Analysis of community income on suren (*Toona sureni* (Blume) Merr.) and cacao crops (*Theobroma cacao* L.) in Simalungun, North Sumatera- Indonesia

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Abstract. Agroforestry is the management and integration of trees, crops and/or livestock on the same plot of land and can be an integral component of productive agriculture. It may include existing native forests and forests established by landholders. The study was conducted in Mekar Sari Raya village, Panei sub, Simalungun regency, North Sumatera. This study aims to gain the ability to use agroforestry in suren crops and cocoa that provides benefits to farmers and the feasibility of the model farm. The study site has *Net Present Value* (NPV) is 2,670,306,905 ( IDR) for 15 of year, *Gross B/C Ratio* (BCR) is 2.3; *Internal Rate of Return* (IRR) is 28 %; and *Payback Period* (PP) for 5 years 4 months 24 days. Agroforestry using commodities cacao and suren crops are financially feasible to be cultivated and developed.

1. Introduction

Agroforestry is combines shrubs and trees in agricultural and forestry technologies to create more diverse, productive, profitable, healthy, ecologically sound, and sustainable land-use systems. Various efforts have been made for cocoa development. Improved cultivation techniques will ultimately bring benefits in the development effort. Efficient nursery techniques, attempts to obtain superior plant material through hybridization, pruning methods to establish good habitat, plant spacing, pest and disease protection efforts aimed at finding an efficient cocoa planting and maintenance period with maximum production target [1].

The reason the farmers do agroforestry pattern on suren and cocoa plants is: (1) increase revenue, (2) developing rural economic activity, (3) realizing food security system, (4) prevent erosion and landslides. Farmers in the area are the majority earning from farming rice, corn, coffee and cocoa. As for rice and maize with the ability of their land categorized fertile can produce or planted 2 times in 1 year. Developments in the Indonesian agricultural sector provide opportunities for farmers with their efforts. One of them is plantation crops, especially cocoa, which is one of the plantation commodities cultivated by many farmers. This commodity has a high economic value and strategic, both to provide increased income farmers can even increase foreign exchange for the country. This research is done to see public expenditure and earnings from their farm in Mekar Sari Raya Village Panei Sub district, Simalungun Regency, North Sumatera. Purposes of this study are: how is the feasibility level of farming by planting suren and cocoa in the research area.
2. Research Methods
The study was conducted from October to November 2016 in Mekar Sari Raya Village, Panei Subdistrict, Simalungun Regency of North Sumatra. The number of families in Mekar Sari Raya is 225 families. According to [2], if the subject is less than 100 people better taken all, if the number is greater than 100 people then taken between 10-25\% or 20-25\%. Thus, the data in this study used 34 head of families. In this study area, data collected in the field by interviewing the farmers directly, in the form of questionnaires on farmers' identity, land ownership, crop species, number of crops per ha and management methods, selling price of products (suren and cocoa), Seed price, worker and others. The revenue earned by the farmer is the product multiplied by the price of the product received by the farmer. While the income of farmers is the result of reduction of total receipts with the amount of costs incurred by farmers in one planting period [3]. Investment activity involves a relatively large amount of funds, which is invested in a certain time and is expected to benefit in the future to avoid losses. Some of the financial feasibility criteria to be used are given below [1]:

a. Net Present Value (NPV)
Net Present Value, the current value of agroforestry activities with the following indicator:
- \( NPV = 0 \), when the agroforestry business value is at the prevailing interest rate in the bank.
- \( NPV > 0 \), when the agroforestry business is profitable.
- \( NPV < 0 \), when agroforestry business loses.

b. Benefit Cost Ratio (BCR)
Benefit Cost Ratio, comparing the profit to the cost of an agroforestry activity or business with the following indicators:
- \( BCR > 1 \), when the agroforestry business is profitable.
- \( BCR < 1 \), when the agroforestry business is a loss.
- \( BCR = 1 \), neutral.

c. Internal Rate of Return (IRR)
Internal Rate of Return, is a parameter at the interest rate of how the agroforestry business benefits with the following indicators:
- \( IRR \geq i \), when agroforestry is feasible.
- \( IRR < i \), when agroforestry is not feasible.

d. Payback Period (PP)
Payback Period, is the period required to recover the investment expenditure using a net cash flow/ proceed with a quick time so that funds invested in an investment can be recovered.

3. Result and Discussion
3.1 Cost of Suren and Cacao Farming
3.1.1 Analysis of Agroforestry Revenue Suren and Cacao in Mekar Sari Raya Village.
The form of suren planting is done on the sidelines of the cocoa tree line in the form of intercropping. Suren plants in the village of Mekar Sari Raya planted with spacing 2 x 3 m, 5 x 5 m, 10 x 10 m. While the distance of planting cocoa with a distance of 3 x 4 m (Figures 1, 2, 3 and 4). The planting of suren is done by people with different patterns such as planted as intercrops, as land boundaries. The shape of the cropping pattern undertaken by the farmers is adjusted to the interests of the farmers. This planting of suren is done with community initiative.
3.1.2 Investment Cost.
Investment costs are the costs incurred for plant investment before there is a yield. Investment costs in suren and cocoa farming include the purchase of cocoa and cocoa seeds. Cacao plants still have to spend on investment until year 3. The first year, the investment cost includes the purchase of cocoa seeds and suren. The second and third year, investment costs include the purchase of cocoa seeds for the purpose of embroidery. The investment cost of cocoa per hectare is presented in Table 1.

Table 1. Average investment cost of suren and cocoa farming in Mekar Sari Raya village.

| Information   | Amount (Units) | Price (IDR/Seeds) | Cost (IDR)    |
|---------------|----------------|-------------------|---------------|
| Cocoa seeds   | 9,745          | 3,500             | 34,107,500    |
| Suren seeds   | 1,448          | 3,000             | 4,344,000     |
| Amount        | 11,193         |                   | 384,515,000   |

a. Labor costs
The labor used in cocoa farming comes from the family's own labor, neighbors and others. The cost of the family labor itself is a calculated cost where the cost is in cash not issued, while labor costs for other workers use the cash paid system and paid. Labor usage is calculated based on daily wages converted into working days (HK). The use of female labor is calculated as the average male laborer's wage, which is IDR 85,000.00 - IDR 110,000.00 / day.
b. Fertilization and Pesticide Costs
The cost of fertilization is a considerable cost to farmers, the use of fertilizer enough each year to cause farmers to set aside income large enough to be used in purchasing fertilizer. The fertilizer costs incurred during farming can be shown in Table 2.

| Year | Manure spreader (IDR/ha) | Urea (IDR/kg) | TSP (IDR/kg) | KCL (IDR/kg) | Diazinon (IDR/kg) |
|------|---------------------------|---------------|--------------|--------------|-------------------|
| 1-15 | 9,459,681                 | 7,822,059     | 3,799,253    | 3,708,750    | 325,000           |

Fertilizers commonly used by farmers in the study sites are in the form of manure, Urea, and KCL. Manure is used at the time of land preparation, i.e. before the planting. Then for Urea and KCL fertilizer given the community at the time of planting is done. Urea and KCL fertilizers were administered two to four times a year by the community. In the maintenance activities, farmers also use pesticides. In addition to using pesticides, suren leaf extract is very helpful to prevent symptoms of damage caused by pest attacks. According to [4], states that suren leaf is often used as a vegetable pesticide and its pyrethropic active substances are capable of destroying the pest’s nervous system. The substance works very quickly and cause symptoms of lethal paralysis. Suren extract can be an alternative in expelling aphids. According [5], states that the suren is rich in surenon, surenin and surenolakton which acts as a barrier to growth, insecticide, and antifeedant (inhibition of feeding power) against insect larvae.

3.1.3 Suren and Cocoa Revenue.
The results obtained from cocoa plants are dry cocoa beans in which the cocoa beans have been dried 1-3 days (if the weather is hot). Cocoa crops can be harvested at the age of 3 years with the production (dry beans) produced on average. The total production of dry cocoa beans and suren wood for each plant can be seen in Table 3 and Figure 5.

There are fluctuations in production from 3-15 years of suren and cocoa, because among farmers one with other farmers has a difference in the pattern of cocoa farming. For example, the difference in the use of fertilizers. The table above also shows that the largest cocoa seed production occurs at the time of the 13-year-old plant, which is 2,775 kg / ha / year.

According to [1] those cocoa plants have the largest production between 10 - 20 year-old plant, and the older age of cacao plants fruit production decreased. The lowest production occurs when the 3-year-old plant, which is 727 kg / ha / year. Because at the age of this plant, cocoa plants are still said to learn to bear fruit. According to [6], the average national productivity of cocoa reaches 845 kg / ha / year, while on private plantations slightly better with productivity of 907 kg / ha / year and 914 kg / ha / year respectively. The yield of cocoa production in Mekar Sari Village is below than the production potential. Based on Table 3, the average production of dry cocoa beans is about 1,960.42 kg / ha / year, so farmers get revenue of IDR 49,010,500 / year.

Suren trees are harvested in the 15th year of 168 trees, with an income of IDR 48,000,000. Suren trees can not be harvested together because the age of suren trees is not the same, Suren trees can be harvested with> 15 years and not all suren trees that are 15 years old can be harvested, due to the size of the tree diameter is different. Now, some farmers use suren trees only as intercrops, wind breakers, road shutters, and land boundaries. According to [7] (2016) states that suren tree can be sold which has a diameter of
≥ 30 cm, Suren diameter ≥ 30 cm has a price of IDR 1,000,000 - IDR2,000,000, the average market price of suren stands valued at IDR1,000,000 during the study.

Table 3. Average production of dry cocoa beans and suren wood

| Age of plants (Year) | Production of Dry Seed (Kg) | Price of dry cacao (Kg) | Suren Wood Production | Selling Price of Suren Stand (trunk) |
|----------------------|----------------------------|------------------------|-----------------------|-------------------------------------|
| 1                    | -                          | -                      | -                     | -                                   |
| 2                    | -                          | -                      | -                     | -                                   |
| 3                    | 727                        | 18,000                 | -                     | -                                   |
| 4                    | 1,074                      | 20,000                 | -                     | -                                   |
| 5                    | 1,103                      | 20,000                 | -                     | -                                   |
| 6                    | 1,303                      | 22,000                 | -                     | -                                   |
| 7                    | 1,612                      | 20,000                 | -                     | -                                   |
| 8                    | 2,485                      | 22,000                 | -                     | -                                   |
| 9                    | 2,295                      | 21,500                 | -                     | -                                   |
| 10                   | 2,485                      | 20,000                 | -                     | -                                   |
| 11                   | 2,319.5                    | 22,000                 | -                     | -                                   |
| 12                   | 2,754                      | 23,000                 | -                     | -                                   |
| 13                   | 2,775                      | 26,000                 | -                     | -                                   |
| 14                   | 2,645                      | 25,000                 | -                     | -                                   |
| 15                   | 1,910                      | 26,000                 | 161                   | 500,000                             |
| Amount               | 25,485.5                   | 285,500                | 161                   | 500,000                             |
| Average              | 1,960.42                   | 21,961                 | 21                    | 500,000                             |

Figure 5. The average income of farmers in the village of Mekar Sari Raya for 15 years.

3.2 Revenue Analysis
The income analysis is used to determine the ratio between the amount of costs incurred by the receipt of a production process, whether the production process is feasible to cultivate and can provide benefits. Table 4 shows the magnitude of NPV at 12% interest rate is IDR 2,670,306,905.84 for 15 years which means the value of NPV is positive or greater than zero, This indicates that net income of cocoa farm is
bigger than total cost, so it can be said that cocoa farming in Mekar Sari Raya Village is feasible to be developed because of NPV > 0 value. The advantage gained by cocoa farmer causes the increase of farmer’s cocoa welfare in Desa Mekar Sari is evident from the number of farmers who are able to increase the area of land, besides cocoa farmers are able to meet the needs of families and send their children to school.

**Table 4. Analysis of cocoa and suren farm income per hectare at 12% (DF = 12%).**

| Criteria             | Results                                      |
|----------------------|----------------------------------------------|
| Net Present Value (IDR) | 2,670,306,905.84                           |
| Gross B/C            | 2.3                                          |
| IRR (%)              | 28%                                          |
| Payback period (year)| 5.4 (5 years, 4 months, 24 days)            |

Table 4 shows that Gross B/C Ratio of 2.3 > 1 is obtained which means that the benefits obtained are greater than the cost incurred, so that the farming business of suren and cocoa is feasible to continue. The IRR value obtained from the calculation is 28%. The IRR value obtained is greater than the prevailing market rate of 12%. It can be concluded that the agroforestry of cocoa and suren is feasible to be cultivated financially. Based on the calculation result, obtained payback period for 5.4 years. This means that the initial investment will be refunded within 5 years 4 months 12 days, so the investment payback period is shorter than the project’s economical life of 15 year.

4. Conclusions
An income analysis conducted at the interest rate of 12% obtained Net Present Value (NPV) value of 2,670,306,905.84(IDR) for 15 years, Gross B/C Ratio (BCR) 2.3, Internal Rate of Return (IRR) 28% and Payback Period (PP) for 5 years 4 months 24 days. Based on the results of financial feasibility parameters namely NPV, BCR, IRR and PP obtained then agroforestry suren and cocoa in Mekar Sari Raya Village Panei Sub district financially feasible to be cultivated and developed.

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