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To cite this article: I Gautama *et al* 2021 *IOP Conf. Ser.: Earth Environ. Sci.* **807** 022011

View the article online for updates and enhancements.

The cost of harvesting process in teak community forest during the covid-19

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Abstract. This pandemic also affected the amount of costs incurred from the teak harvesting process. Based on previous research, we tried to compare the costs arising from teak harvesting during the pandemic. On the other hand, Cost analysis of community teak harvesting aims to analyse the costs incurred by the community at each harvesting process, starting at the felling, skidding, to transportation stages, both in self-managed systems and in wholesale systems. Data were collected through observation and interviews which were then analysed using quantitative descriptive analysis by calculating the costs for each harvesting process. Machine costs are obtained by adding up fixed costs and variable costs incurred, while operating costs are obtained by adding up machine costs with operator and helper wages. The results showed that the total cost for felling group I was IDR 53,837.17 per m^3 with an average cutting ability of 0.72 m^3 per hour. Meanwhile, the total cost for felling group II was IDR 40,361.69 per m^3 with an average cutting capacity of 0.87 m^3 per hour. Loggers' costs of harvesting forests during the pandemic do not differ significantly from the costs incurred by loggers before the COVID-19 pandemic.

1. Introduction

In a series of forest exploitation operations, the forest harvesting process also determines whether the planned target is achieved or not. The amount of harvesting costs in community forests can be influenced by several factors, for example labour wages, the number of workers, the volume of wood including the COVID-19 pandemic situation. The results of data on June 14, 2020, a total of 7.690.708 people were confirmed to be exposed to Covid-19, with cases of death totaling 427.630 people [1] The application of this lockdown is the best way to control the spread of the Covid-19 virus. The application of lockdowns is the result of a review of past pandemic cases [2]. Likewise, people who live around the forest, they still have to survive by exploiting the potential of timber forest products that are owned in a pandemic situation. This pandemic has had a direct or indirect impact in increasing the cost of the forest harvesting process.

According to the results of research conducted before the pandemic, in community forests in Mengkendek Regency Tana Toraja, South Sulawesi Province in 2018, the average cost of harvesting community forests for 10 timber entrepreneurs was IDR147,727,850 per year or IDR194,888.98 per m³ [3. These costs are influenced by several factors such as volume felled, wages for labour, maintenance and repair costs of machines and others. Meanwhile, Bone District has a forest area of 145,053 ha with an area of 4,582 ha community forest and 4,220 ha of community teak forest. The area has a community forest that is quite potential, the plants that are mostly developed are teak species which are planted with cocoa. Harvested logs include the cutting, skidding and transporting stages. Harvesting activities are carried out

by timber entrepreneurs and use local people as labour. So the community can get employment from this harvesting activity [4].

Wages for logging activities in community forests are paid by piece rate, which is different from natural forest which uses the per wage methods. To run the equipment, it requires operators and operator assistants and all other things that ensure the smooth running of these tools, including labour wages. For the payment of wages, maintenance of the equipment, and operation of the tools used, it is necessary to calculate a cost analysis to determine the cost efficiency of harvesting community teak forests. Community forest exploitation requires a significant cost for investment or operational activities. In every stage of harvesting activities, good management is needed so that its implementation is more efficient. Professional business will produce products of sufficient quality and quantity. The harvesters / timber entrepreneurs who carry out the felling activities do not know accurately the costs incurred. Therefore this research was conducted to find out how much it costs the actors of community forest harvesting at all stages of community teak forest harvesting during the current covid-19 pandemic. The results of this study are expected to provide information and consideration for related forestry agencies in determining community teak forest harvesting policies.

2. Research methods

The population of this study were timber harvesting entrepreneurs in Amali District, Bone Regency. The sample determination in this study is by quota sampling. The number of respondents was five entrepreneurs and five wood harvesters with the following criteria during the pandemic: logging in the community teak forest; harvesting wood in community teak forests; and harvested wood is sold to industry. The data collected in this study consisted of primary data and secondary data. Primary data collected include: identity of the respondent (name, age, gender, latest education, number of family dependents); repair costs; machine maintenance costs; fuel costs; labour costs; tree purchase costs; general description of community teak logging activities; and general description of the felling locations for community teak wood. Meanwhile, secondary data collected includes reports or research results from various parties related to research and interviews from the community. Based on the data collected, a descriptive analysis was carried out to describe the process of each activity in community forest timber harvesting. Fixed costs in this study consist of depreciation costs and capital interest which are calculated using the following formula of cost depreciation. Depreciation of tools is calculated according to the length of time the tool is used, so that the term tool life is known. In depreciation, the price of a tool is divided by the number of units of time during the life of the tool to obtain depreciation in a certain time. [5] states that depreciation expense can be calculated using the formula:

$$D = (M - R) / N \; x \; t \tag{1}$$

where:

D	= Depreciation expense (IDR / year)
M	= Capital (IDR)
R	= Residue / residual value (IDR)
N	= Economic age of equipment (year)
t	= Working time of the tool in a year (year)

Interest is the amount of cost that must be paid to capital. To calculate interest on capital we need to know the average investment per year and the interest rate. [6] states that capital interest can be calculated using the formula:

$$I = \frac{\dfrac{M - R \,(N + 1)}{2} + R \; x \; 0{,}0i}{N \; x \; t} \tag{2}$$

where:

I	= Interest on capital (IDR)
M	= capital (IDR)

R = Residue / residual value (IDR)
N = economic age of equipment (year)
i   = Interest rate (%)
t   = Working time of the tool in a year (year)

The variable costs calculated in this study are: labour costs (felling and skidding); fuel costs; equipment maintenance / repair costs; equipment maintenance costs; skidding costs and freight costs.
Total production costs are costs incurred to produce a finished product that is ready for sale or not for sale, it can be calculated using the formula:

$$TB = BT + BV \qquad (3)$$

where:
TB   = Total Production Costs (IDR/year)
BT   = Fixed Costs (IDR/year)
BV   = Variable Costs or Variable Costs (IDR/year)
Reception

$$P = (Bn \ x \ Pn) \qquad (4)$$

where:
P   = revenue (IDR/year)
Bn   = selling price of wood (IDR/m³)
Pn   = total wood production (m³)
Income

$$F = P - TB \qquad (5)$$

where:
F   = Net income (IDR/year)
P   = revenue (IDR/year)
TB   = Total production costs (IDR/year)

3. Result

3.1. Logger description
Operators and assistant operators of logging activities carried out at the research location are residents of Mattampa Pole Village. Consisting of two group of felling, some consisted of four people and the second felling team consisted of three people. Each of which consists of an operator and the rest as a helper. For more details, see table 1.

An operator and helper must have special expertise and skills because with work experience it can support cutting efficiency and can reduce errors that can be caused during logging activities. Thus, operators and helpers who have expertise and experience in operating tools when carrying out felling activities can carry out their work optimally compared to operators and helpers who are inexperienced and have no expertise in logging activities.

Table 1. Logger description

Age (years)	Education	Work experience (years)	Specializations	Other jobs	Remarks
45	High School	8	Operator	Driver, farmer	Group I
36	Middle School	6	Helper	Farmer	Group I
32	Middle School	5	Helper	Farmer	Group I

21	Middle School	5	Helper	Farmer	Group I
55	Elementary School	9	Operator	Farmer	Group II
37	Middle School	6	Helper	Farmer	Group II
57	Elementary School	8	Helper	Farmer	Group II

Source: Data Processing, 2020

3.2. Logging equipment used

The specifications for the logging equipment used are shown in table 2. The felling equipment used in the felling site in Mattampa Pole Village, Mallawa District, Maros Regency is a chain saw stihl 070 with other equipment such as machetes, jerry cans, axes and others. During the research conducted, the number of chain saws used at the location was two and belonged to the loggers themselves. The lifespan of the chain saw used for felling team I is for seven years of service life, while for felling team II for five years, it uses mixed gasoline and lubricating oil which is prepared and brought to the location by the loggers of each team.

Table 2. Chain saw logging equipment specifications are Stihl-070

Specifications	Remarks
Engine	2 stroke
Cylinder	106 cc
Engine Power	4.8 KW (6.5 BHP)
Ignition System	Platina
Chain oil tank capacity	0.53 Is
Fuel tank capacity	1.2 I
Fuel	Gasoline mixed with oil
Oil: gasoline ratio	1 : 15
Machine weight complete bar and chain	15 kg
Bar length	80 inch
Equipment lifespan	7 years and 5 tears

The logging activities carried out in Mattampa Pole Village, Mallawa District, Maros Regency were carried out by two logging groups. The first felling group consisted of an operator and three helpers and for the second felling group consisted of an operator and two helpers who used the chain saw stihl 070 as a felling equipment. The felling activity is intended starting from the preparation of felling until the tree falls. Costs were calculated for each team because the ability of each group to cut trees was different.

3.3. Costs incurred by loggers in the harvesting process during the covid-19 pandemic

3.3.1. Fixed cost. Fixed costs incurred every hour at the felling site with chain saw stihl 070 in the area of the people's candlenut forest in Mattampa Pole Village, Mallawa District, Maros Regency in the form of depreciation costs and capital interest for the two logging groups are as follows:

Depreciation costs
Depreciation costs are costs incurred to cover investment in equipment. The amount of depreciation cost over the lifespan of chain saw lifespan for logging group I is seven (7) years which has a depreciation cost of IDR 893 per hour with a chain saw purchase price of IDR7,000. Whereas for felling group II the chain saw was used for five years so that the depreciation cost was IDR1,071 with the price when purchasing the chain saw was IDR6,000,000. The depreciation cost of cutting group I is smaller than the depreciation cost

of cutting group II apart from the different purchase price of the chain saw, the lifespan of the chain saw used is different.

Capital costs

The capital interest rate for felling group I is IDR 750 per hour with a seven-year tool lifespan. Meanwhile, the amount of capital interest for felling group II was IDR 685 per hour with a five-year tool lifespan. The fixed costs used by the two felling groups were IDR 1,642 per hour and 1,757 per hour, respectively. The average fixed cost for the two felling groups was IDR 1,700 per hour. One of the factors affecting fixed costs is the price of the equipment. In the calculation of fixed costs, it is assumed that the price of the equipment used is based on the purchase price of the chain saw by the operators and operator assistants. Fixed costs are always constant in total so that the cost per unit varies with the volume of activity. Fixed costs are always incurred even if the appliance is not operating. Therefore, efforts are made to operate the equipment continuously so that there is no loss.

3.3.2. Variable costs. The variable costs used in the logging activities with chain saw stihl 070 in the area of the community candlenut forest in Mattampa Pole Village, Mallawa District, Maros Regency include maintenance costs, repair costs, fuel costs, lubricant costs (used oil) and wages for each of the two felling groups (table 3). Maintenance costs are intended as an effort to maintain equipment performance. Routine maintenance costs are incurred if the tool operates continuously. Meanwhile, the repair costs are intended as an effort to restore the chain saw stihl 070 so that it can operate again. The costs incurred if the equipment continues to work on each felling team is IDR2,032 per hour and IDR1,738 per hour. Maintenance and repair costs for felling group I were higher because the chain saw used was seven years old. Meanwhile, felling group II had a five-year chain saw lifespan, resulting in lower maintenance and repair costs. Thus it can be concluded that the older the equipment, the greater the repair costs incurred.

Fuel costs are costs incurred by the operator and operator assistant according to the needs of the chain saw machine. The longer chain saw is in production, the more fuel it consumes so that it costs more to buy the fuel. The fuel used is gasoline mixed with oil and filled according to the capacity of the logger jerry can (5 liters). The price of fuel at the time of the research was IDR5,500 per liter. So the fuel spent for feller group I was IDR6,490 while the fuel used for felling group II was 1.07 liters per hour. So the fuel costs incurred for felling group II were IDR5,885. The fee for the intended wages is the wages given to operators and operator assistants. In this case the wage system used is a piece work system. The amount of wages can be calculated per hour of work and the amount of productivity of felling per hour.

Based on observations during the study, the wage for an individual was IDR10,000 per m^3 so the wage for felling group I was IDR40,000 per m^3 which had an average cutting volume of 4.35 m^3 per day so that the average wages of operators and assistant operators per hour of IDR29,022. For felling group II which consisted of three (3) workers so that the average cutting volume was 5.22 m^3 per day so that the average wage given was IDR26,100 per hour.

Based on the results of the calculation, the wages of felling group I were greater because they had more workers than felling group II, which only had three (3) workers. But even though they have a small workforce, the cutting ability of felling group II is greater. This is because the chain saw's lifespan is different from that of felling group I, which is five-years lifespan.

The variable costs for felling group I and felling group II were IDR37,119 per hour and IDR33,357 per hour, respectively. And the average variable cost for the two felling grops is IDR35,238 per hour. The variable cost of felling group I was greater because in addition to having a workforce of four (4) people and the service lifespan of the chain saw used for seven-years, the costs incurred were greater. Compared to felling group II, which has a chain saw life of five-years and only has a workforce of three (3) people.

3.3.3. Logging cost. Based on the calculations, the total cost incurred for felling group I was IDR53,837 per m^3 due to the use of chainsaw that was used for seven-years so that the costs incurred were large which had four (4) workers while the total cost for felling group II was IDR40,361 per m^3 where the lifespan of the chain saw is five-years and only has three (3) workers. According to [6], Total cost is the amount of money that must be paid for the use of production factors or services and is a component in running a business for

a company. The role of cost analysis, among others, is to streamline production costs, maximize the resulting product with minimized costs and determine profit, to assess management performance, and to compare current earnings with previous ones so that management can be evaluated to choose which one is more profitable for the company.

Table 3. Logging cost by the logger.

No	Component Costs	Felling group I (IDR per hour)	Felling group II (IDR per hour)
(1)	(2)	(3)	(4)
1.	Fixed Costs		
	a. Depreciation costs	892.86	1,071.43
	b. Capital interests	750.00	685.71
Amount		1,642.86	1,757.14
(1)	(2)	(3)	(4)
2.	Variable Costs		
	a. Maintenance and repair costs	2,032.90	1,738.34
	b. Fuel costs	6,490.00	5,885.00
	c. Used oil costs	48.00	48.00
	d. Wages	29,022.22	26,100.00
Amount		37,119.90	33,357.53
Total		38,762.76	35,114.67

Source: Data Processing, 2020

If the average felling capacity for felling group I is 0.72 m^3 per hour, then:

$$Total\ Cost = \frac{IDR\ 38,762.76/hour}{0.72 m^3/hour}$$

$$= IDR\ 53,837.17\ /\ m^3$$

As for the average felling ability for felling group II of 0,95 m^3 per hour, then:

$$Total\ Cost = \frac{IDR\ 35,114.67/hour}{0.87 m^3/hour}$$

$$= IDR\ 40,361.69/m^3$$

$$Average\ Logging\ Costs = \frac{IDR\ 53,837.17/m^3 + IDR\ 40,361.69/m^3}{2}$$

$$= IDR\ 47,099.43/m^3$$

4. Conclusion
Based on the results of this study, it can be concluded that the total cost for felling group I was IDR53,837 per m^3 with an average cutting ability of 0.72 m^3 per hour. Meanwhile, the total cost for felling group II was IDR 40,361 per m^3 with an average cutting capacity of 0.87 m^3 per hour. Loggers' costs of harvesting forests during the pandemic do not differ significantly from the costs incurred by loggers before the COVID-19 pandemic.

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