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Optimization Of Rubber Farmer Revenue In Relation To Rainfall Fluctuations In South Sumatera

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Abstract. The yield of rubber plantation has a strong correlation with the amount of rainfall. Rainfall pattern in South Sumatera is not distributed evenly round the year, hence the rubber plantation production is fluctuated, especially at the peak of wet and dry season. This research aimed to determine the revenue that can be optimized by using rain guard to save yield loss on wet season as well as by adoption of rubber drought tolerant clone to increase yield on dry season. This research was conducted in Indonesian Rubber Research Institute by collecting weather data as well as rubber production in Indonesian Rubber Research Institute experimental field in the last eight years (2013 – 2021). The results of this study showed that optimal yield was achieved in wet season although some tapping days were lost due to rainfall. On the contrary, the yield was reduced to 50% on the dry season. The average of potential revenue that can be optimized during wet and dry season was equal to IDR 5,050,488/ha/year and IDR5,106,630/ha/year respectively. This potential revenue can be optimized by installing rain guard on wet season as well as adoption of rubber drought tolerance clone.

1. Introduction

Rubber tree (*Heveabrasiliensis*Muell. Arg.) is the most important source of natural rubber native to the Amazonian rainforest. Most natural rubber is grown between 15°N and 10°S where the climax vegetation is lowland tropical forest and where the climate is permanently hot and humid[1]. Currently, Indonesia is the second largest rubber producing countries after Thailand with the total plantation area of 3.6 million ha. South Sumatra, one of provinces in Indonesia, has the largest rubber plantation area, which are mostly smallholders with an average productivity of 1215 kg/ha in 2018[2].

Adequate rainfall is a key success for rubber (*Heveabrasiliensis*) cultivation. Adequate rainfall is a key success for rubber (*Heveabrasiliensis*) cultivation. Rubber plantation requires 2000 – 4000 mm of rainfall that distributed about 100 – 150 days/year (Cahyo et al., 2011; Priyadarsha, 2017; Cahyo et al., 2020; Hasibuan dan Mariati, 1970). In general, rubber plant produces optimum yield when the climate condition is steady round the year[1]. When the excessive rainfall is occurred, the latex production can be decreased due to loss of tapping day and water logging that induce plant stress[1,5]. On the contrary, when the rainfall is less than rubber plant water requirement, the latex production will also be decreased. Usually, rubber plant experience stress when rainfall is less than 100 mm/month[6].

Rainfall and rainy days partially or simultaneously affect the productivity of rubber plants. High rainfall can reduce crop production because disrupt the activity of tapping rubber. Some rainfall falls straight to ground surface, some flows through branch and stem, and small part traps in canopy. The flow of rainfall that passes through the branches and stems will cause wetness on tapping panel that interfere the latex flow into the cup. In addition, rainwater can also dilute the latex that has accumulated in the cup. In the wet zone area in Sri Lanka, around 35% of potential yield loss was recorded due to rainfall disturbance[7].The negative effects of these rainfall disruption can be minimized by using rainguard. Setting up the rain guard on rubber tree can block the flow of rainwater to the tapping panel and prevent water from entering the cup. Rainguard usage can improve yield by 7 g/t/t due to more cup lump can be collected[8].

In addition, to cope with drought problem that usually occurred in South Sumatera from July to August every year[9], rubber farmer need to plant rubber drought tolerant clone in their field. Hence the drop of rubber production can be minimized and revenue of the rubber farmer can be optimized. The example of rubber drought tolerant clone is GT1 [10]and RRIM 600 [11].

This research aimed to determine the revenue that can be optimized by using rainguard to save yield loss on wet season as well as by adoption of rubber drought tolerant clone to increase yield on dry season.

2. Material and Methods

This research was conducted in Indonesian Rubber Research Institute experimental field on August 2021 by collecting rainfall and latex tapping activity data from 2013 to 2021. The field block of the collected data was field with BPM 24 clone planted as the dominant clone. These rubber plants were planted in 2004 (17 years old) using normal plant spacing (6 x 3 m). Tapping activity was started from year 2008/2009 using bottom ward half spiral method, conducted once in three days. The climate data around the experimental field from 2013 to 2021 were collected from Automatic Weather Station (AWS) Davis Vantage Pro2 Plus located at 02°55'40" S and 104°32'16" E with an altitude of 10 m above sea level.

Calculation of yield loss due to excessive rainfall was conducted by counting the tapping activity that conducted on the rainy day. This activity potentially resulted in yield loss because of rainfall wash out of the collected latex in the cup as well as in the tapping panel [8]. In addition, calculation of yield loss due to dry season was conducted by comparing the difference between the yield of rubber drought sensitive and tolerant clones on the dry season. The yield loss then was converted to potential revenue loss using the recent rubber price. Calculation of revenue loss in rupiah used the average of rubber price (SIR 20) collected from SICOM[12], and the rupiah exchange rate from 2021 was sourced from Bank Indonesia. The average rubber price was 1.66 USD and the rupiah exchange rate were IDR. 14,092.

3. Results and Discussion

Rubber production in the research site was fluctuated due to the occurrence of wet and dry season during a year. The fluctuation of the average monthly rubber production from 2013 to 2021 is presented in figure 1

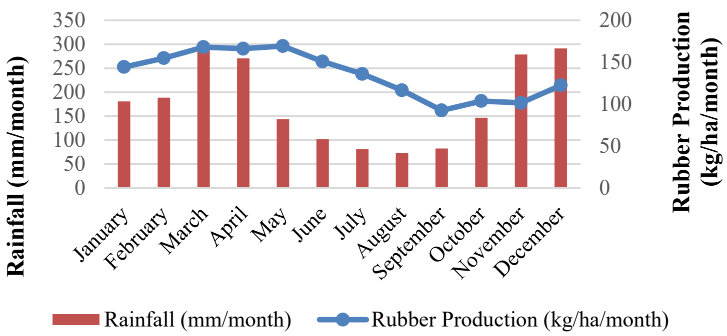

Figure 1. Monthly average of rainfall (2013 – 2021) and rubber production in Sembawa, South Sumatera

Figure 1 shows that the peak of rubber production was occurred on wet season (October – May). On the contrary, the lowest rubber production was occurred on dry season (July – September). On the wet season, some months experienced with excessive rainfall, hence the increase in rainfall did not result in the significant increase of latex yield. One reason why the yield increase is not optimal was because some of the latex yield was washed out by rainfall[13]. On the contrary, on the dry season, rainfall was decreased until less than 100 mm/month. This condition resulted in plants stress, hence the rubber leaves were defoliated and fall. In normal year, the leaf fall season usually happened from May to August. Usually, the drought sensitive clones (PB 260) defoliate the leaves faster than the drought tolerant clones (GT1)[10]. Finally, the defoliation of rubber leaves resulted in the decrease of rubber production.

On the wet season, water is abundant, hence rubber plant water requirement was fulfilled ideally and production was increased sharply compared to production on the dry season. From the plant water requirement point of view, water from rainfall was not a constraint for rubber production. The problem raised when the rainfall occurred at the same time with tapping activity (several hours before and after tapping time). This condition resulted in the latex washed out from the tapping groove if the tapping panel was in wet condition. Moreover, it can also result in the latex washed out from the cup if the rainfall occurred in the afternoon just after the tapping activity was completed. Therefore, the production of cup lump gained from the late latex drop was decreased. Some study stated that higher rainfall trends to be climatic factor causing the decrease of tapping days and latex yield[14]. In Malaysia, tapping day and yield loss reached 71 days/year and 535 kg/ha/year respectively [8,15]. Finally, this condition caused total monthly production of rubber was no optimum and resulted in the not optimum revenue of rubber farmer.

In Sembawa, based on tapping record from 2013 to 2021, the total tapping day loss reached 8 days per year and the estimation of rainfall occurrence at the same time as tapping activity was 62 days. This information is presented in Table 1.

Table 1. Monthly average of production, rainfall, tapping day loss in Sembawa from 2013 to 2021.

Month	Rubber Production (kg/ha/month)	Rainfall (mm/month)	Rainy Days (days)	Average Number of Tapping Days Lost due to Rainfall (days)	Estimation of Average Number of Tapping Days at Rainy Day (days/month)	Estimation of Additional Yield by using Rainguard (kg/ha)
1	144	180.6	19	0.3	6.2	21.8
2	155	188.7	17	0.2	5.7	20.1
3	168	289.5	20	0.4	6.6	23.1
4	166	270.4	23	0.8	7.3	25.5
5	169	143.6	16	0.7	5.0	17.5
6	151	101.8	10	1.1	2.9	10.0
7	136	81.0	9	0.3	3.0	10.6
8	117	73.3	11	0.6	3.4	11.8
9	93	82.3	12	1.5	3.5	12.4
10	104	146.3	16	1.3	4.8	16.6
11	101	278.8	21	0.3	7.0	24.4
12	122	291.6	19	0.1	6.3	22.2
Total	1626.2	2128.0	193	8	62	215.9

A solution to cope with excess rainfall in wet season that can disturb tapping activity is adoption of rainguard (Figure2). Adoption of rainguard was reported can save rubber yield loss due to rainfall as much as 7 gram/tree/tapping (g/t/t) due to more cup lump can be collected[8]. Hence it can be

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estimated that by using rainguard, the rubber production loss due to rainfall can be saved about 215,9 kg/ha/year. Therefore, by using rainguard the revenue of rubber farmer can be optimized as much as IDR5,050,488 per hectare per year or average IDR 421.075 per hectare per month. The cost of rain guard installation was IDR 437.500 per year [8], hence the rubber farmer who adopted the rainguard still could get profit of IDR 4,612,988 per hectare per year. This technology is one that can be adopted to increase the income of rubber farmer.

Figure 2. Application of rain guard to protect rubber tree tapping panel from water flow

On the contrary with condition on wet season, at dry season water availability is a constraint for rubber growth and production. Latex is a cytoplasm composed of about 60% water. Limiting factors for water uptake by trees, such as rainfall and drought, will have an impact on latex yields, and any water deficit will immediately decrease latex regeneration capability [6,16]. From the experiment, the decrease of rubber production on the dry season reached about 50% of rubber production on wet season (Figure 1). To cope with this condition, rubber farmer need to plant rubber drought tolerant clones as monoclonal or to be mixed with other clones. Adoption of drought tolerant clone (GT1) could preserve rubber production on the dry season compared to drought sensitive clone (PB 260) [10]. This information is presented in Figure 3.

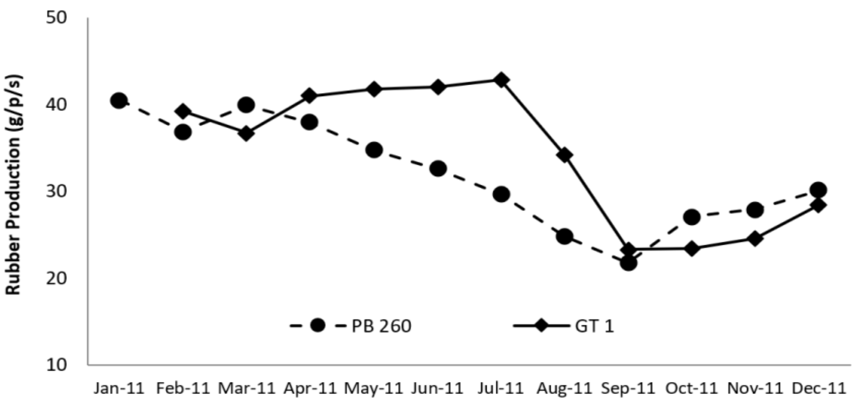

Figure 3. Production of drought tolerant clone (GT1) vs drought sensitive clone (PB 260)

Figure 3 shows that during wintering season, production of GT1 was higher than PB 260 as high as 218.3 kg/ha/year. This yield was equal to IDR5,106,630 that very valuable for rubber farmer to support their life necessities. Based on data on the decline in plantation production influenced by the climate in certain seasons, the option for the use of recommended clones was highly recommended. In addition, the adoption of rainguard technology becomes very important so that it can minimize the loss of tapping days that can harm rubber plantations and farmers' household income. Assistance in the form of training and technical guidance related to rainguard technology must also be disseminated to rubber plantation businesses and self-help farmers so that efforts to overcome the decline in the productivity of plantation products due to high rainfall and the cessation of certain tapping days did not resulted in huge yield loss.

4. Conclussion

This study concluded that optimal yield was achieved in wet season although some tapping days were lost due to rainfall. On the contrary, the yield was reduced to 50% on the dry season. The average of potential revenue that can be optimized during wet and dry season was equal to IDR 5,050,488/ha/year and IDR 5,106,630/ha/year respectively. This potential revenue can be optimized by installing rain guard on wet season as well as adoption of rubber drought tolerance clone, and also assistance and training for technology transfer must be conducted. The example of rubber drought tolerance clones are RRIM 600 and GT1. Rainguard technology is able to cope with production loss when rainfall is high.

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