Assessing factors to influence the willingness of smallholders to participate in a replanting zonation scheme in Pelalawan District, Riau Province, Indonesia

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Assessing factors to influence the willingness of smallholders to participate in a replanting zonation scheme in Pelalawan District, Riau Province, Indonesia

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Abstract. Forest cover is one of the most important indicators to sustainable development. Illegal logging arises because of the rising demand for wood products due to increasing population and economic growth, while the total supply of log from forests remains stable or even decreases. To overcome the supply gap for wood, the utilization of wood sources beyond natural forest areas is necessary. One proposed policy option to increase utilization of wood from non-forest areas is to implement replanting zonation scheme for oil palm plantation. This policy option is implemented through three main activities. First, mapping the age divergences of the oil palms; second, making replanting zonation map; and third, integrating the utilization of oil palm trunks in the forest industry's raw material fulfillment plan (RPBI Kehutanan). Through these policies, the waste of palm trunks can be used as raw materials in wood industries. Without a replanting zonation scheme, oil palm trunks are not a feasible replacement for forest timber because of their scattered location, limited volume, and size.

1. Introduction

Illegal logging often arises prior to wildfire because of a large gap between log supply and demand along with increasing population and economic growth [1] which impacts for increasing problems of climate change [2]. The supply gap for raw wood materials is difficult to overcome without a diversity of source alternatives [3] To overcome the problem of the lack of wood supply, the utilization of wood sources other than forest areas is a must.

One option to reduce land fires is by implementing a policy for replanting of oil palm and land clearing zonation by arranging time and area allowed for a replanting scheme. By enacting a policy of zonation for replanting and land clearing activities, the potential location of land fires can be easily identified because the replanting periods (month and year) is set for each district based on the average age of oil palm plantation. Making differentiation, cluster, or zonation of natural resource potential is very important as an enabling condition for optimal resource utilization and management ([4]; see also

[5]). Through a replanting zone, land clearing activities are carried out within a certain time and area, so that the waste of palm trunk becomes a feasible alternative to raw materials from the forestry industry. Without employing this scheme, oil palm trunks cannot be utilized because of their scattered location and small yield.

The potential waste of oil palm trunks in Indonesia reaches more than 40 million m^3 per year, which can meet the shortage of wood raw material supply of national forestry industry, estimated at approximately 20 million m^3 [6]. Since logs produced by the timber estate or industrial forest plantation, (HTI) is very limited, the utilization of oil palm trunks is a promising solution for supplying raw materials for timber industries. However, oil palm trunks must be regulated as a source of timber (RPBI) to allow integrated management and provide a better, official database for legal sources of wood [7]. Fulfilling the supply gap for raw wood material promises to reduce the demand for illegal logging. Further, this will reduce burning in oil palm estates since the increased value of oil palm trunks would incent their sale to nearby wood-based industries. The trunk would therefore cease to accumulate around oil palm estates as a fire source. Although there may still be combustion activities in some small areas, this replanting zonation scheme is an important step to break the fire chain through a comprehensive approach, so that economic and environmental losses from illegal logging and land fires (depletion and degradation) can be avoided ([8]; see also [9]).

Studies show that most of the causes of land and forest fires are deliberate, especially when preparing land for fields or plantations [10]; [11]; [12]. The hotspot data in oil palm, rubber and cocoa plantation areas in Riau Province shows that overall hotspots are located outside the active plantation. This indicates that fire is initially not located in mature crops or annual crop areas [13]. Burning for land preparation, including oil palm plantations, occurs due to social, cultural, economic and technical factors. Socially and culturally, burning has been traditionally handed down through generations by the community. Economically, the cost required for the preparation of land by burning is much cheaper than the mechanical means. The study of [14] also reveals the fact that burned land increases the selling price of agricultural lands. In Sumatra, the price of 1 ha of unburnt land is burned is about IDR 8.5 million. Once burned, its value increased to more than IDR 11 million. This price difference occurs because clearing land for plantation takes a long time and is difficult for people to use without using heavy equipment.

Palm oil trunks are often fuel for burning on oil palm estates. However, they represent a source of raw woody material outside the forest area. Oil palms have a relatively short productive life, ranging from 25-30 years [15]; [16]. Unproductive palm trees are cut down and the trunks left on plantation land and can become a hotbed of pests. [17]; [18], [19]; [20] reported that the average yield of sawmill of oil palm trunk is 30%. That is, from 40 million m^3 of oil palm trunk waste will be obtained raw materials for more than 10 million m^3 of construction wood, and the rest can be used for other wood industry materials, including biomass for energy, pulp, or particle board. The extent of land use for oil palm plantations based on sub-districts in Pelalawan Regency in 2015, is presented in table 1 [21].

This study aims to map oil palm plantation according to age group and evaluate the response of oil palm farmers to replanting policy plan in Pelalawan Regency, Riau Province.

Table 1. Land allocated for oil palm plantation in Pelalawan District

No	Sub-district	Oil palm area (hectares)
1	Langgam	52.637,14
2	Pangkalan Kerinci	9.444,71
3	Bandar Sei Kijang	31.478,70
4	Pangkalan Kuras	37.517,55
5	Ukui	19.110,53
6	Pangkalan Lesung	38.431,46
7	Bunut	8.124,21

No	Sub-district	Oil palm area (hectares)
8	Pelalawan	26.762,63
9	Bandar Petalangan	18.212,48
10	Kuala Kampar	4.805,17
11	Kerumutan	36.429,90
12	Teluk Meranti	13.283,77
	Total area	296.238,25

2. Methodology

The study was conducted in Pelalawan District, Riau Province in August 2017. Pelalawan District is one of three districts in Riau Province, which has the highest palm production compared to other districts and has many wood processing industries that are expected to utilize trunks. Primary data for this research were collected through field observations and interviews. During field observation, researchers collect data by directly observing events or processes in the field (see [22]). This research marked some observed spots with GPS to determine plantation. Field observations were conducted in five sub-districts with the largest oil palm plantation area, namely: Langgam Sub-district, Pangkalan Lesung Sub-district, Pangkalan Kuras Sub-district, Kerumutan Sub-district and Bandar Sei Kijang Sub-district. In addition to field observation, this research includes data from interviews 35 smallholders in 12 villages across 5 sub-districts (see table 2). Data obtained through interviews with oil palm farmers consist of respondent identity, annual consumption level, palm production and income level, replanting schedule and treatment of palm trunk waste and farmers perception of replanting zonation policy when applied.

Table 2. Distribution of respondents by sub-districts and villages in Pelalawan District

No	Sub-District	Number of respondents (person)	Village
1	Langgam	3	Segati
2		1	Langgam
3		1	Padang Luas
4		3	Pangkalan Gondai
5		4	Langkan
6		4	Penarikan
7	Bandar Sei Kijang	4	Lubuk Ogong
8		3	Muda Setia
9	Pangkalan Kuras	4	Kesuma
10		1	Betung
11	Pangkalan Lesung	5	Sari Makmur
12	Kerumutan	2	Pematang Tinggi
	Total	35	

3. Results and Discussions

3.1. Potential utilization of oil palm trunks

The Ministry of Agriculture through the Director General of Plantation released a technical guidance for the oil palm replanting program. The government will conduct a replanting program for oil palm in Riau Province, covering 20,780 hectares (information from the official of Bappeda (Regional Development Planning Board) of Riau Province). We distinguished independent smallholders and plasma farmers, included ordinary plasma and company partnership's farmers (so-called KKPA

farmers). Historically, the age of oil palm plantations that belonged to ordinary plasma farmers and KKPA in Riau has been well inventoried.

The Ministry of Finance launched funding for a one million hectare replanting program for oil palm plantations throughout Indonesia. This fund, according to the regulation is sourced from *BPDP Sawit* (Treasury Plantation Funds of Oil Palm) who gets a fee of USD 50/ton crude palm oil (CPO). BPDP will give smallholders a grant for replanting worth IDR 25 million/hectare, with a minimum replanting area of 50 hectares, under terms and conditions, i.e. replanting is done for palm aged over 25 years, the second is early replanting for palm aged over 10 years with low productivity. If the replanting zone is applicable, then the oil palm trunks can be used for the wood industries. Thus, utilization of palm trunk requires government intervention and engagement with the private sector. Although the current technology for utilizing oil palm trunk in the plywood industry is available, utilization of oil palm trunks by small and medium enterprises in Riau remains limited.

According to smallholder interviews, respondents are dominated by the Malay ethnic group (60.00%). 22.86% of respondents were Javanese, 11.43% Batak, and 2.86% Sundanese. Javanese respondents generally had an aging oil palm plantation. This is because they acquired the palm oil plantation part of the Nucleus-Community Estate program, or PIR program, which was integrated with the transmigration program in the early 1990s and known as PIR-Trans. 48.57% of all respondents have an oil palm plantation area of 4 to 6 ha. However, 11.43% of respondents who had a land area of more than 10 ha of palm. While the respondents who had the smallest oil palm plantations were found in the Village Betung, Pangkalan Kuras Sub-district and in the Village Sari Makmur, Pangkalan Lesung Sub-district with an area of only 1 ha. Most respondents had an oil palm plantation less than 10 years old (42.19%), while 17.19% of respondents had oil palm in peak production (11-15 yrs). Based on the planting year, only 6.25% of respondents planted oil palm before 1990. 37.50% of respondents planted oil palm between 2001 and 2010. Respondents who planted during this period were mostly found in Sub-Districts of Langgam and Bandar Sei Kijang. The 32.81% of respondents who planted oil palm between 1991 and 2000 were in Kerumutan and Pangkalan Lesung Sub-Districts.

Independent smallholders represented 76.56% of respondents. They managed their oil palm plantation at their own cost and can sell products to any party without a contract. Plasma farmers represented 20.31% of respondents. They managed their own oil palm plantations, but are still tied to a palm oil company in the case of the sale of fresh fruit bunches (FFB) because they were still indebted to the company. Thus, plasma farmers cannot sell FFB to other parties other than to the "nucleus" company. The remaining respondents represent company-partnership farmers (KKPA), commonly found in Betung Village, Pangkalan Kuras Sub-district. KKPA farmers do not independently manage their oil palm plantation, but were managed by the partner company in return for benefit sharing.

3.2. Oil palm production and schedule of replanting

The average ownership of oil palm farm is 5.11 hectares per household. The range of oil palm productivity of farmers is 0.3-2.6 ton/hectare/month with an average of 1.07 tons/hectare/month. This productivity is considered very low compared with the oil palm companies, which typically can harvest double that volume in a hectare. All respondents said that their oil palm plantations had not yet been replanted. Most respondents (34.29%), planned to replant in the next six to ten years, while 25.71% of respondents will replant within the next five years, most of them follow the PIR program that had planted oil palm in 1989-1992. This program is commonly found in Sari Makmur Village, Pangkalan Lesung Sub-district.

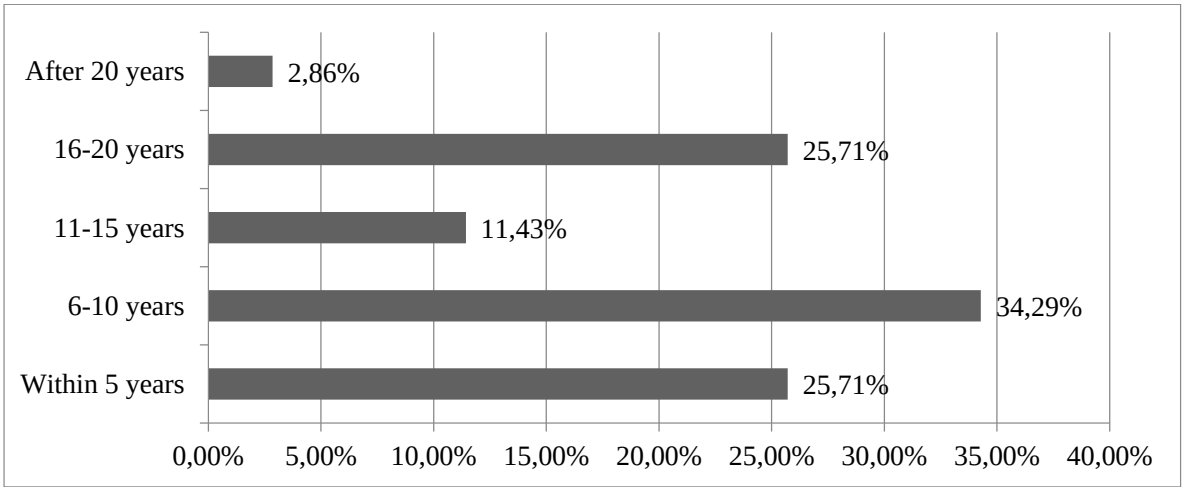

Figure 1. Respondents' schedule for replanting in Pelalawan Regency of Riau Province

Most respondents (71.43%) had prepared replanting costs from their own money, resulting from long- savings from ten years before replanting. In addition, some respondents planted their own oil palm seeds prior to the replanting schedule. Some respondents planned to conduct replanting gradually, with 2-4 years per hectare. Others planned to replant together with the company's replanting time as plasma farmer, to ensure that the planted seedlings were certified superior seeds with high production.

Most respondents (62.86%) indicated they will treat palm trunks during replanting by subverting palm trees, cut into pieces, then left to rot. The risk faced with this treatment is that the palm trunk becomes a horn beetle's nest, called *wangwung*. The beetle usually eats young plants which will eventually make the oil palm tree unproductive. As for the cost of subverting the tree, it is different in each village, between IDR 5,000/tree to IDR 25,000/tree. Some even offer IDR 2 million/ha for the cost of palm tree decline. While another 20.00% of respondents treat their palm trunks by chopping. The cost for enumerating palm trunks is IDR 3 million/hectare if done manually and IDR 5 million/hectare with a chipper machine. In fact, they are also counted per tree at a cost of IDR 100.000/palm tree that is chopped. In addition, 14.29% of respondents will treat their palm trees when replanting by injection of toxins and then allowed to die without subverting palm trees. The cost required for this activity is IDR10.000/trunk of palm for worker's wage, while the cost of toxins required for a hectare of plantations is IDR 2 million.

3.3. The willingness of smallholders to participate in replanting zonation scheme

Most respondents (77.14%) allow their oil palm trunks taken by other parties when replanting, because they do not need to spend money to subvert and split the palm trunk. However, 17.14% of respondents will allow their oil palm trunks to be taken by other parties as long as the road inspection is not damaged, the palm fronds are also transported, the land is clean again, and some also require a financial compensation.

Most respondents (54.29%) were not willing to join a replanting scheme if the time schedule for replanting is accelerated. 37.14% of respondents are willing and 8.57% are willing as long as it meet their requirements. The reason some respondents are willing to participate in a replanting program is because the age of the palm is more than 25 years, or they planted bad seedlings resulting in low productivity. The rest is the respondents will participate if their land is replanted with certified high-quality seedlings and they get a subsidy for daily needs before the new oil palm plantation has fruited (4 years). The respondents who are willing to participate in replanting scheme because they have it will bring additional income other than the existing plantation. They also had plantations in other location(s), or work as employee, entrepreneur, labor, or had saved money years prior to replanting.

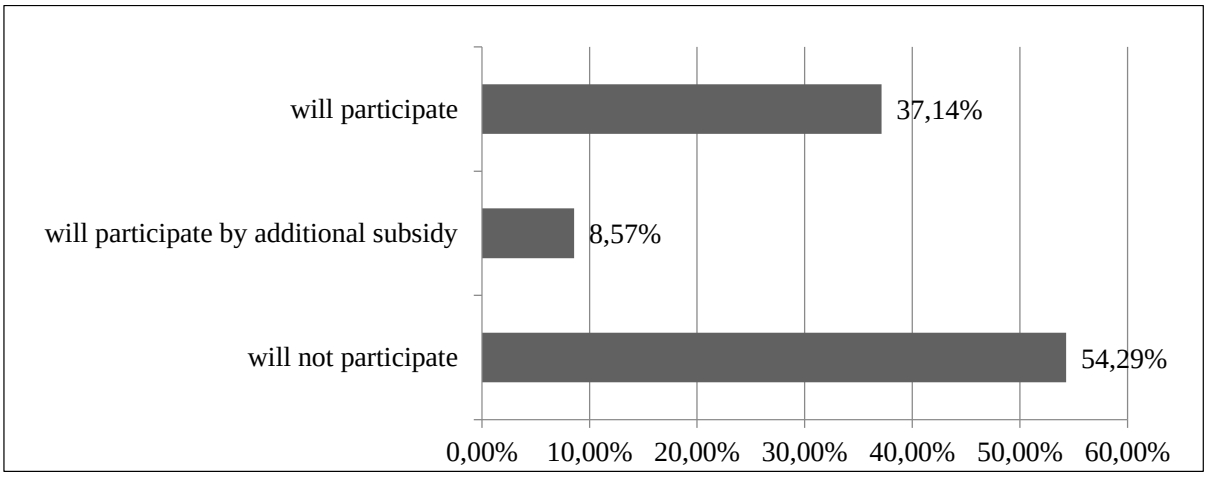

Figure 2. Willingness of respondents to participate in replanting zonation scheme

Most respondents (37.14%) mentioned that the oil palm seedlings planted in their plantation come from the company. The seeds from the company are given to plasma and planted in KKPA plantations. 28.57% of respondents bought certified superior seeds or seedlings from the center of oil palm research (PPKS) in Medan. In addition, 17.14% of respondents applied low-quality seedlings from local people, resulting in low oil palm productivity. Table 3 shows a data normality test of the respondents concerning their willingness to participate in the replanting scheme, using the one-sample Kolmogorov-Smirnov method to six independent variables, i.e. farmer's age, years of education level, number of family members, size of oil palm area, and oil palm productivity.

Table 3. Normality test of data using one-sample Kolmogorov-Smirnov method

		Farmer's age (year)	Education level (year)	Family members (person)	Oil palm area (hectare)	Oil palm age (year)	Productivity (ton/year)
N		33	33	33	33	33	33
Normal Parameters[a,b]	Mean	48.76	2.00	4.45	4.479	13.263	49.382
	Std. Dev.	13.416	1.000	1.716	2.3051	6.7859	32.1761
Most Extreme Differences	Absolute	.087	.235	.150	.128	.114	.184
	Positive	.087	.235	.150	.128	.114	.184
	Negative	-.075	-.235	-.083	-.081	-.075	-.138
Kolmogorov-Smirnov Z		.498	1.352	.861	.734	.657	1.056
Asymp. Sig. (2-tailed)		.965	.052	.448	.655	.781	.215

The normality test of data (see table 3) shows that if the value of asymp. sig. (2-tailed) > 0.05, then the sampling data can be inferred as normally distributed. The results of data test using Kolmogorov-Smirnov method indicates that the value of asymp. sig. (2-tailed) of each variable is 0.965 for X1; 0.052 for X2; and 0.448 for X3; 0.655 for X4; 0.781 for X5; and 0.215 for X6. Also, because of the whole value of asymp sig. (2-tailed) is greater than 0.05, then the sampling data is normally distributed.

Table 4. Multi-collinearity test of independent variables

Model	Unstandardized Coefficients		Standardized Coefficients	T	Sig.	Correlations			Collinearity Statistics	
	B	Std. Error	Beta			Zero-order	Partial	Part	Tolerance	VIF
(Constant)	.291	.632		.461	.649					
Farmer's age (yr)	.007	.008	.179	.788	.438	.143	.153	.142	.625	1.599
Education (yr)	-.075	.106	-.153	-.702	.489	-.192	-.136	-.126	.682	1.465
Family member (person)	.021	.055	.074	.388	.701	-.017	.076	.070	.877	1.141
Oil palm area (ha)	.020	.049	.095	.411	.685	-.159	.080	.074	.608	1.645
Age of oil palm (yr)	.003	.014	.040	.200	.843	.003	.039	.036	.817	1.223
Productivity (ton/yr)	-.006	.004	-.426	-1.738	.094	-.282	-.323	-.313	.539	1.854

The presence of symptoms of multicollinearity in the regression model is shown by Tolerance Value <0.01 and VIF> 10 in the Collinearity Statistics column. SPSS output shows that the Tolerance value for each independent variable is 0.625; 0.682; 0.877; 0.608; 0.817; and 0.539 which are all more than 0.05. In addition, the VIF value of all the independent variables is less than 10. Thus, it shows that there is no multicollinearity among independent variables, i.e. the age of the farmer, the education level of the farmer, the number of family members, the area of the plantation, the age of the palm and the production of the oil palm.

According to the table of coefficients (see Table 5), then we obtained regression model as follows:

$$\boldsymbol{Y = 0.291 + 0.007\ (X1) - 0.075\ (X2) + 0.021\ (X3) + 0.020\ (X4) + 0.003\ (X5) - 0.006\ (X6)}$$

Where:

Y = Willingness to replant; where the value of Y is between $0 \leq Y \leq 1$; If the value Y = 0 or close to 0, the farmer is not willing to replant; If the value Y = 1 or close to 1, the farmer willing to do replanting.
X1 = Farmer's Age (year)
X2 = Farmer's Education Level: No School = 0; SD = 1; SMP = 2; SMA = 3; Bachelor = 4
X3 = Number of Family Members (person)
X4 = Area of Oil Palm Plantation in hectare (ha)
X5 = Oil Palm Age (years)
X6 = Palm Oil Production in ton/year

Table 5. Regression model to estimate the willingness of smallholders to participate in the replanting zonation scheme

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Correlations			Collinearity Statistics	
	B	Std. Error	Beta			Zero-order	Partial	Part	Tolerance	VIF
(Constant)	.291	.632		.461	.649					
Farmer's age (yr) – X1	.007	.008	.179	.788	.438	.143	.153	.142	.625	1.599
Education (yr) – X2	-.075	.106	-.153	-.702	.489	-.192	-.136	-.126	.682	1.465
Family members (persons) – X3	.021	.055	.074	.388	.701	-.017	.076	.070	.877	1.141
Oil palm area (ha) – X4	.020	.049	.095	.411	.685	-.159	.080	.074	.608	1.645
Oil palm age (yr) – X5	.003	.014	.040	.200	.843	.003	.039	.036	.817	1.223
Productivity (ton/yr) – X6	-.006	.004	-.426	-1.738	.094	-.282	-.323	-.313	.539	1.854

The model demonstrates an accuracy level of 66.67% from actual respondent data (n=33).

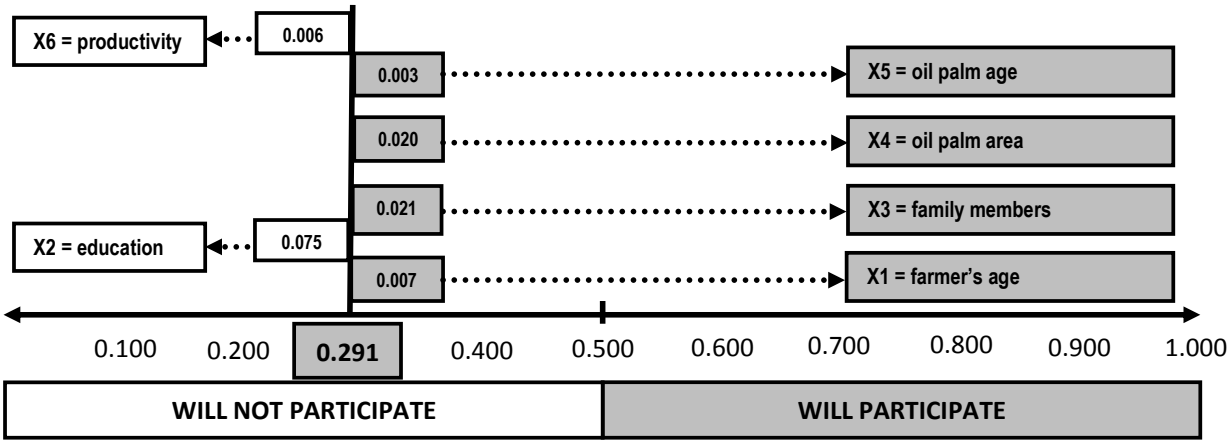

Figure 3. Factors influence to the willingness of smallholders to participate in replanting zonation scheme

The regression model indicates that willingness of smallholders to participate in replanting zonation scheme is positively influenced by the age of farmer, family members, oil palm area, and age of oil palm plantation. This means the older the farmer, the bigger the family, the larger the oil palm area, and the older the oil palm plantation have a higher opportunity to follow replanting zonation scheme. The willingness to participate in replanting zonation scheme, however, has a negative correlation with education level and oil palm productivity.

4. Conclusions

The Ministry of Finance launched a one million hectare replanting program for oil palm plantations throughout Indonesia, sourced from BPDP funds provided in grants for replanting worth IDR 25 million/hectare for palm oil aged over 25 years, and those aged over 10 with poor production. The Ministry of Agriculture in 2017 will conduct a replanting program for oil palm in Riau Province covering

an area of 20,780 hectares. The program will be successfully implemented only through replanting zonation. To make a proper zone for replanting, an inventory of oil palm plantations is necessary. Before undertaking an inventory of independent smallholders, however, it is important to prioritize the inventory of plasma and KKPA plantations.

The utilization of oil palm trunks requires government intervention and cooperation with interested private parties. Most of the oil palm trunks are currently waste, because of the discontinuity of supply. This occurs because the locations of oil palm replanting are scattered. Consequently, utilizing oil palm trunks will be very costly. On the other hand, leaving those trunks in the plantation area can attract pests and disease. The average smallholder plantation is 4-6 hectares, and the most common age of planted oil palm in the research site is less than 10 years old, planted in the period from 2001-2010. Production of palm oil per hectare is at 1 ton with an average price of IDR 1,300/kg. Most respondents are planning to cut and leave oil palm trunks, despite the risk pests and disease. Most smallholders have no objections if a company or other parties collecting and utilizing the oil palm trunks.

Through a mapping of oil palm plantations according to age groups in both Riau province and sample districts, palm production can be more measurable and replanting schedules can be easily monitored, both at the provincial and district levels. However, further study with a larger sample is required to improve the representativeness and reliability of this model. A reliable model is useful in predicting investment calculations in subsequent years, both for business actors and for policy makers. With a guideline on the timing of land preparation and replanting schedule of oil palm plantations, the opportunities for eradicating forest fires will be increased. The design of integration of the utilization of palm oil waste in the planning of raw material supply for timber industries *(RPBI kehutanan)* can be well structured. Implementation of replanting zone will make utilization of oil palm trunks feasible because it meets the economics of scale. A successful utilization of oil palm trunks and other biomass for timber industries can reduce illegal logging and maximize forest sustainability.

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