The impact of replanting oil palm plantations on the farming income of the Sungai Bahar community in Muaro Jambi Regency

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Abstract. The research objectives are: (1) to know the description of oil palm farming income in replanting to underplanting and conventional method (2) to know the level of oil palm farmer income in replanting to underplanting and conventional method, (3) to know the ratio of oil palm farming income in replanting to underplanting and conventional method. The research conducted in Sungai Bahar Subdistrict: Suka Makmur, Mekarsari Makmur and Marga Mulya Village. The study area is chosen purposively. The study conducted three calendar months. Respondents were 60 farmers consisting of 30 farmers applied the conventional method, and 30 farmers applied underplanting method. Data were analysed by descriptive and t-test statistics. The results showed that there are differences in the number of plants in both replantings that affect production and income. The oil palm farming income who applied conventional method is higher than the underplanting method. The analysis shows that the oil palm farming income through conventional method is significantly different from the income of underplanting method.

1. Introduction
The plantation sub-sector has a huge opportunity to become a mainstay of exports. Development in the plantation sector has directed to further accelerate the rate of growth of production from both large plantations, private and state plantations to support the industrial development, as well as increasing the utilization and sustainability of natural resources (SDA) in the form of land and water. The role of the plantation sector is so great for increasing the income of the farmers and providing raw materials for domestic industries and as a source of foreign exchange.

Oil palm plantations in Sungai Bahar District opened in 1983 by PTPN VI. The establishment of PTPN VI in Sungai Bahar District in the background behind the Central Government Program for the development of areas outside Java through the transmigration program. Then the transmigration program integrated with the development program of oil palm plantations with a partnership pattern between large plantations and smallholder plantations. The partnership pattern is known as the PIR-Plasma Pattern. In the partnership program between large plantations and the transmigration program, the plasma was a participant in the transmigration program so that the pattern of PTPN VI Sungai Bahar's Oil Palm Plantation Program called the PIR-Trans Pattern [1].
During the partnership process, PTPN VI was entirely responsible for all facilities and infrastructure in the development of oil palm plantations, ranging from fertilizing, gardening and road maintenance, while the Village Unit Cooperative (KUD) acts as a deposit of production to the company during the partnership process. From the results of the sale of the product, each farmer deducted for a credit instalment of 30% or as much as the instalment stated in the Debt Recognition Letter (SPH). The company after receiving a list of name of farmers, who sell products from KUD, make payments to KUD by 70% or according to the list of farmers' liability payments, and 30% paid to the Bank as instalments [2].

Apart from the pattern of partnership carried out by PTPN VI with farmers in Sungai Bahar Subdistrict in 2002, farmers began to cultivate or develop their oil palm plantations privately, and farmers who separated from the partnership pattern given the term Ex-PIR Plasma PTPN VI. Ex-PIR Plasma is a term made as a differentiator between purely independent palm oil farmers and transmigration oil palm farmers who have worked or collaborated with PTPN VI. Given the long-term planting of oil palm in Sungai Bahar Subdistrict, which began in 1983, indicates that oil palm plants located in Sungai Bahar Subdistrict must be immediately rejuvenated due to the declining ability of plants to produce fresh fruit bunches (FFB).

Sungai Bahar Subdistrict consists of 11 villages, which out of the 11 villages there were only three villages that had carried out the rejuvenation of oil palm, namely Suka Makmur Village, Mekarsari Makmur Village and Marga Mulya Village. The decision of the farmers to rejuvenate oil palm is due to a large number of old plants that cause a decrease in production and crop productivity so that there is a decrease in farmers' income. The area of the old palm oil plantations of Ex-PIR Plasma in Sungai Bahar Subdistrict is 7,260 Ha or 75.9% of the total area of oil palm in the Sungai Bahar District.

Rejuvenation is the replacement of unproductive old plants with new crops that are more productive and profitable. In the cultivation of oil palm plants, there are applied several alternative rejuvenation models including conventional rejuvenation, underplanting rejuvenation, and intercropping rejuvenation. People's palm oil worship needs to consider the sustainability of the farmer's income during rejuvenation. The selection of appropriate rejuvenation techniques needed, to provide alternative income for farmers during the revival period [3].

The productivity standard that used as a reference for the rejuvenation period is around 12 tons of FFB/ Ha/Year. In addition to productivity, crop effectiveness and plant density are other considerations in determining the rejuvenation period. The effectiveness of harvest will be low if the height of the oil palm tree has exceeded 12 meters. In addition, rejuvenation needs to be done if the plant density is <80 trees/ha [1].

Conventional rejuvenation technique is a developed rejuvenation technique through the development of oil palm rejuvenation models/demonstration plots. It was carried out starting in 2011 in Mekar Sari Makmur Village, Marga Mulya Village and in 2012 in Suka Makmur Village, Sungai Bahar Subdistrict, Muaro Jambi Regency, through APBN and BI funds in collaboration with the Plantation Office of Jambi Province (http://rosenmanmanihuruk.blogspot.co.id). Conventional rejuvenation carried out by farmers from three villages totalling 30 people through government programs has now entered the age of 4 to 5 years and has produced fresh outer bunches (FFB).

The selection of oil palm rejuvenation techniques in Sungai Bahar Subdistrict will affect the size of the production costs that farmers will spend on their oil palm plantations. The low production costs will have a significant effect on the obtained farmer income.

Based on the description above, this research is aimed to, 1) To find out the description of oil palm farming from each rejuvenation technique in Sungai Bahar Subdistrict; 2) To find out the level of oil palm farming income from each rejuvenation technique in Sungai Bahar Subdistrict; and 3) To compare the level of oil palm farming income from each rejuvenation technique in Sungai Bahar Subdistrict.
2. Material and methods
This research was carried out in Sungai Bahar Subdistrict namely in Suka Makmur Village, Mekarsari Makmur Village and Marga Mulya Village. The choice of this location purposively made, with the consideration that in this area, the farmers have been rejuvenating oil palm using conventional rejuvenation techniques and underplanting. The number of farmers as many as 60 farmers, namely 30 farmers who apply conventional techniques and 30 farmers who apply the underplanting technique. A sampling of conventional techniques used census and underplanting techniques used Snowball Sampling techniques.

Data analysis used in this study is descriptive analysis and differential analysis. Descriptive data analysis is an analytical technique used to analyse data by describing or describing the collected data soberly without any intention to generalize from the results of the research. For the first purpose, the analysis used is income analysis consisting of an analysis of the acceptance of oil palm farming. Inferential data analysis is a statistic used to perform data analysis by making conclusions, which are generally applicable. Characteristic of inferential data analysis is the use of specific statistical formulas, and then the calculations have done the results are what will become the basis for making generalizations that come from the sample for the population.

2.1. Farming income
To calculate the oil palm farming income the formula used:
\[ P_d = TR - TC \]
Where:
- \( P_d \) = Revenue (Rp)
- \( TR \) = Total Receipt (Rp)
- \( TC \) = Total Expenditures (Rp)

2.2. Significant Testing (t-test)
Significance test (t-test) to see the significance performed of the influence of independent variables on unbound variables individually and considers other variables constant. To test whether there are differences in oil palm farming income in conventional rejuvenation techniques and done with the statistical hypothesis formula of underplanting testing:
- \( H_0 : \mu_1 = \mu_2 \)
- \( H_1 : \mu_1 > \mu_2 \)

Hypothesis testing using t-test two separated variance independent samples [4] formulated as follows:
\[ t_{hit} = \frac{X_1 - X_2}{\sqrt{\frac{S_1^2}{n_1} + \frac{S_2^2}{n_2}}} \]
Information:
- \( n_1 \) = Number of respondents of conventional oil palm rejuvenation farmers
- \( n_2 \) = the number of respondents to the rejuvenation of oil palm underplanting
- \( X_1 \) = Average income of conventional palm oil rejuvenation farmers
- \( X_2 \) = Average farmers rejuvenation of oil palm underplanting rejuvenation
- \( S_1^2 \) = Variety of average oil palm rejuvenation income conventional
- \( S_2^2 \) = Variety of average income for oil palm rejuvenation farmers underplanting

The test conclusion did by comparing the \( t_{count} \) value with the \( t_{table} \) value as follows:
a. If \( t_{count} > t_{table} \), then \( H_0 \) is rejected, and \( H_1 \) is proven right which means that conventional palm oil rejuvenation techniques provide higher income compared to and underplanting rejuvenation techniques.
b. If $t_{count} \leq t_{table}$, then $H_0$ cannot be rejected, $H_1$ is not proven right which means that conventional oil palm rejuvenation techniques do not provide higher income compared to underplanting rejuvenation techniques.

3. Results and discussion

3.1. Characteristics of respondents

The number of respondents in the study area was 60 farmers, namely 30 farmers who applied conventional techniques and 30 farmers who applied the underplanting technique. The average age of farmers in the study area shows that farmers who apply conventional techniques and underplanting are mostly not in productive age in farming, with the level of pursued formal education mostly at the primary school level. All oil palm farmers have experience working on two years. The average number of dependents of farmer families is 1-2 people. The area of oil palm farming in the study area is quite varied. However, the average is less than 2 hectares, which is 1.90 hectares from what set by the government through the transmigration program for each farmer who applies conventional rejuvenation techniques and underplanting. Land ownership status of farmers who apply conventional techniques and the common underplanting technique are as owners.

3.2. Overview of oil palm farming in conventional rejuvenation techniques and underplanting in research areas

Sungai Bahar Subdistrict is one of the Districts producing palm oil in Muaro Jambi District. Sungai Bahar Subdistrict has been working on rejuvenated palm oil starting in 1983. Sungai Bahar Subdistrict cultivates oil palm by applying two rejuvenation techniques namely conventional techniques and underplanting. Conventional oil palm rejuvenation techniques carried out in 2011 and 2012 while underplanting rejuvenation techniques implemented from 2008 to present.

The number of farmers who apply conventional rejuvenation techniques and underplanting in this study amounted to 30 farmers. In cultivating oil palm farming, farmers are more effective in using underplanting techniques compared to conventional petroleum techniques. This is due to the ability of farmers to rejuvenate oil palm in their gardens. The main difference from conventional rejuvenation techniques and underplanting is in the process of planting and planting oil palm, but there are several other things that distinguish conventional rejuvenation techniques and underplanting in the study area and can be seen in the following description.

3.3. Land processing

The land is a factor that influences the level of production. It said that the land area has a positive effect on production. The ownership status of farmers' land in the research area, namely the status of the owner with the land area per farmer in each rejuvenation technique is approximately two ha. In 2011, 20 farmers carried out the rejuvenation with conventional techniques in Mekarsari Makmur Village and Marga Mulya Village with 40 Ha of total land area. In 2012, the application of conventional rejuvenation techniques carried out again in Suka Makmur Village with 10 farmers with a total land area of 20 Ha. The process of land clearing and land processing in Suka Makmur Village is not much different from the farmers who did the rejuvenation with previous conventional techniques. The 30 farmers who applied the underplanting technique in this study on average did not process their land as done with conventional techniques. The process of planting young plants in the underplanting technique directly planted between the old plants that still exist.

3.4. Oil palm planting

Oil palm planting begins with the preparation of plant seeds. Superior and quality seeds are one of the keys to success in the cultivation of oil palm plants. The use of good seeds expected to get good results
later. Seedlings used from the two rejuvenation techniques at the research location are types of marihat obtained from PTPN VI. Plant spacing used in both rejuvenation techniques in the study area is 8 x 9 m. There was no difference in the distance of planting in both techniques because each farmer followed the recommendations from PTPN VI, while the underplanting technique followed the planting distance of the old plants, which cultivated by PTPN VI.

In the process of planting oil palm, farmers who apply conventional techniques do the erection first on their land in order to straighten the direction of the line and the spacing determined before the making and planting take place. While on the land of farmers who apply the underplanting technique, farmers do not do the erection because farmers plant between old plants that are still in production. The process of piling up to planting in conventional techniques takes approximately 26 days per 20 ha.

3.5. Care

Plant maintenance carried out with the aim that plants can grow well and are able to provide good production as well. The treatment of oil palm plants is done after the young plants are planted in the field, which first done by farmers in conventional techniques that are fertilizing plants after the age of 3 weeks to 1 month is planted. This fertilization aims to stimulate growth and to get maximum yield. Fertilization at the research location in each technique is carried out twice in one year, and in underplanting techniques, there are fertilizers too once a year. Fertilizers used by farmers in the study area include NPK Phonska, Urea, KCL, Sp-36 and Dolomite.

Treatment or spraying is done twice a year. Herbicides used by farmers in the research area are Round-Up and Gramaxon. Furthermore, pruning or pruning done to stimulate oil palm plants to quickly flower and bear fruit. The process of pruning palm midribs on conventional techniques carried out at each harvest takes place because, considering the small oil palm plantations, the process of processing is not too difficult to do. While underplanting rejuvenation techniques farmers do pruning fronds once a year. This midrib trimming process can take approximately 3 to 4 days.

Harvesting is the process of taking TBS (Fresh Fruit Bunches) from oil palm plants. The harvesting process of both rejuvenation techniques is carried out 24 times a year. Palm kelp plants start production from the age of 3 to 4 years. During the process of oil palm plantation maintenance, farmers in conventional techniques use more labour in the family than outside the family because small plants and uniform plants make it easier for farmers to carry out maintenance, whereas in the underplanting technique farmers use more outside the family labour because of the not uniform and difficult plant maintenance due to older plants that are getting taller and harder during the harvesting process.

3.6. Production

Production is an activity that converts the input into output. In economic theory, a producer or entrepreneur must decide: (1) how much output that must be produced, and (2) how and in combination how the factors of production (input) are used. Production according to technical function is the integration of various resources used, such as land, labour, capital and management resources into the output, while production according to economic functions where the production process includes elements of transportation, trading costs, and other costs. Research on oil palm farming in the study area which is meant by production is the production of oil palm which is obtained from the oil palm farming products, namely in the form of fresh fruit bunches (FFB). Field data obtained by the average production obtained by farmers in 2016 is 18,168 tons/ha/year in conventional techniques and 16,274 tons/ha/year in underplanting techniques (table 1).

The production produced by farmers who rejuvenated conventional techniques in 2011 and 2012 was not much different because the amount of product produced was strongly influenced by the number of plants and the treatment carried out by farmers in each month such as fertilizer administration, weed eradication and midrib trimming. While farmers who do rejuvenation with production yield underplanting techniques are not so maximal because there is no variety in the age of
the plants on the land because they are dominated by two plants, young plants and old plants with an average number of plants per hectare of 260 and 166 plants with a different age range.

Plant age that is not uniform in the underplanting technique causes the growth of young plants have to be damaged so that the development of young plants is not good due to the struggle for nutrients and not optimal lighting due to the protection of old plants that still exist. Production produced by young plants in underplanting techniques is less than 1 Ton/ha, the amount of production received by farmers is still dominated by old plants that are still in their fields. We can see performance differences in oil palm farming in conventional rejuvenation and underplanting techniques in table 1.

Table 1. Comparison of Oil Palm Farming Performance in Conventional Rejuvenation Techniques and Underplanting in 2016 Research Areas

| Performance         | Conventional Technique | Underplanting Technique |
|---------------------|------------------------|-------------------------|
| Plant Age           | 4 – 5 Years            | 4 – 5 Years             |
| Plant distance      | 8 x 9 m                | 8 x 9 m                 |
| Seed types          | Marihat                | Marihat dan Others      |
| Number of plants    | 260                    | 260 dan 166             |
| Fertilization       | Twice per year         | Once – twice per year   |
| Treatment           | Twice per year         | Twice per year          |
| Midrib Pruning      | 24 times per year      | Once per year           |
| Harvesting          | 24 times per year      | 24 times per year       |
| Production          | 18,168 Ton/Ha/Year     | 16,274 Ton/Ha/Year      |
| Price               | Rp. 1.621/Kg           | Rp. 1.707/Kg            |

3.7. Cost analysis, revenue and income of oil palm farming

Conversion of forests into oil palm plantations on peatlands increases BD or soil density in the peat surface layer. Increased BD indicates that there has been compression of peat pores in oil palm plantations, peat soil was more compact, and the capacity of peat capillary will also increase. Therefore, the movement of water from the grown water table to the surface layer increases; it can maintain soil moisture on the surface layer of the peat, so maintained the sustainability of peat. Compaction of peat soils can support the peat soil to reduce oblique plant, reduce soil nutrient leaching, reduce CO₂ emissions and reduce peat risk to fires because of smaller peat soil pores but increase crop yields.

Farming income is the difference between total revenue and total costs incurred. The income earned by farmers in this study is the amount of palm oil production multiplied by the price then reduced by the number of costs incurred during the production process. We can see the amount of income of the respondent farmers in oil palm farming in conventional rejuvenation and underplanting techniques in the study area in table 2.

Table 2. Analysis of Oil Palm Farming Revenues in Conventional Rejuvenation Techniques and Underplanting in 2017 Research Areas

| Description         | Conventional | Underplanting |
|---------------------|--------------|---------------|
|                     | Rp/Farmer    | Rp/Ha         | Rp/Farmer     | Rp/Ha         |
| A. Acceptance       |              |               |               |
| 1. Production (Kg)  | 34,520       | 18,168        | 30,920        | 16,274        |
| 2. Price (Rp)       | 1.621        | 1.621         | 1.707         | 1.707         |
| Total Revenue (Rp)  | 55,956,920   | 29,450,328    | 52,780,440    | 27,779,718    |
| B. Fees Paid (Rp)   |              |               |               |
| 1. Fertilize        | 7,807,000    | 4,108,947     | 8,142,000     | 4,285,263     |
| 2. Medicines        | 598,333      | 314,912       | 626,667       | 329,825       |
| 3. TKLK             | 1,219,000    | 641,579       | 2,646,333     | 1,392,807     |
| 4. Other Fees       | 1,250,000    | 657,895       | 1,640,000     | 863,158       |
| Total Cost          | 10,874,333   | 5,723,333     | 13,626,667    | 7,171,929     |
Table 2 shows that the average income of farmers who apply conventional techniques is Rp. 55,956,920/Farmer/Year and income of Rp. 44,686,321/Farmer/Year. While the average income of farmers who apply the underplanting technique is Rp. 52,780,440/Hectare and income are Rp. 39,267,953/Farmer/Year. The size of the income earned by farmers greatly influenced by the size of the use of production costs incurred.

The costs used in the study are the total costs calculated in one year in oil palm farming activities that cover fertilizer costs, medical expenses, labour costs in the family, labour costs outside the family, depreciation costs and deduction costs. The amount of costs incurred in the underplanting technique is due to the uneven age of the plant and the difficulty in performing maintenance due to the age of different commodities in one field.

### 3.8. Comparison of oil palm farming revenues in conventional rejuvenation and underplanting techniques

To compare oil palm farming income in conventional rejuvenation techniques and underplanting, a different test analysis was carried out on average with computer assistance, namely the SPSS (statistical package for social science) program at a 95% confidence level (t-table $\alpha = 5\%$). Test results are provided in table 3.

#### Table 3. Test the Difference between the Average Palm Oil Farming Revenue in Conventional Rejuvenation Techniques and Underplanting in the 2017 Research Area

| No. | Description                  | Conventional Technique | Underplanting Technique |
|-----|------------------------------|------------------------|-------------------------|
| 1.  | Average Revenue (Rp)         | 44,686,321             | 39,267,953              |
| 2.  | Sig. (2 tailed)              | 0.000                  |                         |
| 3.  | t-count                      | 6.158                  |                         |

Based on table 3 it can be seen that the results of the data analysis using SPSS with the results of the test shows that the t-count is 9.404 and the t-table value at $\alpha = 5\%$ is 2.001. So that a decision obtained that refuse, $H_0$ accepts $H_1$. This means that the income received by farmers who apply conventional rejuvenation techniques is higher than the income obtained by farmers who apply underplanting rejuvenation techniques.

The difference in income from the two techniques strongly influenced by the amount of income received by farmers. Acceptance of the conventional technique is higher than underplanting technique; this is because the age and number of plants in the oil palm fields used two different techniques. The difference in age and number of plants dramatically influences the farmer’s amount obtained of production. In addition, the costs incurred by farmers in the underplanting technique are also greater compared to conventional techniques because on the land underplanting techniques there are oil palm plants with different ages so that the cost of maintenance is greater.

In line with the above decision, income in conventional techniques is higher than underplanting techniques. This is supported by research [5] said that from the point of view of conventional rejuvenation farmers are considered more effective and efficient. Farmers will not be difficult in management and supervision because there is relatively the same age of plants so it will optimize the use of production tools and streamline operational costs. Farmers who apply the underplanting technique consider the financial aspects so that the underplanting rejuvenation is more in line with
their socio-economic conditions. Farmers still have rejuvenation the income to finance their lives while some oil palm plants. Nevertheless, both rejuvenation techniques still provide financial benefits for each farmer.

In line with the results of the study above [6] in his research results said that the recommended technique of replanting is intercropping with food crops during the vegetative period of oil palm plants. This model still provides income for farmers during the TBM period. Simultaneous planting will produce plants and with consistent growth, facilitate maintenance and harvesting. In connection with the above results [7] explained that in his research there was a very significant difference between the income of the group of palm oil farmers and the group of plasma oil palm farmers where the income of the group of oil palm farmers was greater than the income of the plasma oil palm group.

4. Conclusion

Oil palm farming in conventional rejuvenation and underplanting techniques in 2016 in Sungai Bahar District has a difference in the yield of FFB produced. This is because the number of plants and the age uniformity of the plant affects the amount of products produced and obtained the farmer’s income.

The income of oil palm farmers in the study area who apply conventional rejuvenation techniques is higher than the income from underplanting techniques that is Rp. 44,686,321/Farmer/Year and Rp. 39,267,953 with a difference of 13.8 percent.

Evidenced by the t-test of two oil palm farming income, made a decision that the income of conventional rejuvenation techniques was significantly higher than the income from underplanting rejuvenation techniques.

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