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Analysis of the farmers' income for pine tappers (*Pinus merkusii*) koakan method at KPH Mamasa Tengah

Nuridin Dalya, A. Mujetahid M, Fira Yuniar and Andi Vika Faradiba Muin

Laboratorium Pemanenan Hasil Hutan, Fakultas Kehutanan Universitas Hasanudin

Email: vikafaradiba@gmail.com

Abstract. One type of Non-Timber Forest Products (NTFP) that sap can use is pine stands. Pine stands must be tapped to get the sap and of course it requires a lot of labor to work as sap tappers. One of the efforts made is to involve communities around the forest. Public interest in getting involved in pine sap tapping is still low. The cause of the low interest in the community to be involved in pine sap tapping is thought to be due to the low contribution of income from pine sap tapping to farmers' income. This study aims to determine the income of pine sap tappers and the factors that influence the income of pine sap tappers in KPH Mamasa Tengah, West Sulawesi. The data analysis used in this research is quantitative descriptive analysis. The results showed that the income of pine sap tappers was Rp. 1,577,500 / month if the tools and materials were borne by the company and the income of the pine sap tappers was Rp. 30,020 / month if the tools and materials were borne by the farmers. The results of multiple regression analysis indicate that the factor that affects the income of pine sap tappers is the area of tapping.

1. Introduction

Source of wealth which is very beneficial for human life, namely the existence of forest products in the form of wood and non-timber. Non-Timber Forest Products (HHBK) is a natural resource that is very abundant in Indonesia and has very good prospects for development [1,2]. NTFPs have a much more economic value compared to the value of wood which is still considered the main product and important for sustainability because the harvesting process can be carried out sustainably and without forest damage, one of which is by utilizing NTFPs in the form of pine resin. Its continuity and sustainability depend on human attitudes and actions in exploiting the forest's potential [3]. Utilization of forest resources is an effort to increase forest use value so that it can benefit humans. One of the uses of forest products for the benefit of humans is pine sap tapping. Pine sap is an important non-timber forest product commodity in the forestry sector and provides benefits to industry.

Pine sap can be obtained through wounds or tapping. Tapping a pine tree can be done in two ways, namely by cutting the wood or only up to the cambium [4]. Pine plant sap is a material that has a complex arrangement, produced by certain glands that form *resin ducts*, which are surrounded by a group of parenchymal cells (*parenchymal cells*) [5]. The sap produced by pine after the distillation process is gondorukem and turpentine which are used in the batik, plastic, soap, printing ink, lacquer, etc. industry, while turpentine is used as a paint solvent from pine resin [6].



There are three tapping systems used in pine sap tapping, namely the koakan system (*quarre system*), the drilling system and the corporal (*real*) system. Of the three systems above commonly used in Indonesia is the koakan system (*quarre system*) because it is a simple way, cheap and easy to do. According to Jesi et al (2019), the koakan system is carried out by scraping the bark first, then cutting the wood 1-2 cm deep, while the width is 10 cm. The wound in this way forms an inverted U with a distance of about 15-20 cm from the ground.

In line with the increasing world demand for pine resin commodities in the future, efforts to increase sap production through expansion of pine plantations are an effective step to be implemented as an effort to utilize forests and increase the income of communities around the forest while increasing the country's foreign exchange. Increasing the production of sap through pine plants can improve forest quality because in addition to protecting the environment, forest products are also enjoyed in the form of sap and wood. Pine stands must be tapped to get the sap and of course it requires a lot of labor to work as sap tappers. One of the efforts made is to involve communities around the forest. The people living around the forest generally work as farmers and raise livestock [7]. The difference in occupation will affect the income level of the community itself. A relatively low income level will involve part of the family members to work.

One of the forest areas that has the potential to produce pine sap is located in the West Sulawesi area of Central Mamasa Regency. Management of pine forests in the West Sulawesi area of Central Mamasa Regency involves a part of the community around the forest to work as pine sap tappers. With this pine sap tapping activity, it will provide jobs for people around the forest. Based on research conducted by Rizka (2019) in Dusun Darungan, Tegalarjo Village, Glenmore District, Banyuwangi Regency, that the community's interest in getting involved in pine sap tapping activities is still low, namely Rp.1,482,000 / month. The cause of the low interest in the community to be involved in pine sap tapping is thought to be due to the low contribution of income from pine sap tapping to farmers' income. Based on the background description, it is necessary to conduct research aimed at determining the amount of income that tappers receive from pine sap tapping and the factors that affect the income of pine sap tappers.

2. Methods

2.1. Data collection methods

The data collection method used in this study is to use a participatory approach with the following data collection techniques:

- a. Observation technique, namely direct observation at the pine sap tapping location to see the tapping process of pine sap.
- b. Interviews, namely data collection by conducting questions and answers to respondents using a questionnaire to collect primary data.
- c. Literature study, namely the collection of secondary data that supports research by means of quoting and recording data from village, sub-district, district, agency and research-related reports which include data on the general condition of the research location and the socio-economic conditions of the research location.
- d. Documentation, which is taking pictures of various objects of research to provide a clearer and more detailed picture of the topic or object of research.

2.2. Type of data

The types of data collected in this study consist of primary data and secondary data.

2.2.1. *Primary data.* Primary data obtained by conducting direct observations in the field and direct interviews with pine sap tapping farmers include:

- a. The tapping conditions include: age, number of family members involved in tapping, education, livelihood, long time being a pine sap tapping farmer.

- b. Tapping activities which include: tapping area, number of tapped trees, working days in a month, effective working hours in a month, distance from house to tapping location, sap production per month, age of tapped stands.

2.2.2. *Secondary data.* Secondary data were obtained from published agencies related to this research and various other literature that supports the preparation of research. This secondary data includes data on the general condition of the location and socio-economic conditions. Data on the general condition of the research location in the form of location, area, climate, rainfall, and land area. Meanwhile, data on the socio-economic conditions of the research location were in the form of population and education conditions.

2.3. Data analysis

The data analysis used in this research is quantitative descriptive analysis. Quantitative analysis was carried out by processing the data that had been collected during the study and tabulating and classified according to the objectives. The data analysis method used in this research are:

2.4. Production costs

The cost analysis was carried out to find out all the money-valued expenditures in producing pine sap. Production expenses are calculated using the total cost formula where. Total costs are the sum of fixed costs and variable costs. The formula used is (Abdullah, 2018):

$$TC = FC + VC$$

Where:

- TC = Total Cost (IDR)
 FC = Fixed Cost (IDR)
 VC = Variable Costs (Rp)

2.4.1. *Fixed Costs (FC).* Fixed costs are production costs whose size is not influenced by production volume and the results do not run out in one production (Balkis, 2015). As for what is included in the fixed costs in this study is the cost of depreciation of the equipment used in the pine sap tapping process. The formula used is as follows (Sitohang, 2016):

$$D = \frac{M-R}{N \times t}$$

Information:

- D = Depreciation Cost (IDR / hour)
 M = Capital / Investment equipment (IDR)
 R = Residual value at the end of the economy 10% (IDR)
 N = Economic age tool (Year)
 T = Hours worked in years (Hours / year)

2.4.2. *Variable Cost (VC).* Variable costs are costs that are used for one time production and cannot be used for subsequent production because they run out immediately (Balkis, 2015). As for what is included in the variable costs in this study, namely the purchase of raw materials (diesel costs). The formula used is as follows (Sitohang, 2016):

$$B = H \times J$$

Information:

- B = Cost of diesel (IDR / month)
 H = price of diesel (IDR / liter)

J = Amount of diesel (liters / month)

2.4.3. *Farmer revenue.* The acceptance analysis was carried out to find out all the results received by farmers from pine sap tapping activities. The formula used is (Suratiah, 2015):

$$TR = P \times Q$$

Information:

TR = Total Revenue (IDR)
P = Production of sap (kg)
Q = Price of sap (IDR / kg)

2.4.4. *Farmer's income.* The income analysis was carried out to find out all the results that can be valued with money obtained from the pine sap tapping activity. The formula used is as follows (Suratiah, 2015):

$$I = TR - TC$$

Information:

I = Income (Rp)
TR = Total Revenue (Rp)
TC = Total Cost (Rp)

2.5. Multiple regression

Regression analysis using the SPSS program (*Statistical Product and Survive Solution*) which is conducted to determine the factors that affect the income of pine sap tappers. There are 3 variables to determine the factors that affect the income of farmers. The multiple regression equation model is as follows (Harwati, 2015):

$$Y = a + b_1X_1 + b_2X_2 + b_3X_3 + e$$

Description:

Y = income (Rp / month)
a = constant
b = regression coefficient
X₁ = Tapping area (ha)
X₂ = Age of farmer (years)
X₃ = Length of time being tappers (years)
e = Residual

Statistical test using multiple regression analysis carried out a suitability test (*Test Of Goodness of Fit*) which consists of (Harwati, 2015):

2.5.1. *Coefficient of Determination (R² or R Square).* The characteristic of R² value is that R² is an increasing function of the independent variables included in the model, the higher the function, meaning the greater the R² value. So each additional significant value of the independent variable in the model will increase the value of R².

2.5.2. *F-statistical.* Test Simultaneous testing of the regression coefficient hypothesis is carried out using analysis of variance. Analysis of variance in multiple regression is essentially to show the sources of the total variation in the regression model. Based on this analysis of variance, it will be possible to obtain an understanding of how the influence of a group of independent variables simultaneously affects the dependent variable. The test statistic used in this case is the F test statistic, with the decision if $F_{count} >$

F_{table} then H_0 is rejected and H_a is accepted, conversely if $F_{count} < F_{table}$ then H_0 is accepted and H_a is rejected.

2.5.3. *T-statistic*. Testtest statistic is the process of testing the model part by part or individually. The statistical t test can be tested by comparing the value of t_{count} with t_{table} , with the criteria if $t_{count} < - t_{table}$ or $t_{count} < + t_{table}$ then H_0 is rejected and H_a is accepted.

3. Results and discussion

3.1. The income level of pine sap tappers farmers

Around the forest 40% make tapping pine sap a side job with their main job as farmers and breeders. However, 60% of the people make pine sap tapping their main job. The following is the percentage of work of farmers can be seen in Table 1.

Table 1. Occupation of Pine Tappers in KPH Mamasa Tengah.

Occupation	Number of Respondents	Percentage (%)
Sampingan	12	40
Utama	18	60
Total	30	100

Different types of work performed result in differences in income. According to Yanti et al. (2017) income is the difference between revenue and all production costs [8]. Income includes gross income and net income. Gross income is the receipt of tappers before deducting the cost of production. Net income is revenue less production costs or revenue less total costs. Production costs in question are all costs] incurred by farmers to finance the production process. The production costs for the pine sap tapping activities at KPH Mamasa Tengah consist of fixed costs and variable costs.

3.2. Pine

Sap farming production costs The pine sap farming production costs are the costs incurred in this farming activity. Production costs are very decisive for the farming activities carried out because this affects the income earned by farmers. Panius in 2015 states that the higher the cost of production, the higher the income received tends to be [9]. If the costs incurred are too large and the income is small, then the business is a loss. The cost factor in a pine resin farming is one of the factors that need attention for every business actor, including pine sap farmers. The production costs for pine sap farming in Mamasa Tengah KPH are as follows.

3.2.1. *Fixed costs*. The component of the value of the fixed costs incurred in pine sap farming in KPH Mamasa Tengah is depreciation. The tools and materials used by farmers in KPH Mamasa Tengah in the tapping process are borne by the company. The total fixed cost component incurred from the pine sap farming costs in KPH Mamasa Tengah if the company is responsible for the tapping equipment is IDR 0. However, if the tapping equipment is borne by the farmer, the total value of the fixed costs can be seen in Table 2.

Table 2. Components of Fixed Cost for Pine Sap Tappers If Tools and Materials are borne by Farmers in KPH Mamasa Tengah.

Component of Fixed	Costs Total Fixed Costs (IDR / kg)	Total Fixed Costs (IDR / month)
Equipment Depreciation		
a. Kedukul	312.5	90,000
b. Talang Sadap	1,562.5	450,000
c. Tapping bowl	3,375	972,000
d. Bucket	93.75	27,000
e. Sprayer	75	21,600
f. Drum	718.75	207,000
g. Stone	41.25	11,880
Total Fixed Costs	Sharpening 6,178.75	1,779,480

Based on Table 2 above, it can be concluded that the component of the fixed cost value of pine sap tapping farmers if the tools and materials are borne by the farmer, it consists of depreciation costs. Total fixed costs are obtained from the sum of all depreciation costs of the equipment, namely Rp. 6,178.75 / kg or Rp. 1,779,480 / month.

The largest shrinkage of tools was tapping cups, amounting to Rp. 972,000 / month. The difference in the amount of depreciation is due to the age of use of the tools, the number of tools and the price of the tools. According to Rugbia (2019), the calculation of the amount of depreciation cost must first calculate the useful life of the tool in question and the remaining value of the tool at the end of its useful life [10]. Farmers use equipment in farming according to the size of their business. The bigger the business owned, the more land is managed, the greater the costs incurred to buy equipment and vice versa. According to Zindu (2020), the more expensive the equipment costs, the greater the depreciation value [11].

3.2.2. *Variable.* Costs costs incurred in the process of tapping pine sap at KPH Mamasa Tengah consisted of stimulant costs and solar costs. The stimulant costs are borne by the company while the diesel costs are borne by the farmers. The amount of diesel used by each farmer is 1 liter / month at a price of IDR 6,500 / liter, so the total cost of diesel spent by pine sap tappers is IDR 6,500 / month. However, if diesel and stimulants are variable costs borne by farmers, the costs incurred are described in Table 3.

Table 3. Components of Variable Cost Value for Pine Tappers Farmers If Tools and Materials are borne by Farmers in KPH Mamasa Tengah.

Component Variable Cost	Amount Variable Costs (Rp / month)
Stimulant	200,000
Diesel	6,500
Total Variable Costs	206,500

Table 3 shows that the total variable costs incurred by pine sap tappers is Rp. 206,500 / month. The variable costs referred to are stimulants and diesel fuel. A stimulant or stimulant is a liquid used by farmers that is sprayed on the wound using a sprayer. The solution used in the stimulant is an acidic chemical, namely Etrat 1240 plus a mixture of sulfuric acid and nitric acid. The use of this solution is not to increase the amount of sap released by the tree, but to extend the renewal time of the koakan wound because using this acid solution will reduce the rate of freezing of the sap so that the sap channels are not clogged and the sap can continue to flow. According to Astria (2015), nitric acid affects the turgor

pressure of the cell walls so that the lymph channels can open up for a longer time [12]. This causes the discharge of the sap to be smoother.

The amount of stimulant used by each farmer is 8 liters / month at a price of IDR 25,000 / liter, so the total stimulant cost incurred by tappers is IDR 200,000 / month. The use of diesel for pine sap tapping farmers is to make it easier for farmers to remove the sap that sticks to the hands when doing the sap tapping process. The use of diesel which is used by pine sap tappers in KPH Mamasa Tengah does not require a large amount because it is only applied to the hands after tapping. The amount of diesel used by each farmer is 1 liter / month at a price of IDR 6,500 / liter, so the total cost of diesel spent by pine sap tappers in KPH Mamasa Tengah is IDR 6,500 / month. The total cost if the tools and materials are borne by the farmer are obtained from the sum of the total fixed costs and the total variable costs. The total fixed costs are IDR 1,779,480 / month and the total variable costs are IDR 206,500 / month, so that the total costs for tapping in February is IDR 1,985,980 / month.

3.3. Revenue from pine sap farming

Revenue is an amount of money received by pine sap tappers from the sale of sap. The acceptance of pine sap tappers at KPH Mamasa Tengah if the sap production is sold to the foreman can be seen in Table pine sap tappers if the sap production is sold, shown in table 4.

Table 4. Acceptance of directly to the foreman Latex.

Description	Amount
production (kg / month)	288
Price of sap (Rp / kg)	5,500
Revenue (Rp / month) / (1x2)	1,584,000

Table 4 shows the average production of pine sap in KPH Mamasa Tengah is 288 kg / month from the sap harvested twice in a month. The average number of trees tapped by farmers was 403 trees. The price received by tappers was Rp.5,500 / kg, so the average pine sap tapping farmer received Rp. 1,584,000 / month. The high and low income of pine sap tappers is very much influenced by the price of pine sap and the amount of pine sap produced. The sale of this sap is sold to the foreman. However, if the sap is sold directly to the factory, the amount of revenue can be seen in Table 5.

Table 5. Acceptance of pine sap tappers If the sap production is sold directly to the factory.

Description	Amount
Sap production (kg / month)	288
Price of sap (Rp. / kg)	7,000
Revenue (Rp / month) / (1x2)	2,016,000

Table 5 shows that the average production of pine sap in KPH Mamasa Tengah is 288 kg / month from the sap harvested twice a month. The average number of trees tapped by farmers was 403 trees. The price received by tappers is IDR 7,000 / kg, so the average pine sap tappers' income is IDR 2,016,000 / month, if the sap is sold directly to the factory. The price of selling sap directly to the factory is higher than that of selling the sap to the foreman. The difference in selling price is due to the cost of transportation costs by the supplier. If the farmer sells the sap directly to the factory, the farmer has to pay the cost of transportation for the supplier. However, at the research location, the sap sales may only be sold to the foreman. Then the foreman will provide wages to the supplier after selling the sap at the factory.

3.4. Income from pine sap farming

Income from pine sap farming is obtained from the revenue from pine sap farming minus the total costs incurred for one month. The amount of farmer income in pine sap farming in Central Mamasa FMU if the tools and materials are borne by the company and sold directly to the foreman can be seen in Table 6. If the company bears the tools and materials and is sold directly to the foreman can be seen in Table 6.

Table 6. Pine sap tappers' income at KPH Mamasa Tengah.

Description	Amount
Revenue (Rp / month)	1,584,000
Total Cost (Rp / month)	6,500
Income (Rp / month) / (1-2)	1,577,500

Table 6 shows that the average income earned by pine sap tappers in KPH Mamasa Tengah is IDR 1,577,500 / month. The income of the pine sap tappers if all the tools and materials are covered by the company will be different if all the tools and materials are covered by the farmer. The factor affecting this difference is the amount of production costs. In addition, the income of pine sap tappers will also be different if the sap is sold directly to the factory. This results in a higher selling price if the sap is sold directly to the factory than if the sap is sold to the foreman. The amount of income of pine sap tappers in Central Mamasa FMU if tools and materials are borne by farmers and the sap is sold directly to the factory can be seen in Table 7.

Table 7. Pine sap tappers' income if tools and materials are borne by farmers and the sap is sold directly to Factory in KPH Mamasa Tengah.

Description	Amount
Revenue (Rp / month)	2,016,000
Total Cost (Rp / month)	1,985,980
Income (Rp / month) / (1-2)	30,020

Table 7 shows that the average income In average, the pine sap tappers obtained if the tools and materials were borne by the farmers and the sap was sold directly to the factory, without going through the foreman at KPH Mamasa Tengah, amounting to IDR 30,020 / month.

3.5. Factors affecting the income of pine sap tappers

Factors that are thought to affect the income of pine sap tappers are the area of tapping, age of the farmer, and length of time he has been tappers. Based on these factors, the calculation or data processing is carried out using the SPSS (*Statistical Product and Service Solution*) version 20.0 program. The results of multiple regression analysis of tapping farmer income can be seen in Table 8.

Table 8. Results of Multiple Regression Analysis of Factors Affecting the Income of Pine Tappers.

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
(Constant)	200.049.17	793,508.52		0.25	0.80
area	Tapping876,905.89	202,007.22	0.66	4.34	0.00
Age of farmers	6,398.67	22,263.09	0.05	0.28	0.77

Old being	tappers	52,086.21	0.10	0.54	0.59
		95,808.53			
Fcount	6.436				
R Square	0.426				

Based on the results of multiple regression analysis in Table 9, the factors that affect the income of pine sap tappers can be formulated in the following equation:

$$Y = 200.049.17 + 876,905.89X_1 + 6,398,671X_2 + 52,086,215X_3 + e$$

Where:

- Y = income (Rp / month)
 X₁ = area of tapping (ha)
 X₂ = Age of farmer (years)
 X₃ = Length of being tappers (years)
 e = Residual

After performing a statistical test using multiple regression analysis, the results of the test obtained of *goodness of Fit* are as follows:

3.6. Coefficient of Determination (R Square)

The coefficient of determination is a value that describes how much change or variation in the dependent variable can be explained by changes or variation of the independent variable. The coefficient of determination from the regression equation is 0.426, meaning as much as 42.6% of the variation or change in the ups and downs of pine sap tapping farmers' income is explained by variations in the tapping area factor, farmer age, and length of time to be tappers. The remaining 57.4% is influenced by other factors not included in the research variables.

3.7. Statistical F test

Testing of the variables in the research data simultaneously or simultaneously is done by using the F test (*F-test*). The test results are with a real level (α) of 1% or a confidence level of 99% degrees of freedom. This means that the tapping area, the number of tapping trees, the age of the farmers, and the length of time they have been tappers together have a significant effect on the income of pine sap tappers.

3.8. Statistical T test

The statistical t test is a partial test of the coefficients of the independent variables. This test is carried out to see the significant level of the independent variables individually in influencing the variation of the dependent variable in other words, to find out whether each dependent variable can explain the changes that occur in the independent variable in real terms.

4. Conclusion

Based on the description of the results and the discussion above regarding "Analysis of the Income of Koakan Method of Pine Tappers Farmers in KPH Mamasa Tengah", it can be concluded that:

- The income of the pine sap tappers is borne by the company and the income of the pine sap tappers is IDR 1,577,500 / month if the tools and materials are IDR 30,020 / month if the tools and materials are borne by the farmer
- The factors that influence the income of pine sap tappers are the area of the tapping area.

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