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# An Analysis On The Investment Of Forestland Modelling Using The Agroforestry Landscape System

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**ABSTRACT**

This research was based on the existence of forestland which had a rather bad degradation, as indicated by the reduced area of forest in East Kalimantan Province, including Kutai Kartanegara Regency due to the natural and human activities. The forest land management by using the agroforestry landscape system was generally profitable for the welfare of people and community surrounding the forest.

This research was conducted in the privately-owned forests using agroforestry system located in Kutai Kartanegara District. The aims of the research were: 1) to study and analyze maximum increment; 2) to find out production level and income rate from each forest land model; 3) to find out the financial feasibility of the forest land modeling using the agroforestry system

The objects of the research included: 1) monoculture super teakwood cultivation; 2) super teakwood and durian cultivation; 3) monoculture durian cultivation; 4) durian and coffee cultivation, and 5) rambutan and mahogany cultivation. Data analysis technique employed in this research was the theories of increment production and other forestland products. Furthermore, the financial feasibility analysis used payback periods, NPV, Net B/C Ratio and IRR.

The results of the research showed that the optimum increment of the monoculture super teakwood and durian production was reached at the age of 25 and 40 years, while for mahogany, this was reached at the age of 30 years. The optimum production of durian, rambutan and coffee was reached at the age of 13 and 25 years. The integrated cultivation of super teakwood and durian generated the biggest income and production compared with other types of forestland cultivation modeling (i.e. the other types of combination). Financially, all types of forestland modeling were worth cultivating because their IRR values were higher than their MAR values. Moreover, the integrated cultivation of super teakwood and durian used the smallest scale of area but the biggest average annual income compared with other types of forestland modeling.

**Keywords:** Investment Analysis, Landscape Agroforestry, Modeling

## 1. BACKGROUND

Agroforestry as a land use system is becoming more acceptable in farming because it has been proved to be profitable for the socio-economic development. Agroforestry has become not only a place for farmer empowerment and for natural resources conservation but also a place for rural environmental management both within and surrounding the forest areas. According to Lundgren (1982) in Lahjie (2003), agroforestry is defined as a land use system in which there is a significant ecological and economic interaction among plant trees and shrubs, and agricultural crops and/or animals.

Privately-owned forests with agroforestry system refer to private forests whose activities cover a combination between forestry activities and other practices such as plantation, farming, cattle farming, and so forth, which are conducted integratedly in one location. Its orientation is to optimumize the land use, both in terms of ecological and economic sustainability. This type of forest is resistant against pests, diseases, and wind. Viewed from economic side, this form of forest grants multiple benefits through gradual and sustainable harvestings. The diversification of vertical and horizontal commodity increasingly makes up high economic value and absorbs more sustainable manpower.

Landscape management is an option to help development planners understand the changing process which forms and affects the forest condition in a large scale for a long term period. This understanding is crucial because there are various factors that the decision makers need to consider besides the various community groups whose interests need to be accommodated in planning land use allocation. Decision makers need a simple abstraction of the complexity of the conditions that must be taken into account. Therefore, landscape ecology focuses on three characteristics of the landscape, the structure, function and dynamics (changes).

## 2. AGROFORESTRY LANDSCAPE

Arifin HS, et.al. (2009) stated that agroforestry landscape is a science which studies agroforestry systems on a landscape scale. Practice systems of agroforestry, agrosilvofishery, and agrosilvopasture are integrated in a landscape scale. They are closely related with the study of farming systems, agroforestry systems, agro-ecosystems, watershed management, landscape architecture and landscape ecology.

Nowadays, agroforestry at the landscape level has been included in the scope of *community forestry and* it is usually termed as *community based forest system management (CBFSM)*. Even though the emphasis of this CBFSM is given to the traditional community regions (Mushi, 1998), considering its sub elements such as farms, plantations, paddy fields, yards, and sacred sites which belong to one integral unit of the communal activities in one or more communities, this system is still regarded as an agroforestry system

## 3. AGROFORESTRY LANDSCAPE MANAGEMENT PLANS

### a. Integrated

The goal of land use planning is to achieve the best use of land. In relation to the concept of sustainability, land use plan is made more specific, that is, a balanced situation or an integration among efficiency, equity, and sustainable use of the natural resources (Hermanides & Nijkamp, 2000; Miranda, 2001).

### b. Ecological

Landscape management is an action of protecting and safeguarding a landscape efficiently and directionally in order to maintain its preservation and sustainability, including its physical and biophysical resources and its surrounding environments based on the applicable laws (Wardiningsih, 2005).

### c. Economical

The advantages obtained from the functions and the roles of agroforestry on biophysical and environmental aspects may not be directly and immediately felt by the agroforestry farmers themselves but these benefits are indeed enjoyed by the community members living around and outside the location (for example, downstream areas) and even by global community. In other words, land conservation action applied by agroforestry farmers does not provide a lot of direct profit for the agroforestry farmers, but they usually suffer from short term loss. Therefore, there should be a compensation for them in the upstream if they intend to apply conservation farming.

## 4. RESEARCH METHODOLOGY

The data that had been collected were then financial analyzed with 1 USD = Rp.9.800,- as follows:

a. *Payback Period* (PP).
b. *Net Present Value* (NPV)
c. *Net Benefit Cost Ratio* (Net B/C)
d. *Internal Rate of Return* (IRR)
e. Equivalent Annual Anuity (EAA)
f. *Minimum* Accestability R*ate* (MAR)

## 5. FINDINGS AND DISCUSSION

### a. Land Use

The pattern of land use in Kutai Kartanegara District includes settlement areas (16.039 Ha or 0.6%), paddy fields (53.437 Ha or 2.05%), dry farms (183.807 Ha or 3.97%), mixed farms (41,489 Ha or 1.59%), plantation (34.812 Ha or 1.33%), forests (1.858.237 Ha or 71.15%), lakes and swamps (58,441 Ha or 2.24% and 12,082 Ha 0.46% respectively), fields, shrubs, and weeds covering 433,346 ha or 16.59% of the total area.

The land use in Kutai Kartanegara District area has changed from time to time as a result of human activities including forest exploitation by the holders of forest concession, shifting farming activities by traditional farmers, the growth of industry and mining as well as the rapid growth of population. In the relatively very short time, these activities will change the land use from year to year, both in urban and rural areas.

### b. STAGES OF FORESTLAND MODELING ACTIVITIES

Stages in forest land modeling activities are as follows:

*Clearing, felling, cutting and drying, seedling, planting, maintaining, fertilizing, harvesting.*

### C. DETAILS OF COSTS AND INCOME FROM FORESTLAND MODELING

**(TEAK, DURIAN, COFFEE, RAMBUTAN AND MAHOGANY)**

1. The estimated cycle of super teakwood was 25 years and its maximum growth increment was reached at the age of 25 years.
2. The estimated cycle of a durian tree for bearing fruits and harvesting was 35 years and its maximum production was reached at the age of 25 year.
3. The estimated cycle of a durian tree for collecting its wood was 50 years and its maximum growth increment was reached at the age of 40 years.
4. The estimated cycle of a coffee tree was 20 years and its maximum production was reached at the age of 13 years.
5. The estimated cycle of a rambutan tree for harvesting its fruits was 35 years and its maximum growth increment was reached at the age of 13 years.
6. The estimated cycle of a mahogany stand was 35 years and its maximum growth increment was reached at the age of 30 years.
7. The cost of forest land modeling activity was based on the need, that is the number of labor per working day. The payment for one labor per day was Rp.50.000/ha.
8. The estimated physical production was determined based on the cycle, Diameter class, and the total plant production.
9. The prices of super teakwood, durian wood, durian fruit, coffee, rambutan and mahogany were based on the market current prices.

## d. THE POTENTIAL OF WOOD INCREMENT AND FRUIT PRODUCTION OF THE FORESTLAND MODELING

### 1. The Potential of Super Teakwood Increment

Planting distance of super teak wood was 3x4 m or 833 trees per hectare with 10 % replanting rate. The result of measurement revealed that the optimum production was achieved at the age of 20 years based on the cycle, where the maximum total volume was 162.14 $m^3$/ha, the average tree Diameter (d) was 47 cm and the height of clear bole stem (h) was 8.5 m. The optimum production of teakwood was at the age of 25, where the average annual increment (MAI) reached 6,49 $m^3$/ha/year and the current annual increment (CAI) reached 6.45 $m^3$/ha/year.

Table 1. The Production Potention Volume of Super Teak Wood (*T.grandis*) based Cycling (25 years)

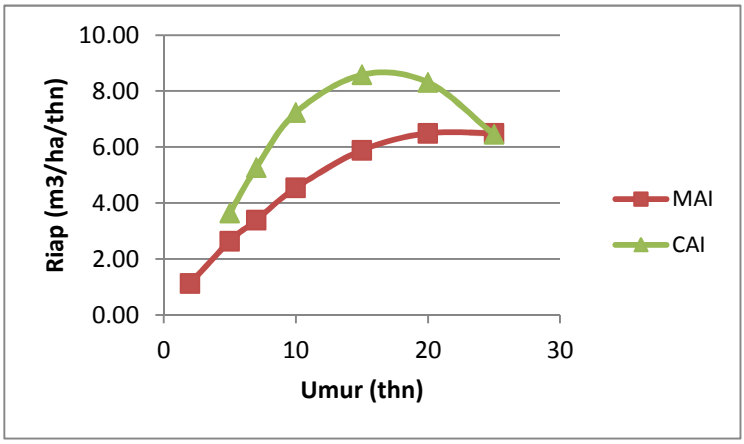
| Age | N | d | h | TV | MAI | CAI |
|---|---|---|---|---|---|---|
| Year | Trees/ha | cm | m | $m^3$/ha | $m^3$/ha/year | $m^3$/ha/year |
| 2 | 800 | 4 | 3 | 2.26 | 1.13 | |
| 5 | 600 | 10 | 4 | 13.19 | 2.64 | 3.64 |
| 7 | 550 | 13 | 5 | 23.1 | 3.39 | 5.26 |
| 10 | 480 | 18 | 6 | 45.41 | 4.54 | 7.23 |
| 15 | 400 | 25 | 7.5 | 88.31 | 5.89 | 8.58 |
| 20 | 235 | 40 | 8 | 129.87 | **6.49** | 8.31 |
| **25** | **220** | **47** | **8.5** | **162.14** | **6.49** | **6.45** |

Note:

N = Plant Population (Trees/ha)
D = Trees Diameter (cm)
H = Clear Stem Height (m)
TV = Total Volume ($m^3$)
MAI = Mean Annual Increment
CAI = Current Annual Increment

The growing graphic of Mean Annual Increment (MAI) and Current Annual Increment (CAI) of Super Teak wood based on Table 1 could be estimated sistematically shown by Picture 1.




Picture 1. MAI and CAI of Super Teak Wood Based on Cycling (Data from Table 1)

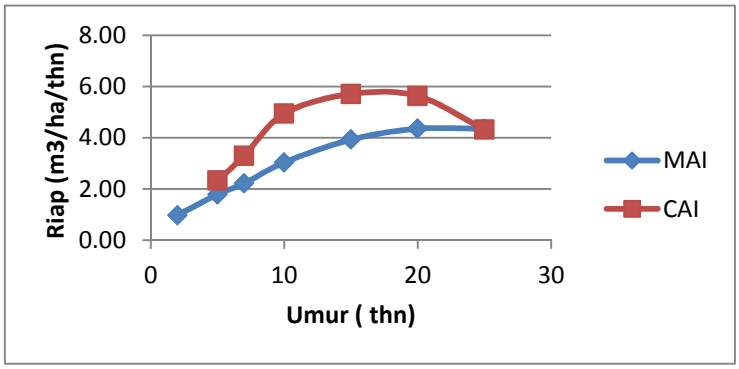
**2. The Potential of Super Teak Wood Increment and Durian Fruit Production**

The second model of forestland is the combination of super teak stands and durian trees. Planting distance of teak is 6x5 m or 333 trees per hectare with replanting rate of 10%. The result of measurement revealed that the optimum production was be achieved at the age of 25 years based on its cycle, where the maximum total volume was 108.9 $m^3$/ha, the average tree diameter (d) was 37.1 cm and the height of clear bole stem (h) reached 10 m. The optimum production of teak wood was at the age of 25, where the average annual increment (MAI) reached 4.35 $m^3$/ha/year and the current annual increment (CAI) reached to 4.34 $m^3$/ha/year.

Table 2. The Production Potention Volume of Super Teak Wood (*T. grandis*) combinated by Durian Tree *(Durio sp)* Based on Cycling (25 year)

| Age | N | d | h | TV | MAI | CAI |
|---|---|---|---|---|---|---|
| Year | Trees/ha | cm | M | $m^3$/ha | $m^3$/ha /year | $m^3$/ha /year |
| 2 | 330 | 5 | 4 | 1.94 | 0.97 | |
| 5 | 325 | 10 | 5 | 8.93 | 1.79 | 2.33 |
| 7 | 300 | 13 | 6 | 15.52 | 2.22 | 3.30 |
| 10 | 275 | 18 | 7 | 30.36 | 3.04 | 4.94 |
| 15 | 250 | 25 | 8 | 58.88 | 3.93 | 5.70 |
| 20 | 230 | 31,2 | 9 | 87.00 | **4.35** | 5.62 |
| **25** | **201** | **37,1** | **10** | **108.59** | **4.34** | **4.32** |

The growing graphic of Mean Annual Increment (MAI) and Current Annual Increment (CAI) of super teak wood based on Table 2 could be estimated sistematically shown by Picture 2.




Picture 2. MAI and CAI of Super Teak Wood (*T.grandis)* Combinated by Durian Tree (*Durio sp*) Based on Cycling (Data from Table 2)

In addition to its valuable wood production, durian also produces fruit which is favored by most people. Durian fruit is also good for fruit parcel because it can be stored in a relatively long time. Its based on the data collected through interview with farmers as the respondents of this research.

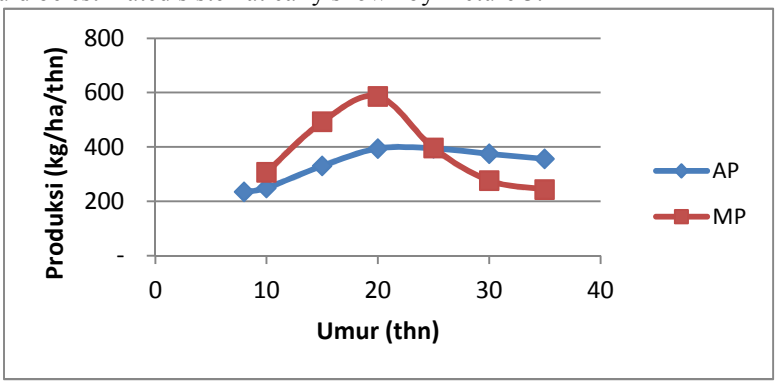
Table 3. The Production Volume Durian Fruit *(Durio sp)* Combination Super Teak (*T. grandis*) Based on Cycling (35 Year)

| No | Age | TP | AP | MP |
|---|---|---|---|---|
| | Year | Kg/ha | Kg/ha/year | Kg/ha/year |
| 1 | 8 | 1,875 | 234 | |
| 2 | 10 | 2,488 | 249 | 307 |
| 3 | 15 | 4,950 | 330 | 492 |
| 4 | 20 | 7,880 | **394** | 586 |
| **5** | **25** | **9,860** | **394** | **396** |
| 6 | 30 | 11,240 | 375 | 276 |
| 7 | 35 | 12,456 | 356 | 243 |

Note :
TP : Total production (kg/ha)
AP : Average product (kg/ha/year)
MP : Marginal product (kg/ha/year)

Based on Table 3 described that the optimum production durian fruit *(Durio sp)* reached to age 25 years, which average product (AP) was to 394 kg/ha/year and marginal product (MP) was to 396 kg/ha/year.

The production graphic of Average Product (AP) and Marginal product (MP) of Durian fruit *(Durio sp)* based on Table 3 could be estimated sistematically shown by Picture 3.




Picture 3. AP and MP Durian Fruit Combinated by Tree Teak Based on Cycling (Data from Table 3)

### 3. The Potential Increment and Production of Durian with Monoculture System

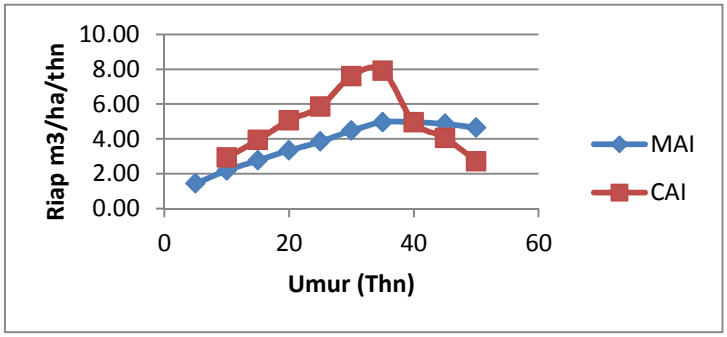
The planting distance of durian farms was 8 x 5 m or 250 trees per hectare and it needed 10% seedlings for replanting. The result of the measurement showed that the optimum production was achieved at the age of 40 years based on its growth cycle, where the maximum total volume (TV) was 198.5 $m^3$/ha, the average tree Diameter (d) was 47.8 cm and the height of the clear bole stem (h) reached 20 m. Based on Table 4 described that the optimum production of Durian Wood *(Durio sp)* reached to the age of 40 years, which Mean Annual Increment (MAI) reached to 4.96 $m^3$/ha/year and Current Annual Increment (CAI) reached to 4.96 $m^3$/ha/year.

Table 4. The Production Potention Volume of Durian Wood *(Durio sp)* Based on cycling (50 year)

| Age | N | d | h | TV | MAI | CAI |
|---|---|---|---|---|---|---|
| Year | Trees/ha | cm | m | $m^3$/ha | $m^3$/ha/year | $m^3$/ha/year |
| 5 | 180 | 10 | 6 | 7.2 | 1.44 | |
| 10 | 170 | 16 | 8 | 21.9 | 2.19 | 2.93 |
| 15 | 160 | 21 | 10 | 41.5 | 2.77 | 3.94 |
| 20 | 150 | 26 | 12 | 66.9 | 3.34 | 5.06 |
| 25 | 140 | 31 | 14 | 96.1 | 3.84 | 5.85 |
| 30 | 130 | 37 | 16 | 134.1 | 4.47 | 7.60 |
| 35 | 120 | 43 | 18 | 173.7 | **4.96** | 7.91 |
| **40** | **110** | **47.8** | **20** | **198.5** | **4.96** | **4.96** |
| 45 | 105 | 53 | 21 | 218.8 | 4.86 | 4.06 |
| 50 | 100 | 58 | 22 | 232.4 | 4.65 | 2.72 |

The growing graphic of Mean Annual Increment (MAI) and Current Annual Increment (CAI) of Durian Wood based on Table 4 could be estimated sistematically shown by Picture 4.




Picture 4. MAI and CAI of Durian Wood (*Durio sp)* Based on Cycling (Data from Table 4)

Based on data collection result by interviewing to the farmer respondent, the duiran fruit volume as long as cycling was shown by Table 5.

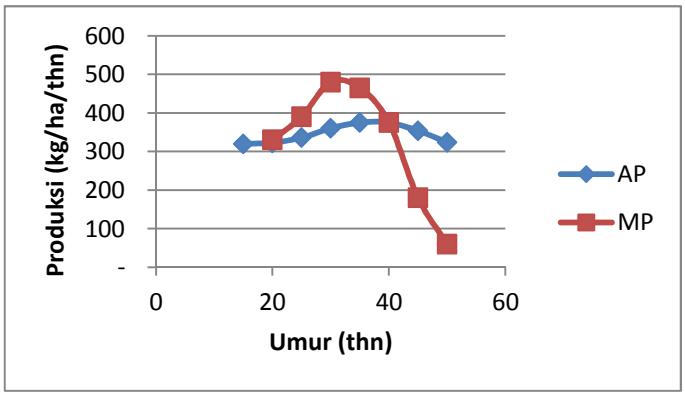
Table 5. The Production Potention Volume of Durian Fruit *(Durio sp)* Monoculture Based on Cycling (50 Year)

| Age | TP | AP | MP |
|---|---|---|---|
| Year | Kg/ha | Kg/ha/year | Kg/ha/year |
| 15 | 4,800 | 320 | |
| 20 | 6,450 | 323 | 330 |
| 25 | 8,400 | 336 | 390 |
| 30 | 10,800 | 360 | 480 |
| 35 | 13,125 | 375 | 465 |
| **40** | **15,000** | **375** | **375** |
| 45 | 15,900 | 353 | 180 |
| 50 | 16,200 | 324 | 60 |

Based on Table 5 described that the optimum production of Durian Fruit *(Durio sp)* reached to the age of 40 years, which Average Product (AP) reached to 375 kg/ha/year and Marginal Product (MP) reached to 375 kg/ha/year.

The production graphic of Average Product (AP) and Marginal product (MP) of Durian fruit *(Durio sp)* based on Table 5 could be estimated sistematically shown by Picture 5.




Picture 5. AP and MP of Durian Fruit *(Durio sp)* Monoculture Based on Cycling (Data from Table 5)

**4. The Potential Production of Durian Fruit and Coffee**

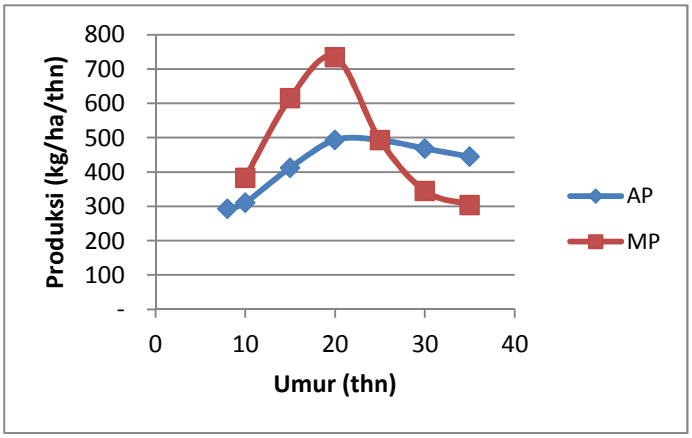
The planting distance of durian farm was 8x5 m or 250 trees per hectare, while the planting distance of coffee was 2.5 x 2.5 or 1,600 trees per hectare. Therefore, coffee tree could be planted on the spaces between durian trees in rows. The result of measurement showed that the optimum production of durian fruit was achieved at the age of 25 years based on its cycle, where its maximum total production (TP) was 12,325 kg/ha. The optimum production of durian fruit was achieved the age of 25, where the average annual production (AP) reached 493 kg/ha/year and the current annual production (MP) reached 493 kg/ha/year.

Table 6. The Production Potention Volume of Durian Fruit *(Durio sp)* Combinated by Coffee Fruit *(cofea barista)* Based on Cycling (35 year)

| No | Age | TP | AP | MP |
|---|---|---|---|---|
| | Year | kg/ha | kg/ha/year | kg/ha/year |
| 1 | 8 | 2,344 | 293 | |
| 2 | 10 | 3,110 | 311 | 383 |
| 3 | 15 | 6,188 | 413 | 616 |
| 4 | 20 | 9,860 | **493** | 735 |
| **5** | **25** | **12,325** | **493** | **493** |
| 6 | 30 | 14,050 | 468 | 345 |
| 7 | 35 | 15,570 | 445 | 304 |

The production graphic of Average Product (AP) and Marginal product (MP) of Durian fruit *(Durio sp)* based on Table 6 could be estimated sistematically shown by Picture 6.



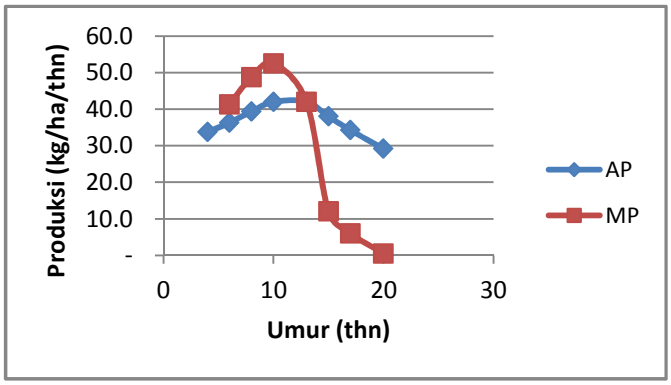

Picture 6. AP and MP of Durian Fruit *(Durio sp)* Combinated by Coffee Fruit *(cofea barista)* Based on Cycling (Data from Table 6)

Based on Table 7 described that the optimum production of coffee fruit *(cofea barista)* was estimated to the age of 13 years, which Average Prooduct (AP) reached to 42 kg/ha/year and Marginal Product (MP) reached to 42 kg/ha/year. The Coffee Fruit *(cofea barista)* started to produce on the year of 4th to the year of 20th, but the optimum production was reached to the age of 13 years by total production to 546 kg/ha.

Table 7. The Production Potention of Coffee Fruit *(cofea barista)* Combinated by Durian Fruit *(Durio sp)* Based on Cycling (20 Year)

| Age | TP | AP | MP |
|---|---|---|---|
| Year | Kg/ha | Kg/ha/year | Kg/ha/year |
| 4 | 135 | 33.8 | |
| 6 | 218 | 36.3 | 41.3 |
| 8 | 315 | 39.4 | 48.8 |
| 10 | 420 | **42.0** | 52.5 |
| **13** | **546** | **42.0** | **42.0** |
| 15 | 570 | 38.0 | 12.0 |
| 17 | 582 | 34.2 | 6.0 |
| 20 | 584 | 29.2 | 0.5 |

The production graphic of Average Product (AP) and Marginal product (MP) of Coffee fruit based on data Table 7 could be estimated sistematically shown by Picture 7.




Picture 7. AP and MP of Coffee Fruit *(cofea barista)* Combinated by Durian *(Durio sp)* Based on Cycling (Data from Table 7)

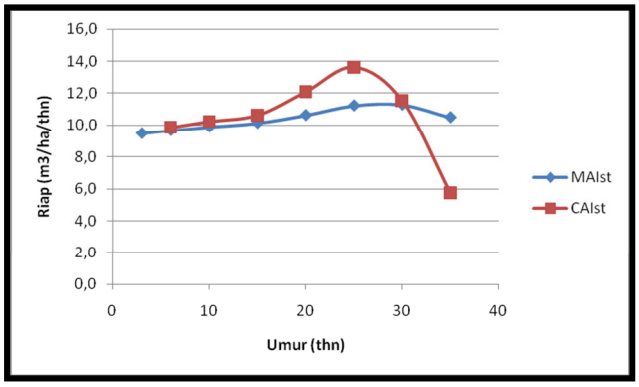
**5. The Potential of Mahogany Increment and Rambutan Production**

The planting distance of mahogany tree was 3x4 m or 833 trees per hectare while the planting distance of rambutan was 8x8 m or 360 trees per hectare. The result of the measurement revealed that the potential increment of mahogany was reached at the age of 30 years based on its cycle, where the maximum total production was 338.4 $m^3$/ha, the average annual increment was 11.3 $m^3$/ha/year and the average current annual increment was 11.5 $m^3$/ha/year.

Table 8. The Increment Potention of Mahoni Tree *(Mahagony sp)* Combinated by Rambutan Fruit *(Nephelium sp)* Based on Cycling (35 year)

| Age | N | d | h | TV | MAI | CAI |
|---|---|---|---|---|---|---|
| Year | Trees/ha | cm | m | $m^3$/ha | $m^3$/ha/thn | $m^3$/ha/thn |
| 3 | 700 | 11 | 5.7 | 28.4 | 9.5 | |
| 6 | 600 | 15.1 | 7.5 | 58.0 | 9.7 | 9.9 |
| 10 | 580 | 18.5 | 9.2 | 98.9 | 9.9 | 10.2 |
| 15 | 570 | 22.3 | 10.2 | 152.1 | 10.1 | 10.6 |
| 20 | 500 | 26.8 | 11.6 | 212.6 | 10.6 | 12.1 |
| 25 | 450 | 31.4 | 13.0 | 280.7 | **11.2** | 13.6 |
| **30** | **355** | **38.0** | **14.5** | **338.4** | **11.3** | **11.5** |
| 35 | 280 | 45.0 | 15.0 | 367.2 | 10.5 | 5.8 |

The growing graphic of Mean Annual Increment (MAI) and Current Annual Increment (CAI) of Mahoni Wood *(Mahagony sp)* based on Table 8 could be estimated sistematically shown by Picture 8.




Picture 8. MAI and CAI of Mahoni Wood *(Mahagony sp)* Combinated by Rambutan Tree *(Nephelium sp)* Based on Cycling (Data from Table 8)

The Mahoni trees *(Mahagony sp)* effort combinated by Rambutan fruit *(Nephelium sp)* produce the different fruit product. The total production of Rambutan fruit *(Nephelium sp)* combinated by Mahoni trees *(Mahagony sp)* was shown on Table 9.

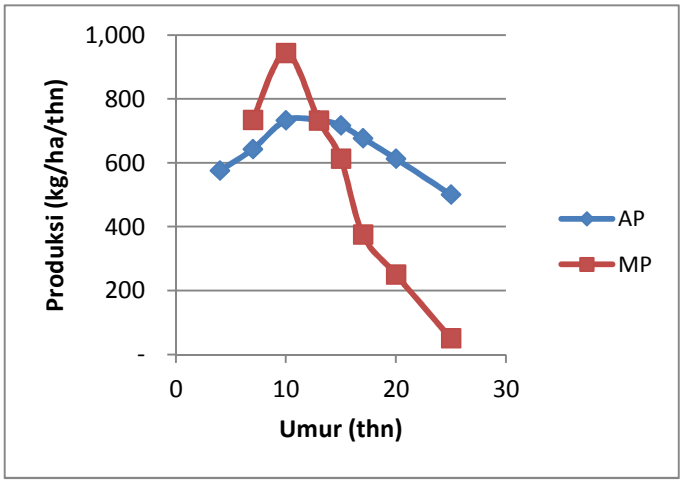
 

Table 9. The Production Potention Volume of Rambutan Fruit *(Nephelium sp)* Combinated by Mahoni *(Mahagony sp)* Based on Cycling (25 Year)

| No | Age | TP | AP | MP |
|---|---|---|---|---|
| | year | Kg/ha | Kg/ha/year | Kg/ha/year |
| 1 | 4 | 2,300 | 575 | |
| 2 | 7 | 4,500 | 643 | 733 |
| 3 | 10 | 7,330 | **733** | 943 |
| **4** | **13** | **9,526** | **733** | **732** |
| 5 | 15 | 10,750 | 717 | 612 |
| 6 | 17 | 11,500 | 676 | 375 |
| 7 | 20 | 12,250 | 613 | 250 |
| 8 | 25 | 12,500 | 500 | 50 |

Based on Table 9 described that the optimum production of Rambutan fruit *(Nephelium sp)* reached to the age of 13 years, which Average Product (AP) reached to 733 kg/ha/year and Marginal Product (MP) reached to 732 kg/ha/year. The Rambutan fruit *(Nephelium sp)* started to produce on the year of 4th to the year of 25th, but the optimum production was reached to the age of 13 years by total production to 9,526 kg/ha.

The production graphic of Mean Annual Increment (MAI) and Current Annual Increment (CAI) of Rambutan fruit *(Mahagony sp)* based on Table 9 could be estimated sistematically shown by Picture 9.




Picture 9. AP and MP of Rambutan Fruit *(Nephelium sp)* Combinated by Mahoni *(Mahagony sp)* Based on Cycling (Data from Table 9)

Based on the Picture 9 above explained that Rambutan Fruit *(Nephelium sp)* combinated by Mahoni Trees *(Mahagony sp)* reached to the optimum production on the age of 13 years by total production reached to 9,526 kg/ha by Average Product (AP) reached to 733 kg/ha/year and Marginal Production (MP) reached to 732 kg/ha/year.

## 6. FINANCIAL ANALYSIS OF FOREST LAND MODELING IN KUTAI KERTANEGARA DISTRICT

The detailed costs required for the forestland by people modeling in each farm industry which had different cycle can be found in the appendix. The price of each commodity can be seen on Table10.

Table 10. The Prices of Wood and Fruit Based on the Current Market Prices.

| No. | Commodity | Price |
|---|---|---|
| 1. | Super Teakwood as the result of thinning | Rp 500.000/$m^3$ |
| 2. | Super Teakwood as the result of mid harvesting | Rp1.500.000/$m^3$ |
| 3. | Super Teakwood as the result of post harvesting | Rp3.000.000/$m^3$ |
| 4. | Durian Fruit | Rp10.000/kg |
| 5. | Coffee | Rp15.000/kg |
| 6. | Rambutan Fruit | Rp5.000/kg |
| 7. | Mahogany Wood | Rp400.000/$m^3$ |

The price of durian wood based on its length and Diameter can be seen on Table 11.

Table 11. The Price of Durian Wood Based on Its Length and Diameter

| Length (cm) | Diameter (cm) | Price (Rp.) |
|---|---|---|
| 130 - 190 cm | 10-19 | 350.000 |
| | 20-up | 450.000 |
| 200-250 cm | 20-29 | 800.000 |
| | 30-up | 1.100.000 |
| 250 – up | 20-29 | 900.000 |
| | 30-up | 1.400.000 |

Source: Rimba Kayu, 03 June 2012

Based on the prices of wood and fruit commodities, the revenue obtained from each commodity can be calculated and described in a cash flow as follows:

**1. Financial Analysis of Monoculture Cultivation of Super Teakwood**

Total cost of the entire activities for monoculture farm of super teakwood for 25 years was Rp205.588.000 and the gross income was Rp486.214.000. Therefore, without considering the time value of money, this farm industry created a benefit value or a B/C Ratio of 2.4, meaning that every Rp1 expended had a return of Rp2.4.

Teakwood is usually harvested at the age of 10 years up to 25 years. The price of the wood depends on the diameter class. Only 80% of the wood is sent to the market in the form of solid wood, while the remaining 10% is in the form of firewood. The result of analysis showed that at the age of 10 years the wood resulted from

thinning with the amount of 4.9 $m^3$ was collected with the price of Rp500.000. Therefore, the total income earned from the production of solid wood and firewood was Rp1.960.000 and Rp98.000 respectively. At the age of 15 and 20 years mid harvesting produced 16.64 $m^3$ and 60.2 $m^3$ respectively with the total revenue of Rp19.968.000 and Rp72.240.000. Post harvesting produced 162 $m^3$ with the returns of Rp388.800.000.

Based on the statement above, it can be explained that at the interest rate of 5%, Pay Back Period, the Net Present Value (NPV) and the Net B/C were 24.1 years; Rp44.441.000 and 1,66 respectively**.** This statement was supported by the result of model analysis of Internal Rate of Return (IRR) which equaled to 7.6% and the average annual income (EAA) was Rp3.153.98. If assumed that the consumption expenditure for each farmer family head/year (5 people/family) was Rp50.000.000/family/year, then to cover their living cost, every family would need 16 ha to operate monoculture cultivation of super teakwood. The above findings revealed that monoculture cultivation of teakwood at the interest rate of 5% was feasible to operate because the value of its IRR (7.6%) was higher than its Minimum Accesstability Rate (MAR = 5%).

**2. Financial Analysis of Super Teakwood and Durian Cultivation**

The total cost for the entire activities of super teakwood and durian cultivation for 35 years was Rp371.416.000 and the gross income was Rp942,082,000, Therefore, without taking the time value of money into account, this types of cultivation generated a benefit value or a B/C Ratio of 2.5. This means that every Rp1 expended had a return of Rp2.5.

Super teakwood and durian cultivation created a variety of income. Durian fruit was harvested from the age of 8 to 35 years with the volume of fruit production as explained in the previous page and the optimum production was achieved at the age of 25 years. If the price of durian fruit was Rp10.000/kg, then the total revenue would be Rp507.490.000. The super teakwood was collected from the age of 10 to 25 years and its price depended upon its diameters class. Only 80% of the wood was sent to the market in the form of solid wood, while the remaining 20% was in the form of firewood. At the age of 10 years, the wood resulted from thinning with the amount of 2.4 $m^3$ was harvested with the price of Rp500.000. Therefore, the total revenue obtained was Rp2.994.000. At the age of 15 and 20 years midterm harvesting was done, producing 10.3 and 26.6 $m^3$ of wood with the total returns of Rp12.360.000 and Rp31.920.000 respectively. The post harvesting produced 108.59 $m^3$ with the total income of Rp389.136.000. By taking the time value of money and the above statement, it can be explained that at the interest rate of 5%, Pay Back Period, the Net Present Value (NPV) and Net B/C were 19.1 years Rp130.158.000 and 2.91 respectively. This statement was supported by the model analysis of Internal Rate of Return (IRR) which valued 10.7% and the average annual income (EAA) which valued Rp7.948.971. If assumed that consumption expenditure for every farmer family (5 persons/family) was Rp50.000.000/family/year, then in order to fulfill their living needs, each family would need an area of 6 ha for operating a durian cultivation which was integrated with super teakwood. The above finding showed that durian farm integrated with super teakwood at the interest rate of 5% was feasible to operate because the value of its IRR (10.7%) was higher than its Minimum Accessability Rate (MAR = 5%).

**3. Financial Analysis of Monoculture Cultivation of Durian**

The total cost for the entire activities for monoculture cultivation of durian for 50 years was to Rp389.563.000 and its gross revenue was Rp1.143.630.000. Therefore, without taking the time value of money, this practice had a benefit value (B/C Ratio) of 2.9. This means that every Rp1 spent would have a return of Rp2.9.

Durian cultivation with monoculture system brought about different incomes. The income was divided into two categories, namely the income gained from the result of wood selling and that gained from the result of fruit selling. Durian fruit was harvested from at the age of 15 years up to the age of 50 years with the production

volume of fruit as explained in the previous page. The optimum production of durian fruit was achieved at the age of 40 years with the price of Rp10.000/kg and this earned a total income of Rp906.750.000. The total income obtained from the durian wood selling was Rp2.236.880.000. By considering the time value of time and considering the above statement, it can be explained that at the interest rate of 5%, Pay Back Period, the Net Present Value (NPV) and Net B/C were 19.6 years; Rp87.538.000 and 2.68 respectively. This statement was supported by the model analysis of Internal Rate of Return (IRR) whose value was 8.8% and its average annual income was Rp4.79.046. If assumed that the consumption expenditure of a farmer family/year (5 persons/family) was Rp50.000.000/family/year, then in order to fulfill their living needs, each family would need an area of 10 ha to operate monoculture durian cultivation. The above finding showed that at the interest rate of 5%, monoculture durian was feasible to cultivate because the value of its IRR (8.8%) was higher than its Minimum Accessability Rate (MAR = 5%).

**4.Financial Analysis of Durian and Coffee Cultivation**

The total cost for the entire activities of durian and coffee cultivation for 35 years was Rp287.261000 and its gross income was Rp684.998.000. Therefore, without taking the time value of money into account, this cultivation had a benefit value or (B/C Ratio) of 2.4. This means that every Rp1 expended had a return of Rp2.4.

Integrated cultivation of durian and coffee brought about different types of income. Durian began to bear fruits and to be harvested at the age of 8 years and was productive up to the age of 35 years with the production volume of durian fruit as explained on the previous page. The price of durian fruit was Rp10.000/kg and the total income was Rp634.462.500. On the other hand, coffee was harvested at the age of 4 and was productive up to the age of 20 years. The optimum production of coffee fruit was achieved at the age of 13 years with the price of Rp15.000/kg. Therefore, the total income obtained from the coffee fruit production was Rp50.535.500. By taking the time value of time into account and by considering the above statement, it can be explained that at the interest rate of 5%, Pay Back Period, the Net Present Value (NPV) and the Net B/C were 14.4 years ;of integrated cultivation of durian and coffee were Rp87.529.000 and 2.42 respectively**.** This statement was supported by the model analysis of Internal Rate of Return (IRR) which valued 10.3% and the average annual income (EAA) which valued Rp5.345.545. If assumed that the consumption expenditure of a family (5 persons/family) was Rp50.000.000/family/year, then in order to cover their living needs, each family needed an area of 9 ha for operating an integrated cultivation of durian and coffee. This indicates that an integrated cultivation of durian and coffee at the interest rate of 5% is feasible to operate because the value of its IRR (10.3%) was higher than its Minimum Accestability Rate (MAR = 5%).

**5. Financial Analysis of Rambutan and Mahogany Cultivation**

Its shown that the total cost for the entire activities of Rambutan and mahogany cultivation for 35 years was Rp256.712.000 and its gross income was Rp550.908.000. Therefore, without taking the time value of money into account, this cultivation had a benefit value (B/C Ratio) of 2.2. This means that every Rp1 expended had a return of Rp2.2. This means that even though this cultivation was feasible to operate, the income level was very low.

Integrated cultivation of rambutan and mahogany brought about different types of income. Rambutan began to bear fruits and to be harvested at the age of 4 years and was productive up to the age of 25 years with the production volume of fruit as explained on the previous page. The price of rambutan fruit was Rp5.000/kg and the total income was Rp353.280.000. On the other hand, mahogany wood was collected at the age of 20 up to 35 years. Its optimum increment was achieved at the age of 30 years with the price of Rp500.000/$m^3$. Therefore, the total income obtained from mahogany wood as the result of thinning, midterm harvesting, and post harvesting

was Rp197.628.000. By considering the time value of time and by considering the above statement, it can be explained that at the interest rate of 5%, Pay Back Period, the Net Present Value (NPV) and the Net B/C were 12.7 years; of the integrated cultivation of rambutan and mahogany were Rp69.867.000 and 2.13 respectively**.** This statement was supported by the model analysis of Internal Rate of Return (IRR) which valued 10.5% and the average annual income (EAA) which valued Rp4,266,897. If assumed that the consumption expenditure of a farmer family/year (5 persons/family) was Rp50.000.000/family/year, then in order to cover the living needs of the family, each family needed an area of 12 ha for operating an integrated cultivation of rambutan and mahogany. The above finding indicates that the integrated cultivation of rambutan and mahogany at the interest rate of 5% was feasible to operate because the value of its IRR (10.5%) was higher than its Minimum Accestability Rate (MAR = 5%).

In general, the financial analysis of forest area management in Kutai Kartanegara Regency can be seen in table 12.

Table 12. The Recapitulation of the Financial Analysis and Cultivation Scale of Forest Management in Kutai Kertanegara Regency

| No | Model Lahan | Cycling | Analisis Finansial | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | PP | NPV | Net B/C | IRR | EAA | Skala |
| | | Year | Year | Rp. | Rp. | % | Rp | Ha |
| 1 | Super Teakwood | 25 | 24.1 | 44.441.000 | 1.66 | 7.6 | 3.153.198 | 16 |
| 2 | Super Teakwood + Durian | 35 | 19.1 | 130.158.000 | 2.91 | 10.7 | 7.948.971 | 6 |
| 3 | Durian Monokultur | 50 | 19.6 | 87.538.000 | 2.68 | 8.8 | 4.795.046 | 10 |
| 4 | Durian + Kopi | 35 | 14.4 | 87.529.000 | 2.42 | 10.3 | 5.345.545 | 9 |
| 5 | Rambutan + Mahoni | 35 | 12.7 | 69.867.000 | 2.13 | 10.3 | 4.266.897 | 12 |

Table 12 above shows that all types of forest area management were feasible to operate because the results of the financial analysis showed positive values (higher than the value of MAR = 5%, NPV>0, Net B/C>1). Among the five types of forest area by people management, it was recognized that the integrated cultivation of super teakwood and durian created the highest average annual income or Equivalent Annual Annuity (EAA) and had the smallest cultivated area scale, namely Rp7.948.971 and 6 ha respectively with the cycle of 35 years and with the rate of capital return of 19.1 years period. This was due to the fact that in the research location durian and super teakwood had a good production potential. This was also supported by the landscape which was suitable with this type of cultivation. Moreover, agroforestry farming system was proven to yield a large income. This resulted in a high production of durian fruit and super teakwood. In addition to the production of durian fruit, this type of cultivation also produced good increment/potential of super teakwood resulting in a high income. On the contrary, monoculture cultivation of super teakwood yielded the smallest average annual income and had the largest cultivated area scale, namely Rp3.153.198 and 16 ha respectively with the cycle of 25 years and with the rate of capital return of 24.1 years period. This was due to the fact that the income gained from super teakwood production was very small and the monoculture cultivation of super teakwood only provides a single source of income, merely from super teakwood production. Monoculture cultivation of durian yielded an average annual income of Rp4.795.046 and needed an area of 10 ha, where as

the integrated cultivation of durian and coffee yielded an average annual income of Rp5.345.545 and an area of 9 ha. The combined cultivation of rambutan and mahogany yielded an average annual income of Rp4.266.897 and needed an area of 12 ha. Therefore, it can be concluded that the forest area model using agroforestry system yielded a better income rate than that which used monoculture cultivation system. If the mean of the average annual income and the area needed for the cultivation for the five types of forest area modeling were calculated, then the results were Rp5.101.932 and 11 ha respectively. This would be sufficient to cover the living needs of the farmer family during the cultivation cycle and this was also feasible to cultivate both using monoculture and agroforestry system.

Among the various models of landscape agroforestry management of forest land, the integrated cultivation of super teakwood and durian was the most prominent model of forest land cultivation. Super teakwood could be harvested from the age of 20 years as the result of midterm harvesting and the result of the post harvesting could be collected at the age of 25 years, while durian fruit could be harvested from the age of 8 years and its optimum production was achieved at the age of 25 years. The purpose of landscape agroforestry was to utilize the land in order to yield the best and financially most profitable production. Therefore, the sustainability of land use becomes the integration of three dimensions: economic, social and environmental dimensions, both present and future uses.

## 6. CONCLUSION AND SUGGESTIONS

### A. CONCLUSION

1. Maximal increment of super teak wood and durian monoculture was reached at the age 25 up to 40 years, whereas mahogany at the age 30 years. Optimum production of durian , rambutan and coffe was reached at the age 25 years and 13 years.
2. Integrated cultivation of super teak wood and durian yielded the biggest income and production compared with other types of forestland modeling cultivation (other types of combination).
3. Financially, all types of forestland modeling were feasible to cultivate because their IRR values were higher than their MAR values and integrated cultivation of super teak wood and durian had the smallest scale of area but the biggest average annual income compared with other types of forestland modeling.

### B. SUGGESTIONS

1. Because the maximum production of each plant was different, it is necessary to have an intensive care in order to gain more optimum production in a shorter time.
2. Forest area modeling with the combination of super teak wood and durian needs to be recommended to the farmers because this model had the largest production and created the highest income among other models of private forest plantation.
3. All types of forest land modeling were feasible to cultivate. Therefore, the government should have a role in giving recommendation to the farmers to work on the existing types of forestland model. Moreover, the government should provide the farmers with working capital assistance to cover the cost of the activity.

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