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The Production Pattern of Rubber Farming and Farmer Behavior in Dealing with Price Fluctuations in Jambi Province, Indonesia

Armen Mara, Fendria Sativa
Agribusiness Study Program, Faculty of Agriculture, Jambi University
♥Corresponding author email: armen_maraa@yahoo.co.id

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Abstract. This study aims to determine (1) the magnitude of the fluctuation in rubber prices (2) the pattern of production of rubber and the behavior of farmers in dealing with price fluctuations and (3) the elasticity of the supply of rubber in Jambi Province. This study uses a survey method with the scope of the study area being Jambi Province by selecting two villages purposively, namely Muhajirin Village in Muaro Jambi Regency and Tanah Grow Village in Bungo Regency. Supply elasticity will be analyzed using secondary data and parametric statistical tests. The results showed that the fluctuation in the price of rubber in Jambi Province was quite large, namely Rp. 4,200 per kg in January 2002, then increased to Rp. 43,200 in February 2011, and decreased again to Rp. 6,000 per kg in June 2020. The pattern of rubber production in Muhajirin Village looks irrational where when the price goes down the farmers actually increase their production, that is, in order to meet their daily needs that cannot be reduced. This means that production can still be increased by increasing tapping frequency. The pattern of rubber production in Tanah Tumbuh Village looks rational, where when the price of rubber goes down the farmers do not tap rubber. To meet the needs of farmers, they switch jobs to other fields, such as laboring on plantations, construction workers, or panning for gold. Rubber's supply elasticity in responding to rubber price changes in Jambi Province is small from one (<1) but the change is significant.
***Keywords**: farmer behavior; price fluctuations; production patterns; rubber farming*

INTRODUCTION

Smallholder rubber plantations have been a mainstay for the economy of Jambi Province since a century ago. This can be seen from the extent of rubber plantations and the number of farmers who depend on these commodities. In 2019 the area of rubber plantations in this province reached 557,644 ha with a total of 263,583 farmers (BPS, 2020).

Rubber is the sap produced by rubber trees (*Hevea brasiliensis*) and is sold in lumps and in everyday life it is called rubber (Rubber Processing Material) (Pratama et al., 2020). While the sap produced by rubber factories is often referred to as rubber but is better known as crumb rubber (rolled rubber) (Junaidi, 2020b). Meanwhile, Bokar is the sap from rubber plantations produced by smallholders (Kurniati et al., 2021). Furthermore, in this paper what is meant by rubber is the sap from rubber plantations produced by smallholders, namely Bokar.

The rubber plant (Hevea brasiliensis) as a plantation crop that has been integrated with the culture of the people of Jambi Province has an environmentally friendly nature (Pratama et al, 2020). In fact, this rubber plant is included in the category of forestry plants that are suitable to be developed in forest areas and other areas so that rubber plants are also suitable to be developed for the purpose of reforestation and forest rehabilitation.

Previous research has shown that rubber plantations have not been able to provide higher welfare to communities in Jambi Province. The facts show that the per capita PDRB (Gross Regional Domestic Product) of regencies whose main producers are rubber plantations is lower than other districts whose main income is not rubber (Mara, 2018). This is related to the low productivity of rubber plantations and the underdevelopment of the rubber industry which has been able to raise the price of rubber at the farm level to a higher level.

According to Junaidi (2020a), rubber prices tend to fluctuate. The price of rubber in the last 20 (twenty) years in Jambi Province has shown high fluctuation. As an illustration, in 2000 the price of rubber was Rp 4,200 per kg. In 2006, it increased to Rp 13,000 per kg and in 2011 to Rp 43,200 per

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kg (Gabkindo, 2020). However, in 2019 it fell back to Rp 12,500 per Kg. Rubber prices at the farm level are much more fluctuating and much lower, even reaching Rp 2,000 per Kg so that at this price the farmers do not tread rubber latex (Syarifa et al., 2016). The low level of the farmer is related to the quality of rubber as measured by the K3 (Dry Rubber Content) set by the trader. In addition, rubber prices will also be lower than factory prices because of the marketing margins enjoyed by traders. According to Aulina et al. (2021) the low productivity of rubber plants causes the low income of rubber farmers. This also encourages farmers to change their mindset.

According to economic theory, producers will respond to high price fluctuations by decreasing or increasing production. This is what is called the elasticity of supply (Es) whose value will lie between 0 and ∞ or is often differentiated as 0 (very inelastic), <1 (inelastic), 1 (elastic), > 1 (elastic), and ∞ (very elastic). The yield of commodity elasticity is usually smaller than 1 because to increase the production of farmers usually requires a lot of time and capital which is difficult for him to fulfill. However, in contrast to traditionally cultivated rubber commodities, little treatment can be given for maintenance. The production of this rubber plant also depends on the frequency of tapping by the farmers. With such garden conditions, farmers can respond to price fluctuations by increasing or decreasing the frequency of sap tapping. This elasticity approach was also used in estimating the pattern of cattle production.

In production economics, the behavior of producers in determining the amount of production to be sold is by production patterns. In general, production patterns can be divided into 3 (three), namely constant production patterns, corrugated production patterns, and moderate production patterns. With traditional rubber plantation conditions, farmers can respond to the very fluctuating rubber prices by using a wavy pattern. If the price of rubber rises to a higher level, farmers have the opportunity to obtain high amounts of rubber production if the tapping is done more than the normal frequency. In fact, farmers also face the problem of the low quality of "Bokar" from old plants but farmers face difficulties in replanting efforts (Nainggolan et al., 2021; Riswani et al., 2020).

The problem that needs to be explored further as the behavior of farmers is the extent to which rubber farmers make changes to rubber production patterns in order to respond to relatively high fluctuations in rubber prices. For that, it is necessary to conduct field research to collect data about the behavior of these farmers. Based on the description in the background above, the research problem to be examined can be formulated, namely how much fluctuation in the price of rubber in Jambi Province during the last sixteen years, how the elasticity of rubber supply is related to relatively high price fluctuations, and how is the rubber production pattern by farmers in response to price fluctuations in Jambi Province.

METHODS

This study uses a survey method with the scope of the study area being Jambi Province by selecting two villages purposively, namely Muhajirin Village in Muaro Jambi Regency and Tanah Tumbuh Village in Bungo Regency. Jambi Province has 6 rubber producing districts. This rubber area can be divided into 2 parts, namely lowland and medium land. Muhajirin Village could represent the lowlands while Tanah Tumbuh Village could represent the mediumland (Mara, 2018). This research was planned for 8 (eight) months consisting of preparation activities, field data collection, data analysis, and report preparation. The research time starts from April 2020 to November 2020.

Data were analyzed using simple regression analysis, namely to determine the magnitude of price fluctuation and price elasticity of rubber. Secondary data is time series data collected (Kadir, 2015) from 2000 to 2019 in Jambi Province. This is intended to analyze the magnitude of rubber price fluctuations and the amount of price elasticity

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in Jambi Province. For this purpose, data was collected from the Central Bureau of Statistics (BPS, 2020), the Jambi Provincial Bappeda and the Jambi Province Plantation Service, and the Jambi Province Trade and Industry Office, and Gapkindo (Indonesian Rubber Entrepreneurs Association).

Besides using secondary data, this study also requires primary data to be collected from sample farmers taken from two selected villages, namely Muhajirin and Tanah Tumbuh villages. From each village, cases of farmer behavior will be studied in responding to rubber price fluctuations. From the two villages, it will be analyzed how the rubber production pattern is a concrete expression of the behavior of farmers in response to high rubber price fluctuations. Therefore, this study will draw conclusions deductively, from general concepts to specific application. For aspects of farmer behavior in responding to price changes, industrial methods will be carried out, namely things that apply specifically to the general public.

RESULTS AND DISCUSSION

General Description of Government in Jambi Province

In 2019 rubber plantations in Jambi Province had an area of 557,644 hectares that spread across 9 (nine) districts. The area of rubber plantations has the largest area in Jambi Province. Other potential crops in Jambi Province are oil palm which has an area of 539,927 hectares and deep coconut which has an area of 119,257 (BPS, 2020).

Table 1. Area of rubber plantations in Jambi Province in 2018 and 2019

Nu	Districts	Area of rubber plantations (Ha)	
		2018	2019
1	Kerinci	1.871	1.871
2	Merangin	139.224	55.907
3	Sarolangun	127.415	127.225
4	Batanghari	113.572	113.581
5	Muaro Jambi	55.907	31.133
6	Tanjab Timur	7.768	7.768
7	Tanjab Barat	9.245	9.243
8	Tebo	113.652	114.008
9	Bungo	98.460	97.108
10	Kota Jambi	-	-
11	Kota Sungai Penuh	-	-
	Jambi Province	667.114	557.644

Source: BPS, 2020.

From table 1 it can be explained that rubber plantations in Jambi Province spread across 9 districts and there are 7 districts that are considered potential, namely Merangin, Sarolangun, Batanghari, Muaro Jambi, Tanjab Timur, Tebo, and Bungo districts. Meanwhile, the districts of East Tanjab, West Tanjab and Kerinci only have less than 10 thousand hectares.

Rubber Price Fluctuation in Jambi Province

Prices of Rubber (Rubber Processing Materials) in Jambi Province have usually been informed from Singapore and forwarded to the Jambi Provincial Trade and Plantation Service to inform farmers. This price is called an indication price, which is the purchase price of a rubber trader with 100% K3 (Dry Rubber Content).

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Farmers usually produce rubber with K3 less than 100% because it still contains water and other ingredients. Therefore, the farmer's selling price is always below the indicated price. The following rubber prices are the average prices of the monthly prices data by Gabkindo (2020) (Indonesian Rubber Entrepreneurs Association). Rubber prices from 2000 to 2019 can be explained in Table 2.

Table 2. Rubber price conditions from 2000 to 2019 in Jambi Province

Year	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Rubber Price (Rp/Kg)	4.686	4.743	4.800	6.101	7.751	9.879	13.301	15.080	18.508	13.116

Tahun	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Rubber Price (Rp/Kg)	23.002	30.566	22.466	19.345	14.981	12.717	12.588	15.703	10.181	8.710

Gabkindo, 2020.

From Table 2, it can be explained that the price of rubber tends to increase from 2000 (Rp 4,686 per kg) to 2011 (Rp. 30,566 per kg). After that the price of rubber continues to decline until 2019 (Rp 8,710 per kg). At this time (2020) or during the pandemic (Covid19) the price of rubber is still low, ranging from Rp 5,500 per kg to Rp 8,000 per kg. This of course has led to changes in the economic and social behavior of farmers, such as switching to other commodities and even switching to other jobs.

For more details, the trend of changing rubber prices in Jambi Province can be shown by using the curve of Figure 1. From Figure 2, it can be seen that the curve is upward curving which shows that the price of rubber initially increased and then decreased significantly again.

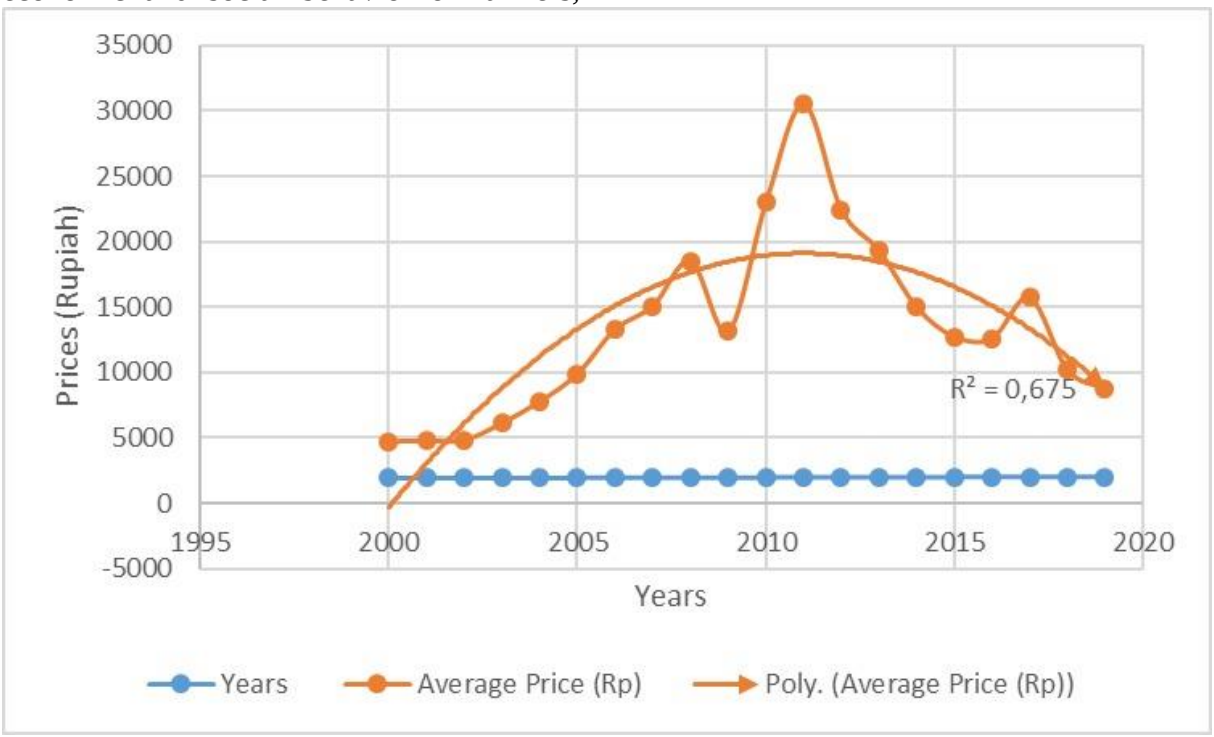

Figure 1. Rubber price fluctuations by time period (2001-2020

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To explain in more detail about rubber price fluctuations in Jambi Province, monthly rubber price data can be shown. Monthly data shows higher fluctuation in rubber prices in Jambi Province. This is understandable because indeed prices can change every week. The changes in prices are so fast that the realization of these price increases does not reach the farmers. How high rubber fluctuations can be explained by the data in Table 3.

The data in Table 3 shows in detail, namely the monthly price data for rubber prices so that the fluctuation of rubber prices in Jambi Province is increasingly visible. The highest price occurred in February 2011, amounting to Rp. 43,200 per kg, while the lowest price occurred in January 2002, namely Rp. 4,200 per kg. Overall, it can be seen that from 2000 to 2019 there was no upward trend in rubber prices. According to Marta Seli et al. (2021) the rubber auction market is quite effective in controlling prices. However, the price of rubber in Indonesia is largely determined by the price of rubber on the world market. So the effectiveness of the auction market actually only applies to stabilizing prices at the local level so that fluctuations in domestic rubber prices are difficult to avoid. Rubber marketing in Indonesia is very dependent on developed countries, especially the United States, Japan and the European Union. As soon as there was an economic problem in the country, the price of rubber in Indonesia immediately plummeted.

Table 3. Monthly Rubber Prices in Jambi Province from 2000 to 2019.

No	Tahun	Harga Bokar (Rp/Kg)												Rata2
		Jan	Feb	Maret	April	Mei	Juni	Juli	Agus	Sept	Okt	Nov	Des	
1	2000	5.100	6.700	6.200	6.500	4.200	4.500	5.600	4.200	5.600	5.700	4.100	5.200	4.686
2	2001	4.000	4.400	5.000	5.300	4.800	4.800	5.300	5.300	6.400	6.600	6.400	6.100	4.743
3	2002	4.200	4.500	4.800	5.100	4.900	5.100	5.200	5.400	6.500	6.400	6.500	6.600	4.800
4	2003	6.700	7.000	7.000	6.700	5.900	5.700	5.600	6.100	7.100	8.200	9.000	8.400	6.101
5	2004	8.500	8.400	8.700	8.800	8.800	8.800	8.800	8.700	9.000	9.200	9.400	9.400	7.751
6	2005	9.600	9.700	9.800	9.900	9.600	10.000	9.800	11.800	12.700	14.600	14.300	14.500	9.879
7	2006	14.600	15.100	15.300	15.100	15.000	15.900	17.600	18.000	15.700	14.800	14.100	13.000	13.301
8	2007	14.500	16.700	17.100	17.100	17.300	17.300	16.600	16.900	17.500	18.200	19.600	20.300	15.080
9	2008	21.100	22.100	22.700	22.700	23.100	24.500	26.200	24.900	23.900	17.000	16.800	12.100	18.508
10	2009	12.600	11.600	11.500	13.000	13.300	13.100	13.100	14.800	17.300	18.400	20.300	22.600	13.116
11	2010	24.300	24.700	25.300	26.100	23.600	23.800	23.800	24.600	25.100	29.600	33.000	36.100	23.002
12	2011	39.800	43.200	35.900	38.300	35.600	35.600	34.900	35.300	36.100	34.200	28.800	28.200	30.566
13	2012	28.600	30.100	30.500	29.900	27.600	23.500	23.600	22.000	22.600	25.200	24.300	24.600	22.466
14	2013	25.800	26.000	23.900	21.000	20.800	19.700	18.800	20.300	23.200	23.000	22.600	23.700	19.345
15	2014	23.100	20.000	18.800	17.900	16.600	16.800	17.100	16.500	15.400	14.600	15.500	15.400	14.981
16	2015	14.900	14.700	14.900	14.800	15.500	16.700	15.600	14.500	14.400	14.100	12.900	13.000	12.717
17	2016	12.500	12.100	12.900	15.000	15.100	13.200	13.200	13.300	13.900	15.300	17.200	20.500	12.588
18	2017	23.100	24.200	22.300	17.800	16.200	15.000	15.900	16.300	17.600	16.600	16.300	16.500	15.703
19	2018	10.000	12.000	10.400	13.000	15.100	11.000	12.100	14.100	10.400	11.200	10.500	10.700	10.181
20	2019	9.100	10.200	12.000	12.200	12.500	7.200	8.300	9.500	10.200	11.200	9.300	8.200	8.710

Source : Gabkindo, 2020.

Supply Elasticity of Rubber (Rubber Processing Materials) in Jambi Province

Price is one factor that determines the amount of rubber produced by farmers. An increase in price will usually encourage entrepreneurs to increase production and vice versa if prices have decreased. The relative comparison between price changes and relative changes in production is called price elasticity. From the perspective of farmers (producers) it is called the elasticity of supply.

Among the commodities, there are commodities whose elasticity is greater than 1 (one) and there are also commodities whose elasticity is smaller than 1 (one). For agricultural commodities, its elasticity is

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usually less than 1 (one). This is related to the fact that to increase production requires a large enough investment and requires a relatively long time. However, for rubber commodity there is something specific, namely rubber production can be increased or decreased without investing, namely by increasing or decreasing the tapping frequency. Therefore, if there is a significant increase in rubber prices, a farmer can increase production by increasing the tapping frequency from 5 times per week to 7 times per week.

The data in Table 4 shows changes in rubber prices and rubber production from 2000 to 2019. This data shows that from 2000 to 2011 the price of rubber tends to increase, namely from Rp. 4,686 per kg to Rp. 30,566 per kg. Then from 2012 to 2019 there was a continuous decline, from Rp 30,566 per kg to Rp 12,500 per kg.

However, production data shows that from 2000 to 2019 rubber production increased continuously, from 238,500 tons to 355,443 tons, only one significant decrease occurred, from 2002 to 2003. Graph 1 illustrates that prices fluctuated. which is high, where in 2011 the price rose drastically or tapered upwards while production still tended to be linear or form a straight line up.

By using the data in Table 5 below, it will be seen that changes in rubber prices have an effect on changes in rubber production. The ratio of changes in price relative to changes relative to production is called "elasticity". The elasticity numbers are positive and some are negative. Positive means that the price change is followed by an increase in rubber production, while negative means that the price change is followed by a reduction in rubber production.

Table 4. The average price of rubber and rubber production from 2000 to 2019.

Num	Years	Average Price (Rp)	Production (Ton)
1	2000	4.686	238.500
2	2001	4.743	239.625
3	2002	4.800	241.704
4	2003	6.101	230.681
5	2004	7.751	242.448
6	2005	9.879	261.284
7	2006	13.301	273.503
8	2007	15.080	226.751
9	2008	18.508	282.886
10	2009	13.116	280.928
11	2010	23.002	298.386
12	2011	30.566	317.263
13	2012	22.466	321.132
14	2013	19.345	328.008
15	2014	14.981	326.190
16	2015	12.717	328.563
17	2016	12.588	334.444
18	2017	15.703	334.463
19	2018	16.700	348.551
20	2019	12.500	355.443

Gabkindo (2020) and BPS (2020).

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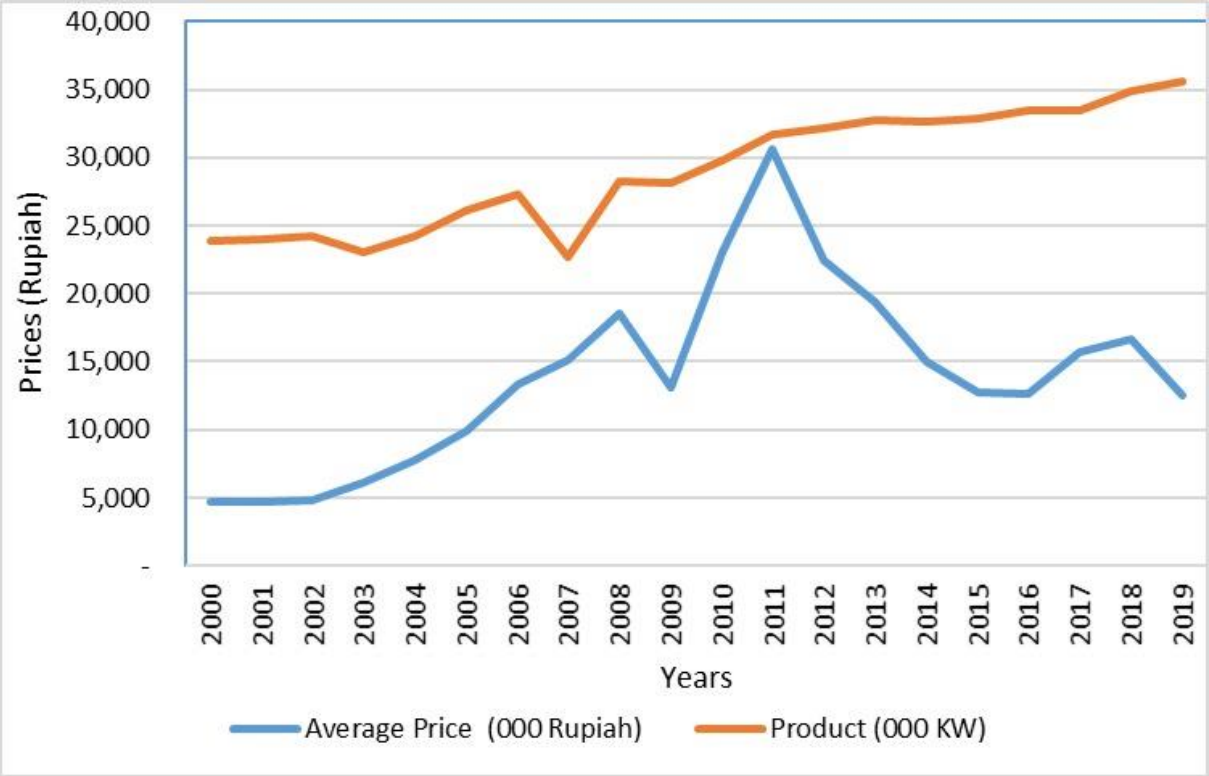

Figure 2. Graph of rubber price fluctuation and rubber production in Jambi Province

The data in Table 5 shows that the average elasticity of rubber supply from 2000 to 2019 is 0.1321. This figure shows that every time there is an increase or decrease in the price of rubber of Rp. 1, it will be followed by an increase or decrease in rubber production by 1.321 tons per year in Jambi Province. The elasticity figure of rubber supply in Jambi Province is indeed small of 1 (one). This figure shows that an increase or decrease in rubber prices will increase or decrease rubber production in a small, even negative ratio. Data for 20 years shows that only 13 (thirteen) years of rubber supply elasticity are positive, while 7 (seven) years are negative, while 7 (seven) others show negative rubber supply elasticity. The negative figure is because the data used in the analysis is annual data, while farmers respond to an increase or decrease in rubber prices in months or even weeks. Regarding the price fluctuation aspect, (Suri et al., 2021) reported that the rubber price fluctuation affected the rubber export value.

Rubber Production Patterns and Farmers' Behavior on Price Fluctuations in Jambi Province

Rubber production patterns can be said to be normal and can also be said to be abnormal. The production pattern is said to be normal. The behavior of farmers in rubber tapping is in accordance with their daily habits, namely tapping rubber 5 times a week. In contrast, the behavior of farmers is said to be abnormal, they can do rubber tapping more than 5 times a week or less than 5 times a week. The tapping was carried out more than 5 times in obtaining more rubber latex, both in response to price increases and for other reasons. On the other hand, tapping was done less than 5 times because there was another job or because the price was not attractive.

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Table 5. Price, production and elasticity of rubber supply in Jambi Province

Nu	Years	Average Price (Rp 000)	Production (0000 Ton)	Elasticity
1	2000	4,686	23,8500	
2	2001	4,743	23,9625	1,9638
3	2002	4,800	24,1704	3,6292
4	2003	6,101	23,0681	- 0,8478
5	2004	7,751	24,2448	0,7131
6	2005	9,879	26,1284	0,8849
7	2006	13,301	27,3503	0,3571
8	2007	15,080	22,6751	- 2,6284
9	2008	18,508	28,2886	1,6372
10	2009	13,116	28,0928	0,0363
11	2010	23,002	29,8386	0,1766
12	2011	30,566	31,7263	0,2495
13	2012	22,466	32,1132	- 0,0478
14	2013	19,345	32,8008	- 0,2203
15	2014	14,981	32,6190	0,0417
16	2015	12,717	32,8563	- 0,1048
17	2016	12,588	33,4444	- 4,5792
18	2017	15,703	33,4463	0,0006
19	2018	16,700	34,8551	1,4123
20	2019	12,500	35,5443	- 0,1641
	Rata2			0,1321

Gabkindo (2020) and BPS (2020).

This analysis was conducted to determine the behavior of farmers in response to fluctuations and fluctuations in the price of rubber. For this reason, a survey was conducted in two villages, namely Muhajirin Village, Muaro Jambi Regency and Tanah Tumbuh Village, Bungo Regency. Overall, the pattern of rubber tapping by farmers in response to price fluctuations in Jambi Province can be explained by using Table 6.

Table 6. Relationship between changes in rubber prices and rubber tapping patterns in Jambi Province

Rubber Price	Rubber Tapping Patterns		Total
	Normal Pattern	Non Normal Pattern	
Normal Price	28	11	39
Non Normal Price	13	18	31
Total	41	29	70

From Table 6, it can be explained that as many as 41 people of the respondents stated that in rubber tapping they always carried out a normal pattern, namely an average of 5 times a week, both in conditions of normal prices and prices were down or up. Another 29 people from the farmers stated that they were using an abnormal rubber tapping pattern. Then 18 people said that the abnormal behavior was done when the price

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was not normal and 11 other people explained that it was done when the price was normal. Furthermore, 28 people from farmers who behave normally do it when the price is normal and as many as 13 others do it when the price is not normal.

To find out more, an analysis was carried out on each village, namely Muhajirin Village and Tanah Tumbuh Village. It turns out that between the two villages there are differences in responding to price fluctuations. The farmer's behavior is not always the same as that described in the supply theory. Table 7 below explains the behavior of farmers in Muhajirin Village in responding to price fluctuations.

Table 7. The relationship between changes in rubber prices and rubber tapping patterns in Muhajirin Village, Jambi Sub-District, Muaro Jambi District.

Rubber Price	Rubber Tapping Patterns		Total
	Normal pattern	Non Normal Pattern	
Normal Price	14	5	19
Non Normal Price	7	9	16
Total	21	14	35

From Table 7 it can be explained that as many as 21 respondents in the village followed normal tapping patterns both in normal price conditions and in abnormal price conditions and as many as 14 other respondents followed abnormal tapping patterns both under normal price conditions and non-price conditions. normal.

Furthermore, it can be explained that as many as 9 respondents in Muhajirin Village said that they actually tapped at abnormal or low prices, especially during the Covid pandemic19 the price of rubber actually dropped. This low price condition certainly has an impact on the family economy. Therefore, they do something deviant to cover the minimum needs of the family. This may also be related to the condition of employment in Muhajirin village which is not open, rubber gardens are the only jobs.

The rubber tapping pattern in Tanah Tumbuh Village seems to follow a slightly different rubber tapping pattern. The fluctuation in the price of rubber is followed by a condition of decreasing the flow of rubber latex out of the rubber stem. This is a serious blow to the farmer's economy, so they have to look for other alternatives. To find out the pattern of rubber tapping behavior in Tanah Tumbuh Village, it can be explained by the data in Table 8.

From Table 8 it can be explained that as many as 19 respondents in the village followed the normal tapping pattern both in normal price conditions and in abnormal price conditions, as many as 15 other respondents followed an abnormal tapping pattern both in normal price conditions and non-price conditions.

Table 8. Relationship between changes in rubber prices and rubber tapping patterns in Tanah Tumbuh Village, Tanah Tumbuh District, Bungo Regency

Rubber Price	Rubber Tapping Pattern		Total
	Normal Pattern	Non-Normal Pattern	
Normal Price	14	6	20
Non Normal Price	6	9	15
Total	19	15	35

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It can be further explained that as many as 9 respondents in Tanah Tumbuh Village did not do rubber tapping at all, they switched to other jobs. As they did in this Covid-19 pandemic condition. Other jobs include being a laborer in an oil palm plantation company and doing gold panning in the rivers around the village. They can do this if the conditions of employment in the village are open, although they can only cover the basic needs of the family. Changes in tapping patterns for smallholder plantation farmers were made possible because there was no external supervision regarding wiretapping guidelines as is done in large plantations (Silaban et al., 2021).

CONCLUSION

The fluctuation of rubber prices in Jambi Province during the last 20 years is quite large, especially when using more detailed data, namely monthly data. Although the rubber price fluctuation is quite large, the elasticity of supply using data for 20 years shows the number 0.1321, which indicates a relatively small elasticity. Farmers in the two survey villages responded to the high fluctuation of rubber prices by changing the tapping pattern, where the decline in rubber prices which caused the family's needs not to be fulfilled was responded to by farmers with deviant tapping behavior, namely by increasing the frequency of tapping in the hope that the production obtained was greater. Meanwhile, farmers in other villages reacted by switching to other jobs.

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