Sustainable Development Models
Of Plantation Forest With Coal Mine In The Forest Production

Fatma Djuwita,
Priyono Tjiptoherijanto, Herman Haeruman, Surna T. Djajadiningrat

Abstract
The dissertation examined integrated exploration of natural forest and coal mines in the area of forests based on Extended Benefit-Cost Analysis. This particular research was conducted in a quantitative research with the design of exploratory and development. The exploration of plantation forest for the purpose of unrestricted coal mining activities in the Production Forest has an effect to the plantation forest and the disturbances to the ecosystems of production forest. It needs an appropriate cost for compensation to the employers of plantation forest, the Governance and the social development of the local communities due to the declining of the exploration areas and the optimal decision of forest plantation which are for the purpose of coal mining.

In order to manage the plantations and coal mines in synergic ways to support sustainable development and at the same time preventing losses among the managers of exploitation, it is necessary to define a model for the plants and forest management based on optimum area suitable for coal mining and establish a certain compensation rate to employers, government and society as a result of the exploitation of the forest areas for mining.

Keywords: Forest Plantation, Coal Mines, Forest Production, Compensation, Optimal Area, Benefit and Cost Analysis.

1. INTRODUCTION

Indonesia is a country rich in natural resources, which include renewable and non-renewable natural resources. Indonesia’s forests as renewable natural resources contained biodiversity of flora and fauna. It also has many mineral resources, which include coals.

Miranti (2008) explained that the Indonesian had a high consumption on coal in the last ten years, i.e. from ± 13.2 million tons in 1997 to ± 45.3 million tonnes in 2007 (up 243%). Based on data collected until the end of 2011 by

Fatma Djuwita is with the Environmental Science Study Program, Postgraduate Program, University of Indonesia, Jakarta, Indonesia

Karo-Karo Gurusingam from The Center for Coal and Mineral Resources, Geology Agency Ministry of Energy and Mineral Resources, it stated that Indonesia’s coal resources has increased to 161 billion tons, which consists of up to 120 billion tons from Open Pit sources and 41 billion tons from Underground sources, with additional reserve of 28 billion tons (Isuenegi, 2012).

Minister of Forestry issued a Decree No. SK. 79/Kpts-II/2001 dated March 15, 2001 on the utilization of Forests and Waters in East Kalimantan Province. It has appointed 14.65 million hectares of forest area in East Kalimantan province to be utilized (in percentage, this area is 10.98% of Indonesia’s forest area or 73.83% of East Kalimantan). From those appointed forest area of East Kalimantan, it resulted in Protected Forest area about 2.75 million hectares, Conservation Area about 2.17 million hectares, Production Area about 9.73 million hectares, and Aquatic Area about 0.50 million hectares.

Based on the digital calculation of coal mines distribution in East Kalimantan Province in 2007, there were a total of 467 coal mines over 2,706,196 hectares area (13.64% from total area in East Kalimantan province. Out of the total area, 1,488,203 hectares or 54.99% were in the forest area which scattered on Protected Forest areas (HL) about 107,084 hectares, forest Conservation (HK) 108,460 hectares, Production Forest (HP) 1,272,658 hectares, and Aquatic area 13,725 hectares (Ministry of Forestry, 2010).

Out of 1,488,203 hectares mining area located on the forest area, there was 77.62% or an area of 1,155,206 hectares that overlap with Forest Product Utilization License (IUPHHK) areas which consists of Business License Timber Utilization on Natural Forests (IUPHHKHA) covering 801,053 hectares and
Exploitation Permit-Timber Forest Plantation (IUPHHK-HT) covering 354,153 hectares. However, the remaining mining area of 332,997 hectares did not overlap with IUPHHK-HA/HT area. The increasing price of coal which leads to a high number of overlapping area between IUPHHK-HT, could be a predicting factor in the steep rise of coal production. In return, the rise of IUPHHK-HT area of utilization could increase of level of damage in IUPHHK-HT areas and its environment and threaten the livelihood of IUPHHK-HT. On the other hand, coal mining has a very strategic role and major contribution to the state economy.

In order for the management of plantations and coal mines to run in synergy with sustainable development, as well as to avoid loss of profit among the managing companies, it was necessary to set crop and forest management model based on an optimum forest area that is viable for coal mining and a fixed compensation for profit losses to the plantation companies, government, and surrounding residents due to mining activities.

To determine whether sustainable development can be implemented in managing forest plants and coal mines in synergy, this study’s hypotheses are:
1. There is a need for extensive analysis on optimum utilization of forest area for coal mining to support the concept of sustainable development.
2. A need to analyze the value of compensation that coal mining production caused on the function and production of actively maintained forests.
3. To create a model of a sustainable development of forest plants and coal mines in the overlapping areas within actively maintained forests.

1.1. Research objective
Research questions that need to be analyzed are:
1. How much the optimal use of extensive plantation areas for coal mining?
2. How to count the value of compensation to be prepared by the management of the coal mine to the plantation managers, government and society?
3. How to build a model of forest management on plant and coal mine in an overlapping areas?

1.2. Study Area
The study was conducted at working area of Sumalindo Hutani PT Jaya Unit II (SHJ Pt. II) due to the Decree of the Minister of Forestry. SK. 675/Kpts-II/1997 dated October 10, 1997 consist of 70.300 hectares valid for 50 (fifty years (1997-2047) and in the area of Forest Area Usage Permit (IPPKH) situated in IUPHHK SHJ-HT PT II at 6,955.17 hectares.

The study was conducted in November 2011 to February 2012. Reasons for conducting the study in November is due to administration paperwork.

1.3. Population and Sampling
This study is using a secondary data, thus no need for the population and sample

1.4. Formulas and Analytical Methods
A development categorized as sustainable if it meets three dimensions, namely: (1) economically feasible, (2) socially appropriate, and (3) ecologically feasible. To ensure the sustainability of forest plants and coal mines, the Cost Benefit Analysis conducted on 3 aspects sustainable development, namely: an analysis of the financial, ecological and social, by using the formula:

The Net Present Value (NPV) analysis used to determine the equivalent value today of cash flow (cash flow) of revenues and expenditures in the future from an investment plan; criteria for acceptance of an investment plan with the current method is if the investment plans of the above have a value Positive current, NPV > 0.

\[ NPV = \sum_{t=0}^{n} \frac{B_t - C_t}{(1+i)^t} \]  

The Benefit Cost Ratio Analysis (BCR), was conducted by way of comparison between the value of benefits equivalent to the cost of an equivalent value; criteria for acceptable / success of an investment plan is that if the BCR has a value greater than one, whereas if the value of the BCR was less than one, then investment plan was rejected / failed.

\[ BCR = \frac{P_{Benefits}}{P_{Costs}} \]  

II. RESULTS AND DISCUSSION

2.1. Benefit and Cost Analysis at Plantation Forest
The data analysis used main plant area 54,131 hectares of plantations (before there was a coal mine) and an area of 44,289 hectares (after a coal mine area of 10%) and 53,639 hectares (after mining is completed as it will void left 10% of the coal mines). Discount factor used is in accordance with the prevailing bank interest rates today, i.e. 11%.

2.1.1. Financial Analysis
The analysis of financial benefit involved these components (a) forest value at recovery time and (b) timber value during company operating time, (c) timber value after mining company completed their
operation. Financial analysis will count (a) planning cost, (b) planting cost, (c) maintenance cost, (d) forest fire preventing cost, (e) tax, (f) social responsibility cost, (g) facility building cost, (h) general administration cost, and (i) timber harvesting cost.

2.1.2. Ecological Analysis

Ecological benefit analysis will involved these components: (a) controlling interference, (b) nutrient cycling regulating, (c) flood stopper (d) flood control, (e) storage of biological diversity, (f) the formation of soil layer, (g) erosion control, (h) air regulator, (i) water supply for domestic use, (j) rice water providers, (k) carbon sequestration, (l) value of the crops have not been harvested, (m) recreation, (n) the value of existence, and (n) the value of choice. Ecological cost component is the cost of plantation establishment. If the forest plantation were not built, then the ecological function within the forest plantation ecosystem will not be existing.

2.1.3. Social Analysis

At this part, the components to be analyzed are: (a) the income of people working as employees in the plantation, (b) the income of forest plant communities who depend on forests, and (c) the availability of facilities and infrastructure for the construction of forest plantation activities. Component that was analyzed as a social cost was a public health fund that was allocated for the community around the forest plantation.

2.1.4. Total Cost Benefit Analysis of Forest Plantation

Calculation results and partial cost benefit analysis showed that the financial, ecological and social forest crops on existing mining operations over 10% area still gave a positive result, which means it was feasible for plantation activities to be carried out together with coal mining activities.

The third analysis of the benefits and costs of plantations showed the highest yield was from the analysis of the benefits and the ecological and social costs, while the financial cost benefit analysis contributed the lowest value compared to ecological and social analysis. It can be seen from the value of financial BCR is only 1.28 whereas the ecological and social value respectively 2.47 and 3.94. Calculation results can be seen in Table 1, and Table 2. And detail calculation can be seen in attachment 1 to 3.

<table>
<thead>
<tr>
<th>Table 1. Total NPV forest plantation, before Coal Mining</th>
<th>(US$ x 1,000)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Item</td>
<td>Financial</td>
</tr>
<tr>
<td>Total Benefits PV</td>
<td>404,794,414</td>
</tr>
<tr>
<td>Total Costs PV</td>
<td>316,931,800</td>
</tr>
<tr>
<td>NPV</td>
<td>87,862,614</td>
</tr>
<tr>
<td>BCR Ratio</td>
<td>1.28</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Table 2. Total NPV forest plantation, after Coal Mining</th>
<th>(US$ x 1,000)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Item</td>
<td>Financial</td>
</tr>
<tr>
<td>Total Benefits PV</td>
<td>372,837,438</td>
</tr>
<tr>
<td>Total Costs PV</td>
<td>342,544,910</td>
</tr>
<tr>
<td>NPV</td>
<td>30,292,528</td>
</tr>
<tr>
<td>BCR Ratio</td>
<td>1.09</td>
</tr>
</tbody>
</table>

As stated, a comparison of total NPV plantations without coal mining activities with a total NPV of forest plant after coal mining activities in the plantation areas showed that there was the difference in total NPV of US $ 210,764,734 (US $ 6,057,374,617 - US $ 5,846,609,883).

With positive NPV result, the forest plantation management with or without mining activity still provide a feasible business activity at the usage of 10% from total area of forest plantation. However, with the existence of mining activity there is potentially loss revenue at US$ 210,764,734.

2.2. Benefit and Cost Analysis at Coal Mine.

2.2.1. Financial Analysis

The analysis of benefit component of coal mining was only the production of coal as a main commodity. Meanwhile, there were 19 cost components that were analyzed, namely: (1) cost of services Mining Areas Information Services, (2) Determination of cost of mining area coordinates, (3) costs Map Document Services Licensing Services, (4) the cost of mining area Compilation Services, (5) contribution Fixed general of Inquiry, Exploration, and Exploitation, (6) Royalty, (7) Technology Services, (8) general and administrative costs, (9) the cost of preparation of the EIA, (10) the cost of preparation of the Long Term, (11) the cost of preparation of the Annual Work Plan, (12) the cost of infrastructure development, (13) the costs associated with the forestry sector, (14) the cost of production, (15) the cost of CSR, (16) Reclamation costs, (17) cost revegetation, (18) the cost of maintenance year 1 to year 3, and (19) environmental cost.
Analysis of the benefits and costs of coal mines, carried out under the following conditions:

b. The area of coal mine according IPPKH is 6,955.17 hectares, but based on the work plan of the area of potential coal mine area of 4,219.40 hectares only, while the other area is not an area of 2,735.77 hectares and a potential mine infrastructure area.
c. Production activities carried out from 2008 to 2021, a total of 106,517,554 tons of coal.
d. Based on data from 6 coal mining company, the market price of U.S. $ 70/ton.

2.2.4. **Total Cost Benefit Analysis of Coal Mine**

The three analysis of the benefits and costs of coal mining, the highest NPV is NPV of social, financial and ecological NPV while contributing less than the social NPV coal mines. It can be seen from the value of 1.02 only financial BCR, BCR zero ecological, social and BCR of 1.20.

Based on the analysis of benefits and costs of coal mines in total, the resulting NPV still has a positive value, ie US $ 165,297,881, which means that coal mining is still feasible, even though in terms of the ecology of coal mining activities is not feasible. Calculation results can be seen in Table 3 and detail calculation can be seen in attachment 4 to 6.

### Table 3. Total NPV Coal Mine

<table>
<thead>
<tr>
<th>Item</th>
<th>Financial</th>
<th>Ecology</th>
<th>Social</th>
<th>Sum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Benefits PV</td>
<td>4,503,784,813</td>
<td>-</td>
<td>406,659,775</td>
<td>4,910,444,588</td>
</tr>
<tr>
<td>Total Costs PV</td>
<td>4,401,598,238</td>
<td>5,091,159</td>
<td>338,457,310</td>
<td>4,745,146,707</td>
</tr>
<tr>
<td>NPV</td>
<td>102,186,575</td>
<td>(5,091,159)</td>
<td>68,202,465</td>
<td>165,297,881</td>
</tr>
<tr>
<td>BC Ratio</td>
<td>1.02</td>
<td>-</td>
<td>1.20</td>
<td>1.03</td>
</tr>
</tbody>
</table>

2.1. **Analysis of Optimal Use of Forest Area For Coal Mine**

Outcomes and cost benefit analysis of forest plant emphasized that the use of forest land for coal mines up to 30% still generate a positive total NPV. It means that with the use of forest areas up to 30% is still in the business of providing feasibility plantations. More can be seen in Table 4.

### Table 4. Results of Total NPV analysis Forest Plantation at Different Levels of Use of Forest Land For Coal Mines

<table>
<thead>
<tr>
<th>NPV Value</th>
<th>The Use of Forest Land for Coal Mines (US$ x 1,000)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>10%</td>
</tr>
<tr>
<td>Financial</td>
<td>30,292,528</td>
</tr>
<tr>
<td>Ecology</td>
<td>5,725,131,959</td>
</tr>
<tr>
<td>Social</td>
<td>81,185,396</td>
</tr>
<tr>
<td>Sum</td>
<td>5,946,609,983</td>
</tr>
</tbody>
</table>

Noted the NPV of each analysis as it is known that the financial NPV with the use of forest area of more than 30% will give a negative NPV, while the ecological and social value of NPV is still positive. So it was determined that for the use of forest land for mining coal plant is at a maximum of 30% of the staple crop plantations.

Components of benefits and costs that affect the feasibility of plantations are:

(a) Use of forest area to 30%.

(b) decrease the potential price of wood or wood up to 22%.

(c) increase in the value of DF to 15.18%.
(d) increase in forest plantation development costs up to 32%.

Increase or decrease the financial component of plantations, as mentioned above, will generate NPV<0 and the value of BCR<1, so that a plantation activities not worth continuing. While the ecological and social components, does not affect the viability of plantations, due to the increase or decrease in the value of the ecological and social components of forest plants, will still produce NPV> 0 and BCR> 1.

2.2. Indemnity Value Analysis Forest Area to Use Coal Mine

Due to coal mining area of 10% (ten percent) of the total principal crop plantations, forestry crops suffer financial loss. By comparing the total NPV of forest plants with coal mining activities with a total NPV of forest plants that no coal mining activities, the value of the loss can be determined.

Difference in total NPV of forest plants are the basis of the value of the compensation paid by the coal mining company. From the analysis of the total NPV of forest plants, obtained compensation values are presented in Table 5.

Table 5. Total difference forest plantation

<table>
<thead>
<tr>
<th>Item</th>
<th>NPV Value (US$)</th>
<th>NPV Value / hectare (US$)</th>
<th>Percentage (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Financial</td>
<td>57,570,086</td>
<td>11,699</td>
<td>27.31</td>
</tr>
<tr>
<td>Ecology</td>
<td>150,055,515</td>
<td>30,493</td>
<td>70.20</td>
</tr>
<tr>
<td>Social</td>
<td>3,139,133</td>
<td>638</td>
<td>1.49</td>
</tr>
<tr>
<td>Sum</td>
<td>210,764,734</td>
<td>42,830</td>
<td>100.00</td>
</tr>
</tbody>
</table>

From Table 5. note that the difference in NPV of financial plantations U.S.$ 57,570,086, while the difference ecology NPV of U.S. $ 150,055,515, and the difference in social NPV of U.S. $ 3,139,133.

NPV of the three mentioned above, the highest difference is in the ecological value of NPV is equal to 71.20%, and 27.31% for the financial NPV and the last is the social NPV of 1.49%.

So the value of compensation as a result of coal mining activities in the area of plantation labor is U.S. $ 11,699/ hectare (NPV financially) to entrepreneurs plantations, U.S. $ 30,493/ hectare (NPV ecology) to the government and amounted to U.S. $ 638/ hectare (NPV social) to the community.

Coal mining activities, by including the value of the compensation in the financial analysis of the coal mine, will produce a positive NPV. What this means is that by entering the burden of compensation to the plantation company for U.S. $ 11,699/ hectare and to the government amounted to U.S. $ 30,493/ hectare well as to the public of U.S. $ 638/ hectare, will result in a positive NPV of U.S.$ 8,858,639.612 with BCR for 1.03%, which means that coal mining is still feasible. Coal mine NPV results can be seen in Table 6.

Table 6. Total NPV Value Coal Mine, after entering the burden of compensation

<table>
<thead>
<tr>
<th>Item</th>
<th>Financial</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total benefits PV</td>
<td>4,503,784.813</td>
</tr>
<tr>
<td>Total costs PV</td>
<td>4,354,854.399</td>
</tr>
<tr>
<td>NPV</td>
<td>8,858,639.612</td>
</tr>
<tr>
<td>BCR Ratio</td>
<td>1.03</td>
</tr>
</tbody>
</table>

III. CONCLUSIONS

Cost Benefit Analysis is based on financial feasibility, ecological and social aspects of natural forest management and Coal Mining can be summarized as follows are: Optimal use of extensive forest areas for coal mining is covering 30% of the staple crop plantations, with patchy distribution pattern in each block of natural forest. The Value of compensation in coal mining concession in the plantation areas is U.S. $ 11,699/hectare (financial NPV) to entrepreneurs plantations, amounting to U.S. $ 30,493/ hectare (NPV ecology) to the government and amounted to U.S. $ 638/hectare (social NPV) to the community. Sustainable Development Model on natural forests and coal mining is feasible to be created in synergy with 30% of forest utilization for coal mining and pay compensation to the value of plantation employers, governments and society.

REFERENCES


Torras., M., 1997. The Total Economic Value of the Amazonian Deforestation. Department of Economic and Finance, Adelphy University, Garden City; NY 11530 USA.

### Financial Analysis of Forest Plantation

| period | Planted | -12 | -11 | -10 | -9 | -8 | -7 | -6 | -5 | -4 | -3 | -2 | -1 | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|--------|---------|-----|-----|-----|----|----|----|----|----|----|----|----|----|----|---|---|---|---|---|---|---|---|---|---|
|        | unit    | 1   |     |     |     |     |     |     |     |     |     |     |     |     |    |   |   |   |   |   |   |   |   |   |
|        | price   |     |     |     |     |     |     |     |     |     |     |     |     |     |    |   |   |   |   |   |   |   |   |   |

#### MANFAAT
1. Land clearing recovery time (RP/m²): 300,000
2. Timber production:
   a. without IPPKH (RP/m³): 500,000
   b. Post IPPKH (RP/m³): 500,000
   c. Total Benefit: 615,125,000

#### DISCOUNT RATE (1/(1+r)^t)
11%

#### PV Benefits
- 3,50 3,13 2,84 2,59 2,30 0,29 0,29 0,29 0,29 0,29 0,29 0,29

#### BIAYA (x Rp. 1,000)
1. Planning:
   a. without IPPKH (RP/m²): 517,228
   b. Post IPPKH (RP/m²): 517,228

2. Planting:
   a. Taman Panak (RP/m²): 8,934,205
   b. Post IPPKH (RP/m²): 8,934,205

3. Cultivation:
   a. Taman Panak (RP/m²): 3,397,859
   b. Post IPPKH (RP/m²): 3,397,859

4. Fire controlling:
   a. without IPPKH (RP/m²): 917,063
   b. Post IPPKH (RP/m²): 917,063

5. Government Tax:
   a. without IPPKH (RP/m²): 151,463
   b. Post IPPKH (RP/m²): 151,463

6. Obligation to the social environment:
   a. without IPPKH (RP/m²): 222,129
   b. Post IPPKH (RP/m²): 222,129

7. Infrastructure:
   a. without IPPKH (RP/m²): 2,005,087
   b. Post IPPKH (RP/m²): 2,005,087

8. General Administration:
   a. without IPPKH (RP/m²): 9,733,512
   b. Post IPPKH (RP/m²): 9,733,512

### Total Costs
26,322,273

#### DISCOUNT RATE (1/(1+r)^t)
11%

#### PV Cost
- 3,50 3,13 2,84 2,59 2,30 0,29 0,29 0,29 0,29 0,29 0,29 0,29

### TOTAL
PER HEKTAR  TOTAL
- PV Benefit  51,823 3,641,149,729
- PV Cost  60,574 2,852,866,301
- NPV  11,246 790,703,578
- BCR  1.28 1.28

www.ijert.org
## Ecology Analysis of forest plantation

<table>
<thead>
<tr>
<th>Period</th>
<th>Year</th>
<th>Unit</th>
<th>Price</th>
<th>Volume</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Benefits</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Survival control</td>
<td>Apr-01</td>
<td>10,000</td>
<td>66.78%</td>
<td>1,002,130</td>
</tr>
<tr>
<td>2. Preventive control</td>
<td>Apr-01</td>
<td>15,000</td>
<td>66.78%</td>
<td>800,687</td>
</tr>
<tr>
<td>3. Pest control</td>
<td>Apr-01</td>
<td>5,000</td>
<td>66.78%</td>
<td>400,530</td>
</tr>
<tr>
<td>4. Pest management</td>
<td>Apr-01</td>
<td>5,000</td>
<td>66.78%</td>
<td>400,530</td>
</tr>
<tr>
<td>5. Fire prevention</td>
<td>Apr-01</td>
<td>5,000</td>
<td>66.78%</td>
<td>400,530</td>
</tr>
<tr>
<td>6. Rabbit control</td>
<td>Apr-01</td>
<td>5,000</td>
<td>66.78%</td>
<td>400,530</td>
</tr>
<tr>
<td>7. Dung management</td>
<td>Apr-01</td>
<td>5,000</td>
<td>66.78%</td>
<td>400,530</td>
</tr>
<tr>
<td>8. Soil management</td>
<td>Apr-01</td>
<td>5,000</td>
<td>66.78%</td>
<td>400,530</td>
</tr>
<tr>
<td>9. Water quality</td>
<td>Apr-01</td>
<td>5,000</td>
<td>66.78%</td>
<td>400,530</td>
</tr>
<tr>
<td>10. Forest planning</td>
<td>Apr-01</td>
<td>5,000</td>
<td>66.78%</td>
<td>400,530</td>
</tr>
<tr>
<td>11. Forest protection</td>
<td>Apr-01</td>
<td>5,000</td>
<td>66.78%</td>
<td>400,530</td>
</tr>
<tr>
<td>12. Forest inventory</td>
<td>Apr-01</td>
<td>5,000</td>
<td>66.78%</td>
<td>400,530</td>
</tr>
<tr>
<td>13. Forest management</td>
<td>Apr-01</td>
<td>5,000</td>
<td>66.78%</td>
<td>400,530</td>
</tr>
<tr>
<td>14. Forest research</td>
<td>Apr-01</td>
<td>5,000</td>
<td>66.78%</td>
<td>400,530</td>
</tr>
<tr>
<td>15. Forest extension</td>
<td>Apr-01</td>
<td>5,000</td>
<td>66.78%</td>
<td>400,530</td>
</tr>
<tr>
<td>16. Forest education</td>
<td>Apr-01</td>
<td>5,000</td>
<td>66.78%</td>
<td>400,530</td>
</tr>
<tr>
<td>17. Forest conservation</td>
<td>Apr-01</td>
<td>5,000</td>
<td>66.78%</td>
<td>400,530</td>
</tr>
<tr>
<td>18. Forest administration</td>
<td>Apr-01</td>
<td>5,000</td>
<td>66.78%</td>
<td>400,530</td>
</tr>
</tbody>
</table>

**Total Benefits**: 1,086,015

**Discount Rate (1/1.01)**: 12%

**PV Benefit**: 2,240,780.954

**Cost (1/1.01)**: 12%

**Total Cost**: 2,240,780.954

**PV Cost**: 2,240,780.954

**Total**

**PER HECTARE**

| Benefits PV | 1,086,015 |
| Costs PV | 2,240,780.954 |
| NPV | 593,765.954 |
| BCR | 2.21 |

www.ijert.org
### Social Analysis of Forest Plantations

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>year</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unit</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Price</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vol</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Blk VI</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Blk I</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Blk II</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Blk III</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Blk IV</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### BENEFIT

1. Community income
   - Without cost mining (Rp/kg-bukit) 2,239,225 1,118 29,773,125 29,773,125 29,773,125 29,773,125 29,773,125 29,773,125 29,773,125 29,773,125 29,773,125
   - with cost mining (Rp/kg-bukit) 2,239,225 1,118 - - - - - - - -

2. Income communities who depend on forests
   - Without cost mining (Rp/kg-bukit) 1,500,000 362 6,516,000 6,516,000 6,516,000 6,516,000 6,516,000 6,516,000 6,516,000 6,516,000 6,516,000
   - with cost mining (Rp/kg-bukit) 1,500,000 362 - - - - - - - -

3. Infrastructure building
   - Without cost mining (Rp/kg-Titan) 48,300 - 48,300 48,300 48,300 48,300 48,300 48,300 48,300 48,300 48,300 48,300
   - with cost mining (Rp/kg-Titan) 57,900 - - - - - - - -


DISCOUNT RATE (1/(1+i)) 11% 1.11 1.35 2.64 2.66 2.32 2.02 0.20 0.02 0.02 0.02 0.02
PV BENEFITS 127,124,070 114,526,737 103,177,240 92,952,469 83,740,963 74,565,167 65,464,744 56,454,323 47,544,003 38,733,683 30,123,363 21,613,043

#### BLAYA (in Rp. 1,000)

1. Public health fund
   - Without cost mining (Rp/kg-bukit) 135,000 7,209 9,977,400 9,977,400 9,977,400 9,977,400 9,977,400 9,977,400 9,977,400 9,977,400 9,977,400
   - with cost mining (Rp/kg-bukit) 345,000 7,209 - - - - - - - -

TOTAL COST 9,977,400 9,977,400 9,977,400 9,977,400 9,977,400 9,977,400 9,977,400 9,977,400 9,977,400 9,977,400 9,977,400 9,977,400

DISCOUNT RATE (1/(1+i)) 11% 1.11 1.35 2.64 2.66 2.32 2.02 0.20 0.02 0.02 0.02 0.02 0.02
PV Costs 34,905,441 31,446,345 28,330,069 25,525,583 22,993,295 20,817,902 18,857,780 16,897,658 14,937,536 12,977,414 11,017,292 9,057,170

TOTAL

| Benefit PV | 18,169 | 1,276,633,590 | 127,124,070 | 114,526,737 | 103,177,240 | 92,952,469 | 83,740,963 | 74,565,167 | 65,464,744 | 56,454,323 | 47,544,003 | 38,733,683 |
| PV Costs  | 7,364  | 517,712,830  | 43,905,441  | 31,446,345  | 28,330,069  | 25,525,583 | 22,993,295 | 20,817,902 | 18,857,780 | 16,897,658 | 14,937,536 | 12,977,414 |
| NPI  | 10,795 | 538,920,760  | 92,219,237  | 83,080,394  | 75,876,714  | 67,429,878 | 60,747,688 | 52,747,265 | 46,607,964 | 40,837,047 | 33,956,269 | 26,700,069 |
| BCR  | 2.47   | 2.47         | 2.64        | 2.64        | 2.64        | 2.64        | 2.64        | 2.64        | 2.64        | 2.64        | 2.64        | 2.64        |
### Ecological Analysis of Coal Mine

<table>
<thead>
<tr>
<th>Year</th>
<th>-10</th>
<th>-9</th>
<th>-8</th>
<th>-7</th>
<th>-6</th>
<th>-5</th>
<th>-4</th>
<th>-3</th>
<th>-2</th>
<th>-1</th>
<th>0</th>
<th>13</th>
<th>14</th>
<th>15</th>
<th>16</th>
<th>17</th>
</tr>
</thead>
<tbody>
<tr>
<td>Benefit</td>
<td>Item</td>
<td>Unit</td>
<td>Price</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>---------------------------------</td>
<td>---------------------------------</td>
<td>---------------------------------</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Forest plantation</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Recreational</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Existence value</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Optional value</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>TOTAL BENEFIT</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>DISCOUNT RATE (1/(1+r)^0)</td>
<td>11%</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>1.00</td>
<td>0.24</td>
<td>0.23</td>
<td>0.22</td>
<td>0.19</td>
</tr>
<tr>
<td>PV BENEFIT</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>COST (in Rs. 1,000)</td>
<td>1. Financial benefit on forest plantation</td>
<td>6955.17</td>
<td>1,428.00</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>11,208,787</td>
<td>6,955,831</td>
<td>6,693,831</td>
<td>6,693,831</td>
<td>6,693,831</td>
<td>6,693,831</td>
</tr>
<tr>
<td>1. Ecological benefit of Forest plantation</td>
<td>6955.17</td>
<td>10,392.54</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>143,224,646</td>
<td>118,340,669</td>
<td>118,340,669</td>
<td>118,340,669</td>
<td>118,340,669</td>
<td>118,340,669</td>
</tr>
<tr>
<td>3. Social benefit of forest plantation</td>
<td>6955.17</td>
<td>310.75</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>3,588,448</td>
<td>5,601,159</td>
<td>5,601,159</td>
<td>5,601,159</td>
<td>5,601,159</td>
<td>5,601,159</td>
</tr>
<tr>
<td>Total cost</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>3,588,448</td>
<td>5,601,157</td>
<td>5,601,157</td>
<td>5,601,157</td>
</tr>
<tr>
<td>DISCOUNT RATE (1/(1+r)^0)</td>
<td>11%</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>1.00</td>
<td>0.24</td>
<td>0.23</td>
<td>0.22</td>
<td>0.19</td>
</tr>
<tr>
<td>PV cost</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>3,588,448</td>
<td>1,442,577</td>
<td>1,129,439</td>
<td>1,170,666</td>
</tr>
<tr>
<td>TOTAL</td>
<td>PER HECTAR</td>
<td>TOTAL</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PV Benefit</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>PV cost</td>
<td>6,587.97</td>
<td>45,101,435.13</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>3,588,448</td>
<td>1,442,577</td>
<td>1,129,439</td>
<td>1,170,666</td>
<td>1,054,654</td>
</tr>
<tr>
<td>NPV</td>
<td>(6,587.97)</td>
<td>(45,101,435.13)</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>(3,588,448)</td>
<td>(1,442,577)</td>
<td>(1,129,439)</td>
<td>(1,170,666)</td>
<td>(1,054,654)</td>
</tr>
<tr>
<td>BCR</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>
### Social Analysis of Coal Mine

<table>
<thead>
<tr>
<th>Tahunke</th>
<th>UNIT</th>
<th>PER UNIT</th>
<th>Harga</th>
<th>-10</th>
<th>-9</th>
<th>-8</th>
<th>-7</th>
<th>-6</th>
<th>-5</th>
<th>-4</th>
<th>-3</th>
<th>-2</th>
<th>-1</th>
<th>0</th>
<th>13</th>
<th>14</th>
<th>15</th>
<th>16</th>
<th>17</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tahun</td>
<td>VALUE</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### Benefit

1. Income of mining community
   - Rp/IND/MONTH: 2,115
   - Rp/IND/MONTH: 7,200
   - Rp/IND/MONTH: 6,685

2. Income communities around the mine
   - Rp/IND/MONTH: 6,795,000
   - Rp/IND/MONTH: 347,040,000
   - Rp/IND/MONTH: 48,300

3. Infrastructure building value
   - Rp/IND/MONTH: 6,685
   - Rp/IND/MONTH: 48,300

**TOTAL BENEFIT**

- Rp/IND/MONTH: 416,803,000
- Rp/IND/MONTH: 416,803,000
- Rp/IND/MONTH: 416,803,000
- Rp/IND/MONTH: 416,803,000

#### DISCOUNT RATE (1/(1+i)^n))

- 11%
- 1,00

#### PV BENEFIT

- Rp/IND/MONTH: 416,803,000
- Rp/IND/MONTH: 113,802,000
- Rp/IND/MONTH: 10,012,000
- Rp/IND/MONTH: 9,124,000
- Rp/IND/MONTH: 84,866,000
- Rp/IND/MONTH: 79,349,000

#### BAYA (xRp. 1,000)

1. Community health
   - Rp/IND/MONTH: 7,200

2. Mine infrastructure building
   - Rp/IND/MONTH: 6,685

**TOTAL COST**

- Rp/IND/MONTH: 702,907,000
- Rp/IND/MONTH: 702,907,000
- Rp/IND/MONTH: 702,907,000
- Rp/IND/MONTH: 702,907,000

#### DISCOUNT RATE (1/(1+i)^n))

- 11%
- 1,00

#### PV Cost

- Rp/IND/MONTH: 702,907,000
- Rp/IND/MONTH: 8,176,000
- Rp/IND/MONTH: 7,981,000
- Rp/IND/MONTH: 6,804,000
- Rp/IND/MONTH: 6,658,000
- Rp/IND/MONTH: 5,482,000

#### TOTAL

<table>
<thead>
<tr>
<th>TOTAL</th>
<th>PER Hektar</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>+ Benefit PV</td>
<td>526,218,34</td>
<td>3,859,597,979,33</td>
</tr>
<tr>
<td>- Cost PV</td>
<td>437,964,25</td>
<td>3,046,115,709,12</td>
</tr>
<tr>
<td>+ APV</td>
<td>81,254,09</td>
<td>613,622,189,34</td>
</tr>
<tr>
<td>+ OCR</td>
<td>1,20</td>
<td>1,20</td>
</tr>
</tbody>
</table>

### Notes

- **IPV**
- **OCR**
### Financial analysis of coal mining

<table>
<thead>
<tr>
<th>Year</th>
<th>2018</th>
<th>2019</th>
<th>2020</th>
<th>2021</th>
<th>2022</th>
<th>2023</th>
<th>2024</th>
<th>2025</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>532,360,000</td>
<td>532,360,000</td>
<td>532,360,000</td>
<td>532,360,000</td>
<td>532,360,000</td>
<td>532,360,000</td>
<td>532,360,000</td>
<td>532,360,000</td>
</tr>
<tr>
<td>Cost of goods sold</td>
<td>532,360,000</td>
<td>532,360,000</td>
<td>532,360,000</td>
<td>532,360,000</td>
<td>532,360,000</td>
<td>532,360,000</td>
<td>532,360,000</td>
<td>532,360,000</td>
</tr>
<tr>
<td>Gross profit</td>
<td>-532,360,000</td>
<td>-532,360,000</td>
<td>-532,360,000</td>
<td>-532,360,000</td>
<td>-532,360,000</td>
<td>-532,360,000</td>
<td>-532,360,000</td>
<td>-532,360,000</td>
</tr>
<tr>
<td>Operating expenses</td>
<td>532,360,000</td>
<td>532,360,000</td>
<td>532,360,000</td>
<td>532,360,000</td>
<td>532,360,000</td>
<td>532,360,000</td>
<td>532,360,000</td>
<td>532,360,000</td>
</tr>
<tr>
<td>Operating loss</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Interest income</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Interest expense</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Loss on sale of assets</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Income tax</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Net loss</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

**Total** | 532,360,000 | 532,360,000 | 532,360,000 | 532,360,000 | 532,360,000 | 532,360,000 | 532,360,000 | 532,360,000 |

**Gross Profit** | -532,360,000 | -532,360,000 | -532,360,000 | -532,360,000 | -532,360,000 | -532,360,000 | -532,360,000 | -532,360,000 |

**Operating Income** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

**Net Income** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

---

**Notes:**
- All figures are in thousands.
- Figures are hypothetical and for demonstration purposes.

---

**Source:** International Journal of Engineering Research & Technology (IJERT) Vol. 2 Issue 5, May - 2013