

Land Use Changes in Dharmasraya District, West Sumatra, Indonesia

Yurike¹, Yonariza^{2*}, Rudi Febriamansyah² and Syafruddin Karimi³

¹Department of Agricultural Sciences, Graduate Program, Universitas Andalas, Padang, 25163 West Sumatra, Indonesia

²Department of Agricultural Socio Economic, Faculty of Agriculture, Universitas Andalas, Padang, 25163 West Sumatra, Indonesia

³Department of Economics Studies, Faculty of Economic, Universitas Andalas, Padang, 25163 West Sumatra, Indonesia

ABSTRACT

Deforestation in the tropics is having significant ecological, economic and social impacts (global warming, biodiversity loss, respiratory problems, flooding). Previous research has indicated a close relationship between poverty and deforestation. This study was motivated by high deforestation rates in Dharmasraya, West Sumatra, Indonesia and a desire to test the assumption that poverty was driving this. Using a mixture of primary and secondary data and drawing heavily on 250 interviews with households living in and around the forest in Dharmasraya, this study describes the context, the forest clearing technique used by households, and analyses what drives deforestation in Dharmasraya. The findings showed that people had cleared as much as 80% of the forest using slash-and-burn techniques. Hotspots were observed from the NOAA satellite. It was found that deforestation in Dharmasraya was driven by middle-class households who control land with an average of 14.97 ha. This finding is significant because it suggests that a forest-related development programme should benefit society economically and socially, the latter in terms of awareness of the importance of protecting the forest because of its ecological functions.

Keywords: Development programme, hotspots, slash and burn technique, society

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E-mail addresses:

ryurike@yahoo.com (Yurike)

yonariza@agr.unand.ac.id (Yonariza)

r_febriamansyah@agr.unand.ac.id (Rudi Febriamansyah)

syafruddinkarimi@gmail.com (Syafruddin Karimi)

* Corresponding author

INTRODUCTION

Tropical deforestation can have a major impact on global warming, water cycle, biodiversity (Geist & Lambin, 2002), carbon emissions, and species lost (Rosa, Smith, Wearn, Purves, & Ewers, 2016). Deforestation, the change of land coverage from forest to non-forest, can have natural

or anthropogenic causes, temporary or permanent, and either legal or illegal conversion of land (Forest Watch Indonesia, 2014). Although tropical deforestation continues to the present day, the protagonists are changing. Previously the state and private sectors were dominant actors, whereas now households are increasingly playing an active role.

Most Asian countries have seen mass-deforestation (> 70%), Indonesia and Malaysia in particular, have seen rapid deforestation (Laurance, 2007). Deforestation in Indonesia is partly caused by widespread poverty and the conversion of the forest by the small-scale farmers. However, this is inversely proportional to deforestation in this case study at Dharmasraya.

Dharmasraya district in West Sumatra, Indonesia has 302,958 ha of forest or 31.12% of total forest cover in Indonesia. The Ministry of Forestry Decree No. SK.695 / Menhut-II / 2013 dated 21st October 2013 established the Production Forest Management Unit (PFMU) in Dharmasraya covering an area of 33,550 ha. Forest coverage within this PFMU has declined by 27,216.57 ha in recent years. Administratively, this PFMU area is the state forest which was awarded a timber concession licence by the government from 1972 to 2002. The high rate of deforestation occurred after the license ended.

There is a forest tenurial conflict where the local community claimed this land as their communal land while in the other FMU areas in Indonesia, land occupation occurred

due to weak forest management and people's need to earn a living. In the Dharmasraya PFMU the land has been occupied and traded for investment. However, forest exploitation in FMU Dharmasraya did not occur spontaneously. It is because in PFMU areas, customary regulations still apply, requiring all communities, and others wishing to manage forests to seek permission from their customary law functionaries. There is a conflict in terms of forest land ownership (Mutolib, Yonariza, Mahdi, & Ismono, 2017) and a new approach of forest encroachment occurs systematically and structurally where formal power holders seek to gain benefits from a vacuum in forest management.

Since 2000, these local communities have gradually converted forest land into oil palm and rubber plantations. Although according to the Government Regulation No.6 of 2007, converting forest land into rubber plantation is still allowed because rubber trees can be categorised as forest plants (Ministry of Forestry, 2007), but not those of oil palm. Based on that regulation, the unproductive forest in this study site has been transformed by local communities into productive rubber plantations.

The official rights to the PFMU land were actually given to the government-owned forest company (called INHUTANI) to convert that forest into industrial forest by enriching a specific kind of plant that is *Dipterocarpaceae* trees. Unfortunately, the local community occupied the forest because INHUTANI failed to develop this industrial forest and left the forest land unutilised

for a long period. However, the local communities have replaced rubber trees with oil palm which is not included in the category of forest plants. This was mainly due to the steady decline in rubber prices, while the price of oil palm is promising.

Forest and land rehabilitation is an effort to restore, maintain and improve the function of forests and land so that the carrying capacity, productivity and its role in life supporting system are maintained (Ministry of Forestry, 2008). Rehabilitation must work in tandem with changing the local community's behaviour. Yet, the factors influencing this behavior are not well understood and many forest rehabilitation programmes failed. It is clear that the factors contributing to this land use change are complex. The relationship between forest clearing and household variable are varied and depends on its management (VanWey, Ostrom, & Meretsky, 2005).

Moonen et al. (2016) concluded only few studies examined the motivation for deforestation due to lack of consistent datasets, especially in the local context. Kaimowitz and Angelsen (1998) reviewed more than 150 cases of tropical deforestation using an economic model. They criticised the multi-nation research due to its low data quality (Moonen et al., 2016). They also found a variety of reasons for deforestation and suggested the need to carry out research at the local level. In addition, Kaimowitz and Angelsen (1998) found that the land market was one of the main uncertainties that could be solved only by further research. This study helps fill this gap.

The paper argues the deforestation in Dharmasraya is strongly related to the role of the households in the forest. Therefore, it is important to find out the characteristics of households contributing to high deforestation rates. The present research examines the forest condition in Dharmasraya, clearing techniques used by the people, and analyses the drivers of deforestation drivers.

MATERIALS AND METHODS

This research was conducted from April to October 2016 in the Production Forest Management Unit (PFMU) Dharmasraya in West Sumatra Province, Indonesia. The study used descriptive method based on a survey. It used various data collection techniques, such as observation, secondary data collection, documentary, historical data, key informants, and household survey. Figure 1 indicates the research site.

Respondents were the households encroaching on the forest land. There are no accurate data about how many encroachers are in the PFMU are, either locals or those from other surrounding villages. This makes it impossible to determine the population of the encroacher. Therefore, this study used a snowball sampling technique (Thompson, 2002). Preliminary visits were made to areas within PFMU Dharmasraya to identify locations where local people clear the forest. We identified encroachers in the following locations; *Bulangan, Sungai Jernih, Bukik Gadang, Sungai Likian, km 25, Sakaladi, Bukik Batu Basalai, Sungai Siek*. The encroachers were identified by asking the

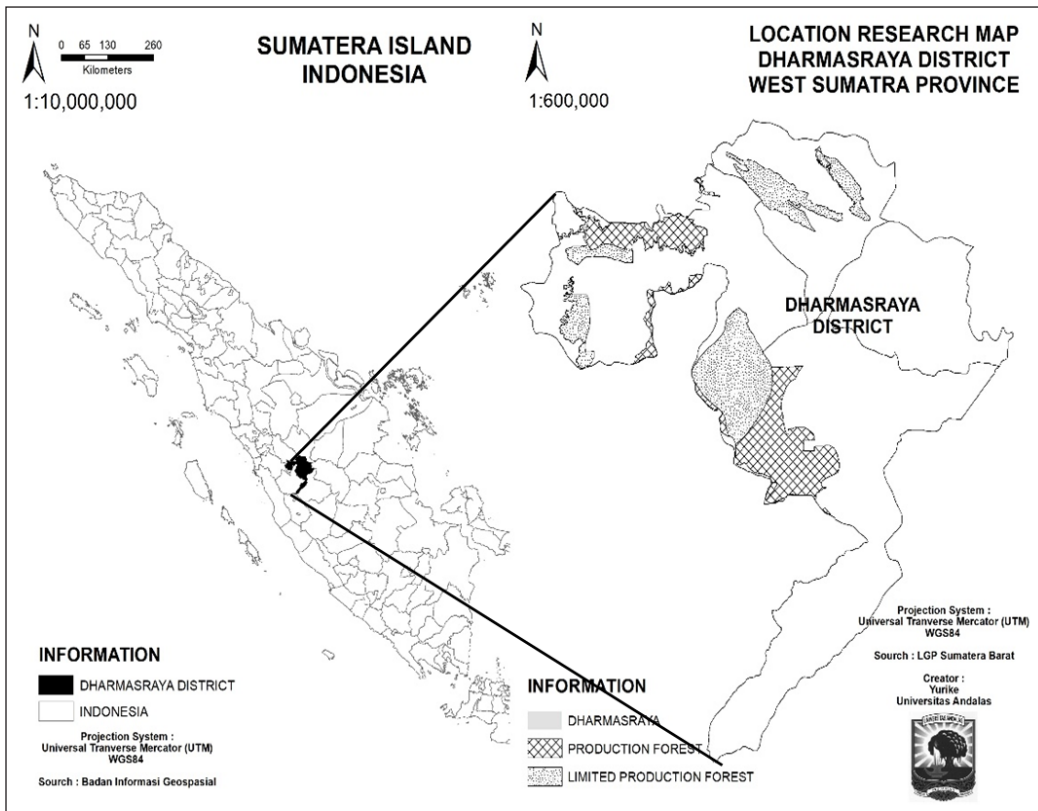


Figure 1. Location of the Production Forest Management Unit (PFMU) Dharmasraya, West Sumatra Province

owners of plot near their land. Overall, there were 250 respondents interviewed from various villages who occupied forest land.

Research variables were livelihood of respondents, plant type, road access condition, land cover change, forest clearing techniques used by households, asset ownership, forest fire hotspots, farmer's land occupation history (year), and size of land (ha). The data were analysed using descriptive quantitative statistics (Williams, 2007) by describing the collected data without generalising the findings (Sugiono, 2012).

RESULTS

Salient Features of Dharmasraya District

Dharmasraya is a district level administrative unit in West Sumatra Province, established in 2004. The current Dharmasraya District Government forest management strategy is a legacy of the previous administration. However, deforestation has increased during the current administration.

The trans-Sumatra highway passes through Dharmasraya and this district is located at the intersection of roads linking various cities in Sumatra Island, i.e., Padang the capital of West Sumatra,

Pekanbaru capital of Riau Province, and Jambi Province. One third of the district's population are migrants from various regions, who resettled in this area and opened new businesses. Previously, this area was still largely covered by forest. In 1979, the government sponsored a resettlement programme known as transmigration. In the first year, immigrants initially only relied on government allocations. After the aid ended people began to move to the plantation.

Most of the land use in Dharmasraya District is for agricultural purposes (89.98%). The plantation area is the largest with an area of 153,822 ha or 51.95% of the total area of Dharmasraya District, while land for rice field is 6,666.8 ha or 2.25% and community forest area is 61,274.8 ha or 20.69%.

Based on the research results, the occupation of forest encroachers are farmers (55.6%), entrepreneurs (18.8%), military personnel (2.8%), employees (20.0%), or have other occupations (2.8%). This showed that for 47.2 % of the respondents were not farmers, where gardening is an investment for them and not their main source of income. Those who have more financial capital tend to outsource the cultivation of their land.

Condition of the Forest

Dharmasraya forest is dry land forest with wet tropical rain forest on undulating areas. The Dharmasraya PFMU is home for about 80 species of plants. There is no competition among the species. The dominant species are Meranti (*Shorea leprosula*), Medang (*Litsia*

firma), Sikubung (*Litsea cubeba*), Kelat (*Xylopiya altissima*), Balam (*Palaquium walsurifolin*), Mempening (*Quercus lucida*), Arang-arang (*Diospyros puncticulosa*), Mahang (*Macaranga hypoleuca*), and etc. The tree species in this forest include rare species with small growing potency (Production Forest Management Unit, 2014).

The forest in Dharmasraya is relatively flat lowland forest (steep areas account for 11.8% of the forest, flat areas for 48.2%, and sloping areas for 40.1%). The area is easily accessible and only requires a low investment cost. Undulating parts of the PFMU are located near settlements, and it is easy to access the forest to harvest timber. More than half of the areas have been converted into plantation, the rest is secondary forest (logged over forest) and newly cleared areas.

The forest is easily accessible. A high demand for land, especially from newcomers, has intensified people's interaction with the forest. The economic activities within the PFMU areas are rubber and oil palm plantations. During the early stage of the rubber planting, the farmers also grow chilli and peanuts. The high interaction between people and forest has caused massive encroachment in PFMU areas (Figure 2 and Figure 3).

The ex-forest concession roads ease access to the forest and results in land conversion by small-holders. This also encourages the community members to clear the land. The local government also facilitated by constructing infrastructure

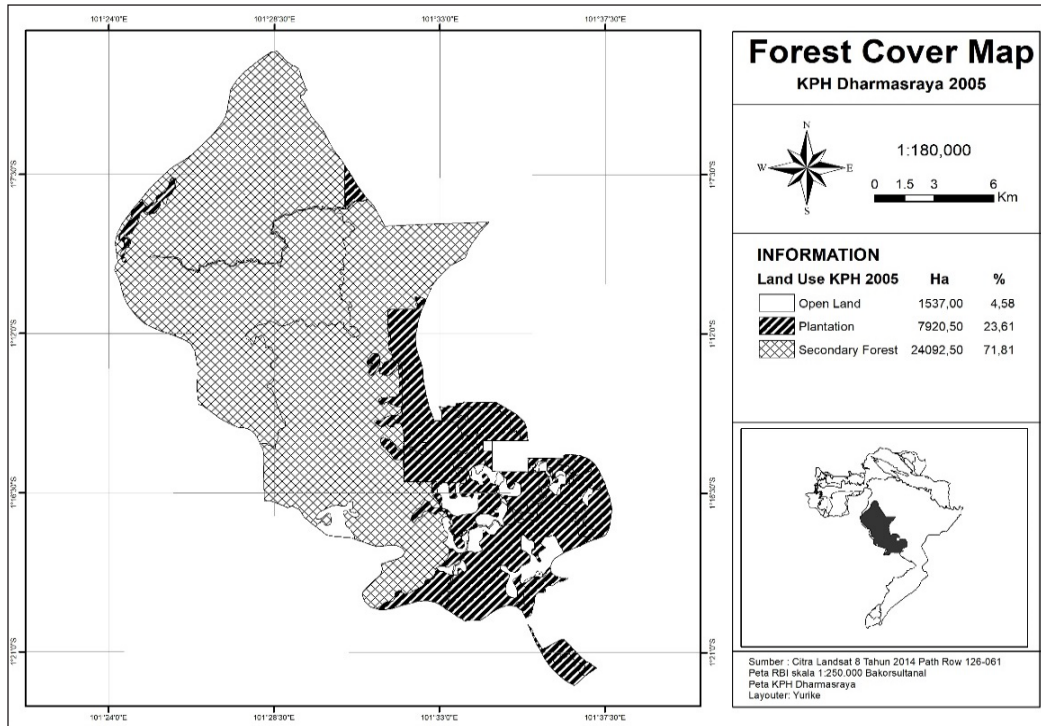


Figure 2. The extend of various forest cover in 2005

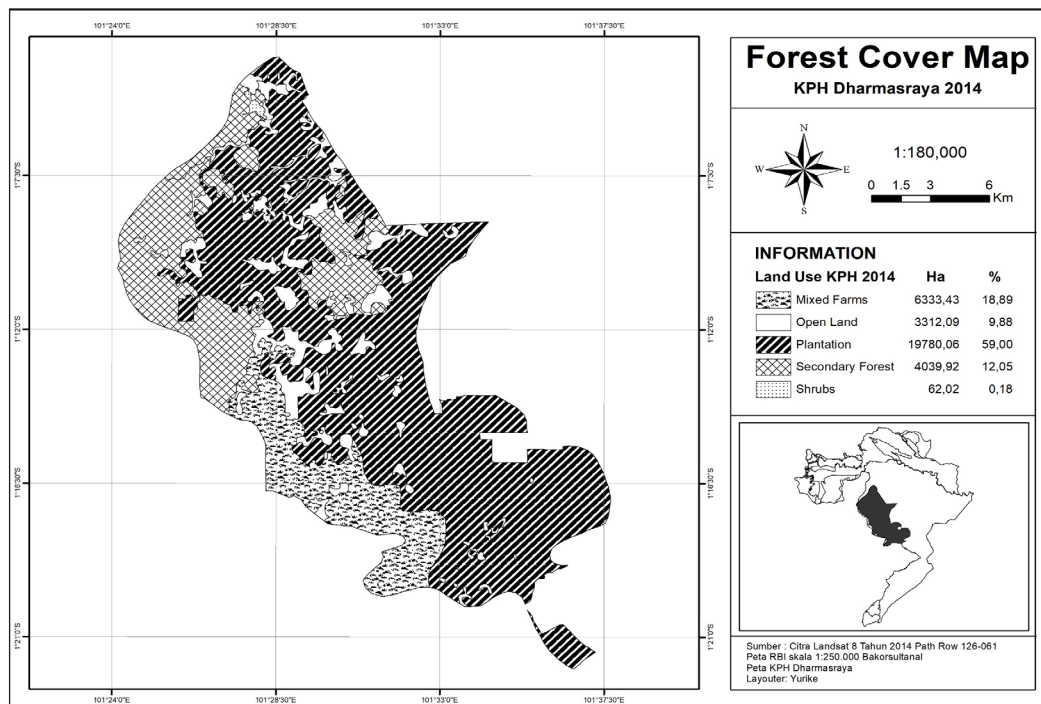


Figure 3. The extend of various forest cover in 2014

such as bridges and road to ease access to plantations in designated forest areas. The easy access obviously influences the forest cover. The negative effect is the loss of forest areas (Caliskan, 2013). This forest conversion, in turn, also affects the environmental and water management in Dharmasraya. It may cause Dharmasraya to be at high risk of environmental hazards, such as floods and soil erosion.

Land Clearing Technique

Communities surrounding the forest land are closely related to the utilisation of forest sources. This association can be seen from their existing assets (Table 1). Household assets that facilitate the plantation in the forest areas, including the possession of working tools, are shown in Table 1.

All farming households have, at least, one motorcycle, giving them easy access even though the distance to the forest can be more than 20 km from their settlement. They also have machinery for forest clearing such as chainsaw. For the rubber farmers, each household has supporting tools such as tapping knives. These assets are used to clear forest land for plantations.

Encroachers who have more financial capital tend to outsource work force to cultivate their land. Despite 47.2% of them not being farmers, the encroachers have agriculture tools and machinery needed to support their own plantations. The plantation is also managed by members of their family as well as by outside workers.

In regard to forest land clearing techniques, the local community in

Table 1
Household farm assets in Dharmasraya District

Farm related asset	Number (and percentage) of asset unit by number of household (n=250)									
		0	1	2	3	4	5	6	7	8
a. Hoe	n	2	235	13	0	0	0	0	0	0
	%	0.8	94.0	5.2	0	0	0	0	0	0
b. Oil palm Harvester	n	0	76	26	9	7	0	2	0	1
	%	0	30.4	10.4	3.6	2.8	0	0.8		0.4
c. Chainsaw	n	53	145	49	1	1	1	0	0	0
	%	21.2	58.0	19.6	0.4	0.4	0.4	0	0	0
d. Rubber tapping knife	n	53	6	93	61	31	3	3	0	0
	%	21.2	2.4	37.2	24.4	12.4	1.2	1.2	0	0
e. Grass cutter	n	102	143	5	0	0	0	0	0	0
	%	40.8	57.2	2.0	0	0	0	0	0	0
f. Manual saw	n	9	215	26	0	0	0	0	0	0
	%	3.6	86.0	10.4	0	0	0	0	0	0
g. Axe	n	13	220	17	0	0	0	0	0	0
	%	5.2	88.0	6.8	0	0	0	0	0	0
h. Motor bike	n	0	113	123	12	2	0	0	0	0
	%	0	45.2	49.2	4.8	0.8	0	0	0	0

Dharmasraya usually use the slash and burn technique. This method has been used for agricultural purposes, especially in plantation development (Yukili, Nuruddin, Adnan, Malek, & Razali, 2016). Initially, the big tree stands were cut and the timber sold. The remaining tree branches were cleared or left to dry naturally. The slashing uses axes, choppers and chainsaws. Vegetation drying rates depend on the season. They usually clear the land during the dry season when the remaining tree branches can be left to dry for a few days and then burned. The remaining

biomass is then cleared after the fire is out. The remaining tree branches are also used as a hedge or for firewood.

The local communities in Dharmasraya have been using this technique for a long time. The main reason for using the slash-and-burn technique is because it is simple, fast and practical. Forest fires are observed through the NOAA satellite and recorded by the West Sumatra Forestry Department. For example, the high number of forest fires spots from 2014-2016 is shown in Figure 4.

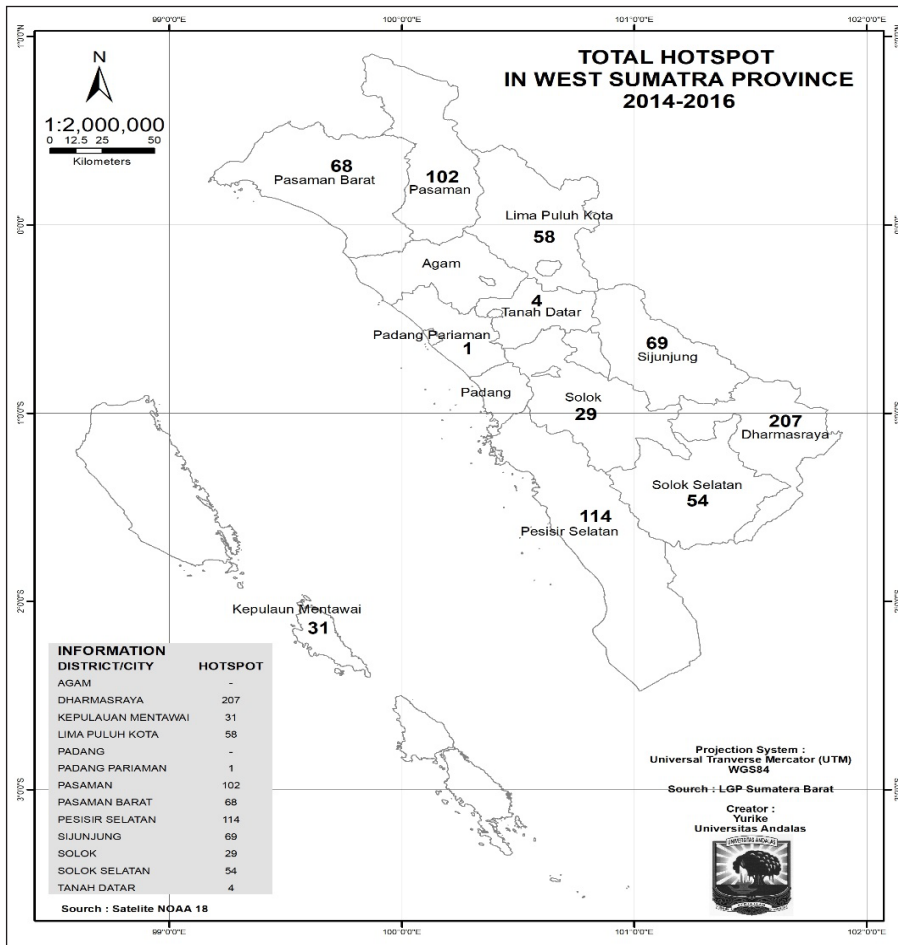


Figure 4. Occurrence of hotspots in West Sumatra 2014-2016

Forest fires are common in Dharmasraya in order to make way for plantations. The slash and burn technique has negative effects, such as environmental impacts on water supply, flooding, biodiversity loss and social effects. There are some negative effects of slash and burn including ecological (Goswami, Choudhury, & Saikia, 2012), land structural damage (Thomaz, 2017), and sedimentation risk (Wagenbrenner, Robichaud, & Brown, 2016). It also decreases soil quality and changes the soil structure in ways that lead to lower agricultural productivity (Tabi, Mvondo, Boukong, Mvondo, & Nkoum, 2013). N and P concentrations decrease after 3 years of slash and burn cultivation (Gay-des-Combes et al., 2017).

Deforestation Drivers at the Household Level

Forest clearing has increased over the last 10 years as shown in Table 2. There is a connection between the closure of timber concession and the time when local people begin clearing the forest for the small holder plantation. It was the time when the last forest management ended.

Table 2
Number of respondents by history of Smallholders' establishment Inside Forest Land

Year of plot clearance	Frequency (n)	Percentage (%)
before 2000	10	4.0
2001 – 2005	16	6.0
2006 – 2010	93	37
2011 – 2016	131	52
Total	250	100

According to local land tenure system, the forest is a communal property or *ulayat* land that is passed from one generation to the next in the Dharmasraya community. However, in 1972, the government granted timber concession to Ragusa Ltd covering an area of \pm 66,000 ha. Then in 2002, the license to this company was revoked by the government because they did not perform as expected. After 2002, a portion of this concession area was given to three plantation companies, namely PT. Incasi Raya, PT. SMP dan PT. AWB, to convert half of this forest land into oil palm plantations. Another portion of the forest concession area was given to three other forest companies (PT. Inhutani, PT. Dara Silva, and PT. Bukit Raya Mudisa) for industrial forestry uses.

PT. Ragusa actually left their forest concession area unmanaged prior to revoking of timber concession in 2002, and the local communities started claiming their traditional rights over forest land for their own benefits. They used the stub roads built by PT Ragusa to go deeply to the forest area for their own purposes. Table 2 shows the increase in local communities who taken over the forests use in this region since before 2000 up to 2016. They claimed these forest areas are their *ulayat* (indigenous customary rights). Currently, those local communities have planted most of these forest areas with oil palm and rubber.

Based on the state administrative regulation, these forest areas are state property but in fact, the local communities recognise it as *ulayat* land. If any investors were granted the right to exploit the

forest from the government, they still need to seek permission from the *ulayat* leader. This caused conflict between the investors and *ulayat* leaders that resulted in ineffective work by the company which has a government licence (Mutolib, Yonariza, Mahdi, & Ismono, 2016; Yonariza, Mutholib, & Yurike, 2015; Yurike, Yonariza, Febriamansyah, & Karimi, 2015). The more local communities occupied the forest for their own purposes, especially small-holders, the more difficult for the licensed companies to use their right to develop plantations. Table 3 shows the size of smallholder plantations in the forests that have already have government licence. This is the main factor causing forest degradation in this study site.

Table 3
Size of smallholder plantation area

Area (Ha)	Number of plantations	Percentage (%)
<10	184	74
11-20	35	14
21-30	15	6
31-40	4	2
> 40	12	5
Total	250	100

Mostly the respondents (74%) have plantations of less than 10 ha but some of them occupy more than > 11 ha (Table 3). The average land occupation is about 14.97 ha. For some households, the main purpose is to have a plantation to increase their level of income. Other reasons include

selling land, clearing an area of 10 ha with the intention of selling half of it to establish smallholder plantation. This clearly shows that plantation development is motivated by monetary factor although its economic value is much lower than that of conserving the forest (Ghani, Haron, Nor, Nuruddin, & Ahmad, 2007) if assessed from the overall economic value of the forest.

DISCUSSION

The findings of this study are consistent with others on the causes of deforestation. As suggested by Wunder (2000) and Kanninen et al. (2007), the main cause of deforestation is open access to forests. Chomitz, Buys, De Luca, Thomas and Wertz-Kanounnikoff (2007) added that road access is a major factor in deforestation. This is the situation in Dharmasraya where access road was provided by the former concession companies, making it easier for people to access the forest.

The finding of this study is also similar to that reported by Medrilzam, Dargusch, Herbohn and Smith (2014) who found that forest degradation in tropical peat land in Central Kalimantan, Indonesia was mainly triggered by community livelihood activity. However, this study also found another driver of change including uncertainty of land tenure, such as land right claims by the community based on customary law. Overlapping land right claims, like in Dharmasraya, reflect the weakness of existing law enforcement. This promotes the community to clear the land which leads to a significant decrease of forest cover.

Findings of the present study on the cause of deforestation at the household level are different from those reported by Zwane (2007) who studied the relationship between poverty and forest clearing in Peru. Zwane (2007) concluded that a small increase to household income will reduce deforestation. The government believes that it is important to increase household income to slow down the deforestation rate (Chomitz & Kumari, 1998). A similar case was reported by Miyamoto, Parid, Aini and Michinaka (2014), who look at poverty in Peninsular Malaysia poverty as a major factor leading to deforestation. The Dharmasraya case is different because many of the encroachers are middle-class people. This can be seen from the ownership of assets and the area of land cleared by households. The middle-class households are active in forest clearing.

These findings filled the research gap (Kaimowitz & Angelsen, 1998) but there is a need for more research at the local level. Moneen et al. (2016) stated relevant local context-specific information is needed for policy makers to design efficient, effective and equitable policies. This research helps fill the gap in information at the local level in Dharmasraya.

CONCLUSION

The physical changes in the forest area of an ex-forest concession in PFMU Dharmasraya areas contributed to a significant decrease in forest coverage. The forest encroachers in Dharmasraya are middle class people

who use a slash and burn approach for clearing the forest. There is a need for forest development programmes that not only improve income of the local community but also people's awareness of the importance of protecting the forest to improve its ecological function throughout the tropical region.

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