is approx. 3,700hax1,100pcs/ha = 4,070,000pcs. Approx. 4,000 pcs of seedlings are moved in one truck, and 1,000 laps on 10km. 1,000x20km=20,000km. Mileage of truck is 6km/litre of light oil. 20,000km/6km X 2.624kgCO2/Liter =8,747kg/20years 8.75CO2-ton/20years = 0.438CO2-ton/year | 0.44 $CO_2$-ton/year |
| Emission from fuel of car for control of project area | Distance of running | 50km/day by one car is standard. 5okmx25daysx12months =15,000km. Mileage is 10km/L, so 1,500Lx2.322kgCO2/L =3,483kg/year=3.48tonCO2/year | 3.48 $CO_2$-ton/year |
| Emission from fuel for pumps of irrigation wells | Running time of pumps | Capacity of pump=10L/sec, mileage of light oil=1L/h, running time =6h/day x 6days/week x 4weeks x 4month Total fuel=1Lx6hx6daysx16weeks=576L 576Lx2.624kgCO2/L=1511kgCO2/year. Units of pump will be 45 unit, so that 1.511tonCO2x45=68.00 tonCO2/year | 68.00 $CO_2$-ton/year |
| Emission from fertilizing | Estimated from a method in Good Practice Guidance | Fertilizer (N=15%) will be provided 80g/tree in the 1st year, and 120g/tree in the 2nd year. 80g X 1,100tree/ha=88kg/ha in the 1st year and 120g/tree X 900tree/ha=108kg/ha, 196kg/ha in total x15%＝29.4kg/ha of Nytrogen. 1.25% of N is changed to $N_2O$ (GPG3.2.1.4.1.2). So that 29.4kg X 1.25% x 310 (Emission factor of $N_2O$) =0.115 $CO_2$ton/ha/planting time. As the total planting area will be 3,700 ha for 20 years , 0.115 $CO_2$ton/ha x 3,700/20years=21.3$CO_2$ton/year | 21.3 $CO_2$ton/year |
| Emission from pick-up bus for labors | Distance of transportation | Working days per year; 250 days, by 4 cars, 40km running per day. 40km X 4units X 250days/6km/litre x 2.624kgCO2 =17,493kgCO2 =17.50CO2-ton/year | 17.50 $CO_2$-ton/year |

| | | | |
|---|---|---|---|
| Emission from heavy equipment and cars for harvest | Running distance | Two heavy equipments working 125 days/year, 1km/day, mileage 1L/km.<br>2kmx125daysx2unit/1km/Lx2.624kgCO2/L=1,312kgCO2 =1.312tonCO2 | 1.31<br>$CO_2$ton/year |
| Emission from chain saw | Running time | Gasoline usage for harvest is 0.2L/m3, and harvest volume for 20 years will be 430,000m3. Hence, 0.2L/m3 x430,000m3 =86,000L.<br>Emission factor of gasoline; 2.322kgCO2/L.<br>Emission for 20 years; 86000Lx2.322kgCO2/L =199,692kgCO2, 199.692/20=9.98tonCO2/year | 9.98<br>$CO_2$ton/year |
| Leakage from trucks for log transportation | Distance from the project site to factory | 10 m3 of log will be transported by one truck, distance from harvest site to factory is 50 km, mileage of light oil is 6km/L, emission factor of light oil is 2.624 $CO_2$kg/L. 50km/6km/Lx2.624/10m$^3$=2.187kg$CO_2$/m$^3$. Harvest started from the 7th year and average volume is 30,000m3 per year. Hence, 2.187 x30,000m$^3$/year=65.6$CO_2$ton/year after 7$^{th}$ year. | 65.6<br>$CO_2$ton/年 |
| Total Emission | | | 119.62<br>CO2ton/year |

## 4. Monitoring methodology

### 4.1 Name of Methodology

“Reforestation of crop land using tree-based agroforestry system“

### 4.2 Carbon stock and other GHG

Carbon stock of above ground biomass, below-ground biomass and soil carbon will be measured. Dead tree and litter will not be considered as they are usually very small compared with the carbon stock of the above ground (Zaini & Suhartatik, 1997; Tresnawan & Wasrin, 2002; Tiepolo *et al.*, 2002 ).

$N_2O$ from fertilizer will be calculated along a method of GPG (Good Practice Guidance) and Methane (CH4) will be disregarded.

### 4.3 Measurement method of carbon pool

(1) Carbon sequestration in above ground biomass and below ground biomass

Above ground biomass will be estimated from diameter at breast height (DBH) and height from destructive sampling and below ground biomass will be estimated from aboveground biomass using conversion factors.

Project participants (farmers and/or land owners) will measure all trees belonging them and report the project developer. The developer will record all data such as measuring date, owners name, all DBH and height of alive trees, estimated below-ground biomass, etc. in computer. If the difference between estimated growth and actual growth is too bigger or to smaller than estimation at the beginning of the project, the growth late and plan of planting and harvest will be revised.

(2) Soil carbon

Soil-carbon is monitored in the steep areas only. Developer will establish plots, and collect soil samples and analyze by Walkley and Black method in every 5 years.

### 4.4 Kinds and measuring method of emission in the implementation of the project

Monitoring will be carried out on the following subjects;

(1) Use of fossil fuel for transportation

(2) Fossil fuel consumption for harvesting

(3) Use of fossil fuel for pumping water

(4) Energy from oming and going of materials and labors by/for agriculture

(5) Fossil fuel and electric energy of project participants

### 4.5 Potential strengths and weaknesses of this project

The strengths and weaknesses of this project are as follows;

#### 4.5.1 Strengths

(1) Simple, easy, low cost for monitoring

(2) No estimate error of sampling by measuring all trees. Easy to measure and no training to the participants

(3) No complaint from participants by measuring themselves

(4) Calculating above ground biomass and analyzing soil carbon are already used by project developer, hence do not need special training to do to the participants.

(5) the project developer can easily develop some of default values such as biomass expansion factor at the time of harvesting.

(6) It is possible to monitor and maintenance the latest data by routine activities consecutively, and this will save project's budget.

(7) Other data such as social economy and environmental impact shall be provided for the project gathered by simple and easy-done method, which need no special

trainee to run.

### 4.5.2 Weaknesses

(1) If the survey carried out would not be run by appropriate and capable persons, thus the data quality will be not eligible for the assessment/ counting of green house gas emission.

(2) Experts or some training are need to calculate the carbon sequestrations.

(3) Sometimes it is hard to collect government data

(4) The satellite image photos are useful for the project, however they are very expensive and there are not always suitable.

## 5. Carbon sequestrations of the project

Carbon sequestration in 1,500ha plantation model is estimated 153,000 ton-CO2 for first ten years and 60,000 ton-CO2 for the second ten years. Baseline is Zero because of no net growth of trees on border of land, emission and leakage for first 6 years is 65,600 ton-$CO_2$ and 175,100 ton-$CO_2$ in total after 7th year. Risk is estimated 5% of total carbon sequestration. The net anthropogenic GHGs removal by sinks is 144,000 ton-$CO_2$ for the first 10 years and 56,000 ton-$CO_2$ for the second 10 years.

While carbon sequestration in 500ha plantation model is estimated 51,000 ton-CO2 for first ten years and 20,000 ton-CO2 for the second ten years. Baseline, emission, leakage and risks are 1/3 of the 1,500ha model. The net anthropogenic GHGs removal by sinks is 48,000 ton-$CO_2$ for the first 10 years and 18,000 ton-$CO_2$ for the second 10 years.

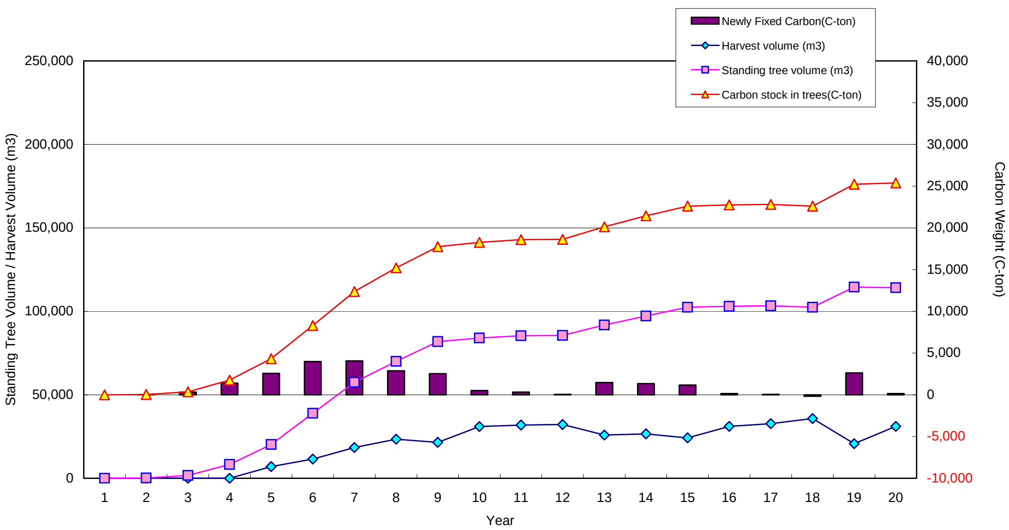


Figure-2 Estimated standing volume, above ground carbon stock and haevest volume of the project area.

## 6. Result of feasibility

We focused expense for land use and CER price. Expense for land use is studied two ways, one is sharing harvest system and land lease. In this sharing harvest system, the share of land owner and developer is 50:50. Three prices of land lease are studied, 50USD/ha/year, 100USD/ha/year and 150USD/ha/year, respectively. Prices of CER are considered from 0 USD/ton-CO2 to 20 USD/ton-CO2, and IRR of each case is calculated. The results are as follows;

(1) Under the standard of investment of IRR is more than 20%, it is feasible in large scale (1,500ha) A/R CDM only in case of land lease is less than 100USD/ha/year and CER price is more than 15 USD /ton-CO2.

(2) In small scale (500ha) A/R CDM, the cost of the project are lower and feasibility is better than large scale. But the high price, more than 15USD//ton-CO2, of CER is needed for clear the investment standard.

(3) The price of CER is very important to shorten the reaching time to the annual surplus or dissolution of deficit, in particular, in case of adopting sharing harvest system or high price of land lease.

Table-4 IRRs in large scale (1,500ha) A/R CDM in various prices of CER and land lease system.

| Land lease (US$/ha/year) | Sharing harvest for developer (%) | Price of CER (US$/ton-CO2) | | | | |
|---|---|---|---|---|---|---|
| | | 0 | 5 | 10 | 15 | 20 |
| 0 | 50% | 0.5 | 4.1 | 6.9 | 9.5 | 12.1 |
| 50 | 100% | 11.9 | 13.8 | 15.6 | 17.6 | 19.4 |
| 100 | 100% | 9 | 10.9 | 12.8 | 14.6 | 16.5 |
| 150 | 100% | 5.8 | 8 | 9.9 | 11.8 | 13.6 |

Table-5 IRRs in small scale (500ha) A/R CDM in various prices of CER and land lease system.

| Land lease (US$/ha/year) | Sharing harvest for developer (%) | Price of CER (US$/ton-CO2) | | | | |
|---|---|---|---|---|---|---|
| | | 0 | 5 | 10 | 15 | 20 |
| 0 | 50% | 6.2 | 9.2 | 12.1 | 15 | 17.4 |
| 50 | 100% | 16.8 | 18.9 | 21.1 | 23.4 | 25.2 |
| 100 | 100% | 13.7 | 15.7 | 17.8 | 19.4 | 22.1 |
| 150 | 100% | 10.6 | 12.6 | 14.7 | 16.7 | 18.7 |
| 200 | 100% | 7.2 | 9.5 | 11.5 | 13.6 | 15.6 |

## 7. Comparison the large scale A/R CDM and small scale A/R CDM

The small scale A/R CDM is advantage to large scale. The main reasons are as follows;

(1) Average area of land of participants (farmers) is less than 1 ha, therefore several thousands persons will join the A/R CDM project. It is difficult to organize and control so many persons, and also difficult to understand the intent and complex rules for them.

(2) The risks on the management and illegal felling increase in larger scale.

(3) Cost and facilities for management on the project is smaller.

(4) Risks for marketing the harvested logs are smaller because of small amount of harvest volume.

## 8. Important points for the promotion of A/R CDM

Some very important points for the promotion of A/R CDM are shown as follows;

(1) Systems and Rules after the Second Commitment Period

There many important points are remained unsolved such as the time span of the Second Commitment Period that effect the time span of validity of CERs. We should take note the next COP 11.

(2) Validity of CER and compensation

The compensation of CER at the closing project is very heavy duty for the developers, CER buyers and investors. Especially, at present it is not clear who are responsible to compensate the credit, hence the CER price is depreciated. Almost investors may hesitate to invest to A/R CDM by this issue.

(3) High transaction cost

High cost for the validation and verification force up the initial cost of plantation. Feasibility of plantation forestry business is usually very low because of long term to get profit and low profitable. The expense of this initial cost is very severe. Any subsidiary scheme will be needed.

(4) Subjects for organizing local peoples

Selecting leaders (including sub-leaders) and organizing cooperation binding local peoples are the most important issues for the project cooperated with many local peoples. Selecting the top leader who are high status and respected person and training the next leaders are needed. Sharing information, promoting planting for the participant, establishment of pickup system for agro crops, supporting system for local peoples' wood manufacturing and/or transportation etc. will be effective for the organization.