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Analysis Value Chain of Green Productivity in Natural Rubber Cultivation Process at Kelompok Usahatani Restu

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Abstract: ***In general, this study aims to formulate a strategy to increase natural rubber produktivity with environmental aspect. The detail purpose of this research are 1) Calculate the productivity of KUR in one year 2) Calculated Green Productivity Index (GPI) 3) Knowing the problems that occurred in the value chain in the cultivation of natural rubber 4) Provide the best strategy recommendations. The primary data collection conducted in-depth interviews with people who is experts in it, The secondary data sourced from articles, journals, reference books and Internet. Qualitative data were obtained and analyzed by using a systems approach, quantitative data were analyzed by green productivity, calculation of productivity and value chain analysis. The results showed that: 1) The level of productivity of farming groups of restu for one year had fallen 2) Green Productivity Index (current state) is 3.6. 3) Problems occur is when use of supporting material that's not environmentally friendly. Recommended strategies to enhance the productivity of environmentally friendly is composting that can reduce waste generated and replace chemical fertilizers to organic fertilizers that are more environmentally friendly.***

Keywords: green productivity index, produktivity, value chain, lateks ,compost

1. Introduction

Natural rubber have many functions for human life, almost of the equipment that we use is mostly made from natural rubber. Global natural rubber consumption is expected to grow 5.9% to 12.585 million tons in 2016, the rubber demand will be stimulated by growth in the tire industry as part of the production of motor vehicles that increase by 4.5% until 2019. Consumption of national rubber is estimated to increase around 40% which reached 700,000 tons, the increase was driven by a number of infrastructure development in the country (GAPKINDO, 2015). This means that the demand for natural rubber has a very good opportunity to improve productivity.

Thailand is a country that contributes the highest exports to the world with production 4.3 million tons in 2014. Subsequently followed by Indonesia with export production 3.2 million tons. While Vietnam occupied the third position with exports production reached 954 thousand tons in 2014 (Rubber Statistical News, 2015). Rubber production in Indonesia is produced by small entrepreneurs who are people's plantations as much as 2,514 million tonnes (79%), private companies as much as 359 thousand tons (11%), and the government as much as 331 thousand tons (10%) (GAPKINDO, 2015). The main obstacle in the development of Indonesia's natural rubber is productivity levels are still low. The level of productivity of land in Indonesia, especially smallholder, reached 1.0 tons/ha/year, while productivity of land in Thailand reached 1.9 tons/ha/year (Ministry of Industry, 2015).

The market of natural rubber present requires a good environmental management in process (APO, 2006). Answering the market demand, Ministry of Agriculture is making a regulation on certification of Indonesian Sustainable Natural Rubber (ISN-Rubber) because many countries consumers of rubber want sertificate of product that enviromental friendly. ISN-Rubber given not individually but in the form of farmer groups or cooperatives that supply raw materials to the rubber processing plant (GAPKINDO, 2014). Green productivity is a strategy to increase company productivity and environmental performance simultaneously in the socio-economic development (APO, 2002). Go green began to be applied by the tire manufacturer to switch from synthetic rubber to natural rubber, and this resulted make natural rubber demand will increasingly. Implementation of green productivity can comparing each alternative solutions that occurred (Saxena et al., 2003).

Southern Sumatra is a province that produces natural rubber number one in Indonesia with production 1,122,005 tons. Musi Rawas is a regency in South Sumatra,people's plantations in this area in the amount of 333 282 ha biggest than other area in sumatera selatan (BPS, 2014). Kelompok usahatani restu is one of the natural rubber producer in the Musi Rawas. There are several groups of natural rubber producer in Musi Rawas as in Table 1

Table 1: Total Area Group Farming Natural Rubber in Musi Rawas and Lubuklinggau 2015

No	Name of farmer grup	Size growing area (Ha)	Located
1	Temam Lestari	150	Plantations (Musi Rawas), Nursery (Lubuklinggau)
2	Maju Bersama	120	Plantations (Musi Rawas), Nursery (Lubuklinggau)
3	Tani Mandiri	100	Plantations (Musi Rawas), Nursery (Lubuklinggau)
4	Restu	65	Plantations (Musi Rawas), Nursery (Musi Rawas)
5	Tunas Harapan	40	Plantations (Musi Rawas), Nursery (Musi Rawas)

Source : Primary data

Kelompok Usahatani Restu (KUR) is a farmer groups whose operations both rubber plantations and nurseries, located in the region the same rubber that is Musi Rawas with the largest plantation area 65 ha. This group was able to produce rubber of 6.5 ton/month. Green productivity study was conducted to analyze the productivity and environmental performance, so that these smallholder farmers are able to realize a sustainable development effort that makes environmental management as one of the main contributing factors.

The research problems are how Productivity Systems in KUR in one year? , How Green Productivity Index (GPI) in KUR? , what is the problem in value chain in cultivation of natural rubber? And whatt is he best strategies to repair problems occur in the value chain of natural rubber cultivation process with green productivity ?

This research aims are to calculate the productivity of KUR in one year, counting of Green Productivity Index (GPI) in current states at KUR, analyze problems that occur in the value chain of productivity in natural rubber cultivation and also give the best recommendations of strategy to repair the problems that occur in the value chain process of cultivation of natural rubber with Green Productivity.

2. Method

Research was conducted on Kelompok Usahatani Restu in Musi Rawas, Province of South Sumatra for two months, from November 2015 until January 2016. Choose the place because Kelompok Usahatani Restu is the bigger smallholder agriculture in that area.

The data collection includes quantitative and qualitative data in the form of secondary data and primary data, data are not available estimated through qualitative and quantitative information obtained from management interviews and review of the literature (articles, journals, reference books and internet). The primary method of data collection conducted in-depth interviews from source of information or informants who are experts in their field and observe the existing documents and documentation of existing activities. Selection of informants using purposive sampling method. The informants were experts in the cultivation of natural rubber.

Population is the generalization region consisting of the objects / subjects that have certain qualities and characteristics defined by researchers to learn and then drawn conclusions (Sugiyono, 2013). The population in the study of natural rubber farming are all the farmers who are members groups of Kelompok Usahatani Restu. Collecting data about the waste generated from the production process of natural rubber cultivation is taken by observations in the field and filled by questionnaire that has been provided, for the data is taken from filling the questionnaire of 25 people who are members of KUR. Determination of respondents who researched, selected with based on the consideration of knowledge, skills and experience in natural rubber process. The experts selected based on reputation, experience, and expertise. The respondents interviewed experts include:
1. Ketua Kelompok Usahatani Restu
2. Riset Perkebunan Nusantara
3. Dinas Perkebunan Musi Rawas
4.Academics who are experts in the field of natural rubber

3. Results

Analysis of productivity

Productivity relates to use of resources are efficient in producing goods or services (Sumanth, 1984). Here is Table 2. describing the dynamics of group productivity farming

Tabel 2: Produktivity in KUR in one period.

Month and Year	Total Input (Ha)	Total Output (Ton)	Produktivity (ton/ha/mth)
November 2014	65	7,00	0,107
December 2014	65	7,25	0,112
January 2015	65	6,50	0,1
February 2015	65	6,50	0,1
March 2015	65	6,25	0,096
April 2015	65	6,25	0,096
May 2015	65	6,25	0,096
June 2015	65	6,25	0,096
July 2015	65	6,50	0,1
August 2015	65	6,50	0,1
September 2015	65	6,25	0,096
October 2015	65	6,50	0,1
Total Produktivity			=1,2 ton/ha/thn

Source : Primary data

In the table above, we see that productivity is highest in December 2014 it is because this month is still in the rainy season from the afternoon until late in the evening so as not to interfere with the activity of tapping rubber farmers, but it is also due to the sale price rubber remained high in the month which makes farmers still the spirit to tap rubber. Productivity decreased every month due to the use of land is not optimal compared to results, the productivity slowdown began in January 2015, the decrease is due to the world market demand of natural rubber tends to decrease in the selling price of rubber at farm level which causes farmers lackluster, it is also in these months the sun is more scorching heat with the lower rainfall. With implementation of green productivity is expected to increase international demand for rubber is sustainable, and long-term benefits such as production efficiency, increased productivity and cost effective management.

Analysis Seven Green Wastes

The value chain in a production aimed at creating added value and competitive advantage for the business person (Arjakusuma, 2013). A production chain enterprises in the agricultural sector there are definitely some of the material either intentionally or not discarded. The waste material known as agricultural waste. Indeed, waste from product material or the residue in a process which was originally viewed negatively because it can reduce the quality or quantity of the material and substantially interfere with the smooth flow of production and may cause health problems for the business in farm. Usually materials including waste has characteristics explosive, flammable, reactive, toxic, infectious, and corrosive. Agricultural waste is generally divided into pre-harvest waste, the time of harvest, and post harvest.

Rubber cultivation means the production chain of latex and rubber wood that would produce waste, where the waste is divided into waste pre-harvest, harvest and post-harvest time. These wastes are deliberately segmented or separated according to the origin of the production chain where produced. This was done to facilitate handling and processing activities then the waste from pre harvest starts from nursery operation and maintenance of immature plantations that usually in the form of generative and vegetative parts of rubber trees that had fallen leaves and twigs eg rubber plant but it also can be a material and emission. The next waste is waste during harvesting and post-harvest plant rubber. Rubber plant can only produce latex after the age of 5-6 years with a production period of 25-35 years. Post-harvest rubber latex include the transfer of activities from the field to storage facilities, and transportation by farming groups before being sold to a rubber processing factory. During the process of harvesting latex and rubber wood until after harvest will certainly produce waste (Tim Penulis PS, 2008).

Tabel 3: Result of analysis seve green waste

Type of waste	Activity Processing						
	Nursery	Maintenance of immature plantation	Maintenance plants produce	Harvesting	Filtering	Transportation	Total
Energy (KWh)	252	0	0	0	0	0	252
Water (liter)	3000	0	0	0	110	0	3110
Material (kg)	1565	492	2801	98,5	106	0	5062,5
Garbage(kg)	308,1	876	1050	1751	565,5	0	4550,6
Transportation(km)	0	0	0	0	0	1270	1270
Emission (kg)	496	0	0	0	0	677	1173
Biodiversity (ha)	5	7	65	0,01	0,02	0	77,03

Source : Primary data

Analysis *Environmental Impact* (EI)

Environmental impact (EI) is the sum of weights for each indicator GP (Gandhi et al., 2006). Identification of waste by Seven Green Wastes consisting of consumption of energy, water, materials, garbage, transportation, emissions and biodeversity. Weights and indicators GP determined based on the analysis of

Environmental Sustainability Index (Yale Center for Environmental Law and Policy Report, 2005). Emissions in the process of activities classified as variable GWG, WC, SWG, and LC (Puspita, 2014). According to Gandhi (2006), environmental impact (EI) resulting from the production process can be formulated as follows:

$$\mathbf{EI = w_1GWG + w_2WC + w_3WG + {}_{w4}LC}$$

Information :

w_1, w_2 ,w_3 and w_4 : The weight from people expert in natural rubber process.

SWG :Solid Wastes Generation
GWG:Gaseous Wastes Generation
WC: Water Consumption
LC:Land Contamination

Based on the Environmental Index can be calculated with the following formula:

$$\boldsymbol{EI = 0{,}375GWG + 0{,}25WC + 0{,}125SWG + 0{,}25LC}$$

EI calculation with basis production one ton of latex, the weight value obtained 0,18ton/month (GWG), 0,48ton/month (WC), 0,7ton/month (SWG), da 0,8ton/month (LC) , Based on these data, the environmental impact from the process of natural rubber cultivation when produce one ton latex can be formulated as follows:

EI = 0,375x0,18 + 0,250x0,48 + 0,125x0,70 + 0,250x0,80
EI = 0,0675 + 0,12 + 0,0875 + 0,2
EI = 0,475

The cost required to produce 6.5 tons of rubber per month in the production of natural rubber in the group amounted Rp30.137.588. Assuming that the cost requirements of natural rubber cultivation process and production quantities of latex same each month, the amount of costs required to produce one ton of latex amounted Rp4.636.552/ month. Revenues were made by KUR to produce 6.5 tons of rubber with an average selling price Rp7.697/kg, the income of KUR amounted Rp50.028.517/month, with one ton of latex basis, the revenue generated is Rp 7.696.695 / tons / month. Economic indicators in the process of natural rubber cultivation in KUR to produce one ton of latex can be calculated by comparing the total revenue from the sale with resulting costs to obtain economic indicator value 1.7. GPI is the ratio comparing the level of productivity (economic indicators) companies with environmental impact (EI) which is produced from natural rubber cultivation. The result of the calculation of Environmental Impact (EI) obtained a value of 0.475 and the value of Economics Indicators to produced of natural rubber is equal to (current state) 1.7 so the GPI become 3.6. This value indicates that level of productivity (current state) which is produced natural rubber production in KUR has been quite good but there are still plenty of opportunities to increase it better.

Green Productivity Improvement with AHP Model

According to Taylor (2004), AHP is a method to rank a series of alternatives and choose the best alternative that includes a wide range of criteria. Meanwhile, according to Sharma (2008) AHP is defined as a multi-criteria decision-making techniques that can describe a complex problem into a multilevel hierarchical structure. According Marimin (2010) AHP structure consists of five levels namely focus, factors, actors, objectives and alternatives. AHP is used to identify and find alternative strategy to increase productivity in the process of cultivation of natural rubber in KUR. Structure of AHP model to increased productivity on production of natural rubber rubber in KUR presented in Figure 1.

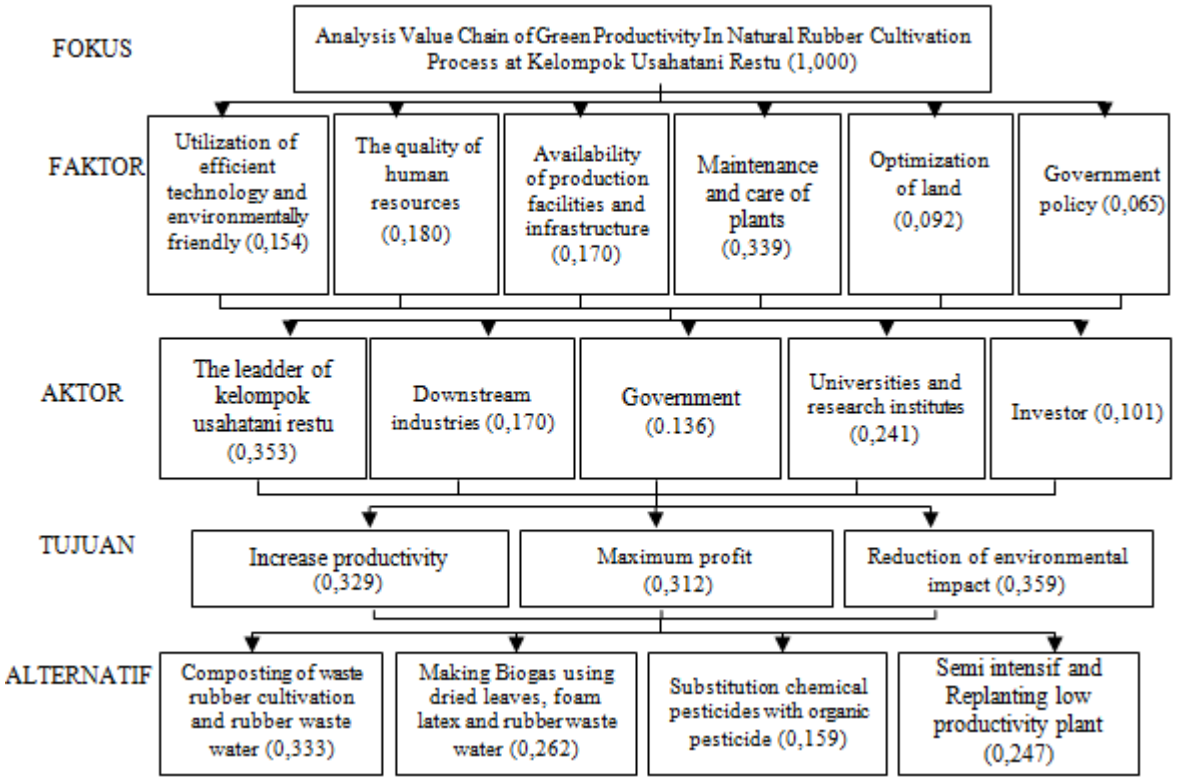

Figure 1: Structure AHP of increased productivity on rubber cultivation in KUR

Based on data that has been processed using software Expert Choice 2000, the four experts have value for level aternatif inconsistency ratio of 0.10 (P1), 0.03 (P2), 0.04 (P3), and 0.05 (P4). Inconsistency ratio of each level of each expert is obtained not more than 0.10, which means consistent expert opinion primary focus on the structure of the AHP.

Productivity improvements with Green Productivity

The concept of implementation GP strategy is based on the integration of two important developments: 1) the development strategy of environmental quality and 2) an increase inproductivity.

So with a combination of two strategies have obtained a framework to do continuous improvement, as well as to sustainable development (APO, 2006). Through the analysis of the election, the alternative chosen strategy by using AHP, the weight of each level as shown in Figure 1. The alternative was selected based on the opinion of experts who can improve productivity index value of green in natural rubber production process is the composting of waste rubber cultivation and rubber waste water with a weight of 0.333. Here's a comparison of productivity index value of green before the repair and after repair through the implementation of alternative strategies are presented in Table 4.

Table 4: Comparison of green productivity index at Kelompok Usahatani Restu

Scenario	Explanation	EI	Indikator Ekonomi	GPI
Current State	The current state condition of natural rubber cultivation	0,475	1,7	3,60
1	Composting of waste rubber cultivation and rubber waste water	0,256	1,8	7,00
2	Making Biogas using dried leaves, foam latex and rubber waste water	0,354	1,75	4,94
3	Substitution chemical pesticides with organic pesticide	0,364	1,63	4,48
4	Semi intensif & Replanting low productivity plant	0,576	3,02	5,24

Source : Primary data

Application of the composting of waste rubber cultivation and waste water rubber can contribute better to increase the productivity of green in production process of natural rubber than other strategies, because composting of waste rubber cultivation and wastewater rubber use fees cheap, easy to make, and relatively safe for the environment. The implementation of selected strategic can reduce the cost of production of natural rubber because of chemical fertilizers required is reduced so that the cost for lower fertilizer procurement and implications for the cost of production is cheaper. For composting average cost that is required is for Rp585/kg (Yansen, 2012) so that the production costs for fertilizer on KUR for fertilization amounted Rp1.755.000/month lower than the initial conditions using chemical fertilizers Rp4.669.167/month. The production cost of natural rubber cultivation in KUR with current state Rp30.137.588 become Rp 27,223,421 \,based on such things then calculated the amount of the costs required to produce one tonne latex amounted Rp4.188.219/month.

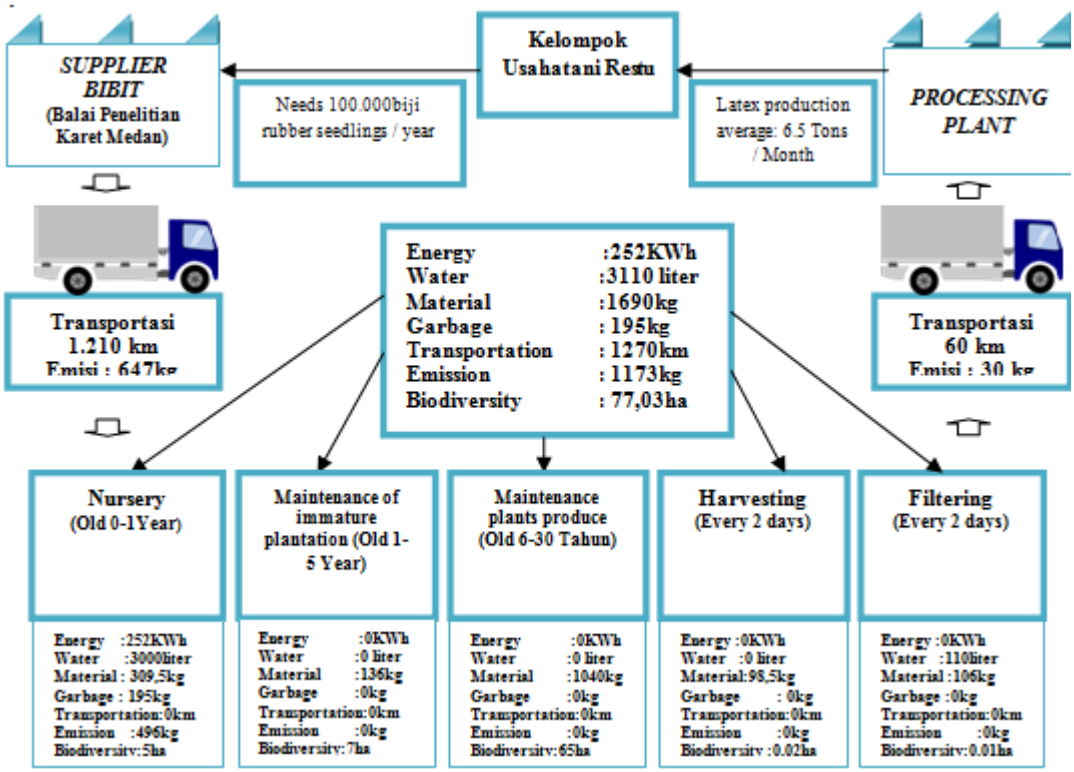

Figure 2: Green Value Stream in KUR (*future state*)

The implementation of the strategy can increase sales revenues amounting Rp7.696.695/tons/month to obtain economic indicator value of 1.8. The environmental impact when application of these alternatives can be suppressed. For the production of natural rubber with a base one ton with these alternatives produce SWG by 0.03 tons, 0.18 tons GWG and WC of 0.48 ton, and 0.26 ton LC the value of EI from cultivation of natural rubber can be seen as the following equation:

EI = 0,375x0,18 + 0,250x0,48 +
0,125x0,03 + 0,250x0,26
EI = 0,0675 + 0,12 + 0,00375+ 0,065
EI=0,256

Green productivity index on the cultivation of natural rubber become 7.0. Implementation of this scenarios can increase the GPI in natural rubber production in KUR. The composting of waste rubber cultivation and rubber waste water will improve GP index, based on Figure 2. The results obtained in the form of use 252 KWh of energy, water 3110 L, supporting material 1690 kg, 195 kg of garbage process, transport 1270 km, emission of 1173 kg, the biodiversity of 77.03 ha. These results indicate there is a reduction in the use of 3372.5 kg supporting material and waste reduction process of 4355.6 kg. Implementation of Green Productivity (GP) is proven to increase productivity through process improvement. The chemical content in the waste can be reduced so that more environmentally friendly. The implementation of this GP, management activities in plantation can produce sustainable improvements in order to minimize environmental impact, increase productivity, and improve farming groups profit.

4. Conclusion and Suggestion

4.1 Conclusion

Productivity in KUR has decreased every month cause initial of land is not optimal compared to results, this decrease is due to the world market demand of natural rubber tends to decrease resulting in the selling price of rubber at farm level which causes the farmers are not eager to tap rubber.

Green productivity index value (current state) is approximately 3.6. This value indicates that the level of productivity (current state) which is produced from natural rubber production in KUR is quite good but there are still plenty of opportunities to increase it to a higher level.

The problem occurs in the value chain of natural rubber cultivation in KUR namely supporting material which is still not environmentally friendly. This problem is caused by the continued prevalence of chemicals that are not environmentally friendly to use.

The solution chosen by AHP and the highest value of GPI is an alternative one, namely the composting of waste and waste water rubber cultivation of rubber. Composting can reduce the waste generated from the cultivation of natural rubber by 95.7% and the use of materials was 66.6%. If the solution is implemented is expected to lower the costs generated, increasing the income of farmers in KUR, and improve produktivity index value of 3.4 points.

4.2 Suggestion

Selected alternative must be socialized to all members of KUR through the chairman of the group and its ranks, so that

the repair solution can be implemented properly as to increase productivity and create environmentally friendly products, in order to answer the world market demand for products that are environmentally friendly.

KUR must undertake continuous improvement in the implementation of the selected alternative in order to meet the world market demand for products that are environmentally friendly and able to meet agreement to obtain a certificate ISN-rubber as to compete in meets the market demand in the rubber industry today. The content of chemical substances in the supporting material used KUR can produce environmentally hazardous waste, this waste can be reduced by improving the quality of the process so that the waste produced does not contain environmental pollutants in high levels. Initial the cultivation of rubber waste into compost or as raw material for biogas is the right combination to suppress the use of supporting material that is not environmentally friendly, need to be implemented as soon as possible.

The Government through the Ministry of Agriculture needs to conduct surveillance, guidance, and assistance to perpetrators of farming especially rubber farmers in order to raise the productivity of farming in an environmentally friendly way so as to meet the world market demand for products that have certivicate environmentally friendly.

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