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Moving towards plantation: The impact of non-burning agricultural policy on land use and farmers' income in Pulang Pisau Regency, Central Kalimantan

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Abstract

Farmers in Central Kalimantan are accustomed to using fire in a limited and controlled way to clear the land before cultivation. This slash-and-burn was initially legal under Governor's Decree No. 52/2008 until it was completely banned following the major fires in 2015. This study examines the effects of the fire ban on land use and farmers' revenue in the Pulang Pisau regency. Data was collected through interviews and field observations. Respondents were selected from two villages, namely Talio Muara (transmigration village) and Pangkoh Hulu (native village), with 15 respondents for each village. In Talio Muara, there was a remarkable change in land utilization: agricultural land decreased by -44%, plantation land increased by 20%, and unmanaged land increased by 24%. In Pangkoh Hulu, the agricultural land decreased by -20%, while the plantation land increased by 17% and the unmanaged land increased by 3%. Farmers' revenue from land utilization in Talio Muara village decreased by -8% in 2017 compared to 2014, while in Pangkoh Hulu village increased by 13% in the same period. These results indicate that local farmers have adapted better to the burning ban than the transmigrants.

1. Introduction

Forest and land fires are a recurring occurrence in Indonesia, particularly during the dry season[1], and have been exacerbated by the establishment of plantations[2]. The 2015 fires were among the most significant in the country's history, resulting in financial losses of Rp 221 trillion[3] and were declared a national disaster, causing widespread economic, social, and environmental damage that hindered development. The fires are often caused by the practice of forest clearance through slash and burn, particularly in peat soil areas, making them difficult to contain. These fires have led to substantial deforestation, with significant impacts on the country's biodiverse forests. The 2019 fire outbreak, for example, devastated 1.6 million hectares of land, causing $5.2 billion in losses and affecting the health of 900,000 people due to respiratory problems caused by the smoke[4].

The term "disaster" often leads people to view fires as a natural occurrence, despite almost 100% of these fires are caused by human activities, either intentionally or due to negligence[5]. One example of intentionally caused fires is the burning used by communities living near forests to clear land for

agriculture or plantations. This practice, which has been passed down through generations, is believed to be more economical and efficient in clearing land[6]. Communities living near forests have developed unique methods to prevent the spread of fires beyond their desired boundaries. Firebreaks are one of the firefighting measures commonly used by these communities, consisting of a strip of unmanaged land or vegetation established or created to retard fire[7]. This approach is believed to be effective in solving the problem of forest fires. However, it is important to note that firebreaks should be constructed by removing vegetation and exposing bare ground or mineral soil to keep the fire from creeping across the firebreak and escaping from the burn unit. Land burning is often used by forest communities to develop or clear land for agriculture or plantations. The plant material left on the field after burning can be used as fertilizer to improve soil nutrients[8,9].

The practice of prescribed burning, also known as controlled burning, is legally permitted in Indonesia. According to Law No. 32 of 2009 concerning the Environment, clearing land by burning is allowed, with attention to local wisdom and certain regulations. In Central Kalimantan Province, burning land for agricultural purposes is permitted based on Governor Regulation 15 of 2010. Prescribed burning actually involves setting planned fires to maintain the health of a forest. This practice is also recognized in other countries, such as the United States[10,11]. The benefits of prescribed fire include reducing dangerous and intense wildfires, controlling invasive species, and creating a mosaic of habitats for various plants and animals[12]. Therefore, while prescribed burning is a legal practice, it is essential to ensure that it is carried out in accordance with regulations and best practices to minimize the risk of uncontrolled fires and maximize its environmental benefits.

The significant fires in 2015 resulted in the withdrawal of permits for land burning that was previously allowed, with violators facing criminal sanctions. The government has employed the police and army to enforce the ban on land burning, even threatening residents who burn rubbish in their yards with criminal penalties. As a deterrent, photos of residents burning land are displayed in strategic locations in the village (Figure 1). While this has led to a reduction in land burnings, it has also resulted in a decline in agricultural activities that were previously carried out through land burning. The enforcement of the no-burning policy is a key measure to manage wildfires, targeting both corporations and individual villagers and farmers who often use fire in their activities. Some farmers stated that they had lost their identity, namely from rice producers to rice buyers[13]. This has sparked a debate over the use of fire for agricultural land in Indonesia, with efforts being made to ban the use of fire to clear forested peatlands and promote sustainable alternatives to traditional burning methods.

Figure 1. Appeal not to burn forests and land from the police and photos of the perpetrators of forest and land burningin Pulang Pisau Regency

Some have suggested that permits for burning land for agricultural activities should again be granted to protect the identity of farmers, increase their income and preserve the local rice supply. However, this proposal has run into problems, such as insufficient local enforcement to ensure compliance and prevent misuse of permits[14]. At this point, it is crucial to have information on the impact of the ban on the use of fire in agriculture, especially on the economic aspects of farmers. Therefore, this study aims to assess the changes in land use before and after the introduction of the ban on land burning. It also aims to examine the changes in income before and after the ban on forest and land burning.

2. Methods

2.1. Study Area

This study took place in the Pulau Pisau region and focused on collecting socio-economic data in the villages of Pangkoh Hulu (native village) and Talio Muara (transmigration village) in the district of Pandih Batu (Figure 2). The selection of the study villages was based on the categorization of transmigration villages and indigenous villages, assuming that the inhabitants of these two villages use different agricultural practises. Data collection took place simultaneously in these villages between September and November 2018.

Pangkoh Hulu is home to a longstanding population of local inhabitants, predominantly from the indigenous Dayak community. The village encompasses a total land area of 35,000 hectares, with various land use allocations, including residential areas (40 ha), rice fields (511 ha), plantations (250 ha), cemeteries (10 ha), home gardens (20 ha), and office spaces (5 ha). Additionally, public infrastructure covers an extensive area of 34,164 ha. The main livelihoods in Pangkoh Hulu consist of male and female farmers, numbering 248 each, 32 civil servants, and one individual engaged in cottage industry crafting.

Talio Muara village has a land area of 1,730 ha. The village's land is utilized for various cultivation practices, including palm oil, sengon (*Albizia chinensis*), and other crops. The land cover consists of approximately 70 ha of oil palm, 240 ha of rubber, 70 ha of sengon, with the remaining por-

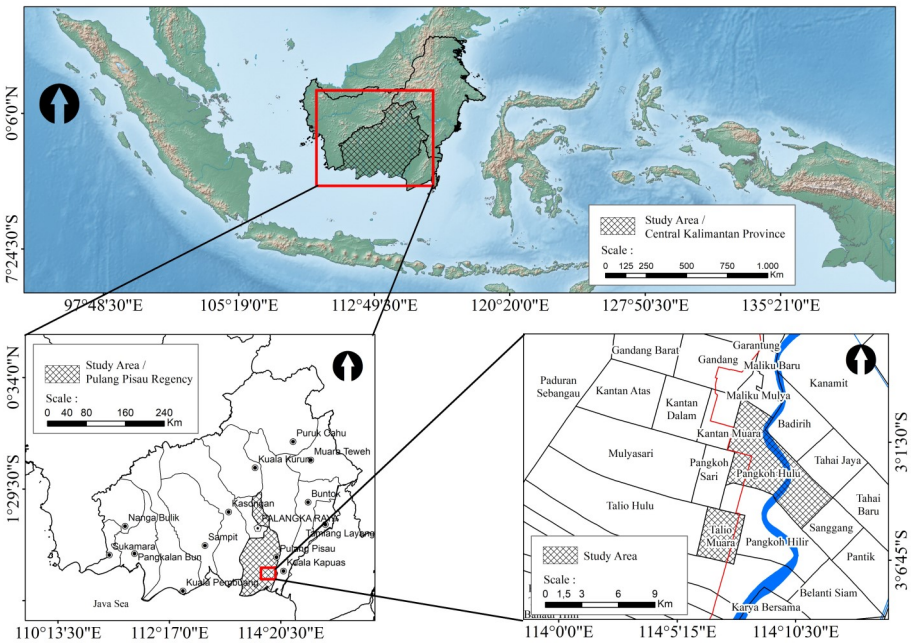

Figure 2. Research location map

tion allocated for agriculture and some left fallow. In 1980, the forest and swamp areas, originally inhabited by the Dayak Pangkoh tribe, were opened for transmigration from Central and East Java. The first wave of transmigrants arrived in 1981 from Kebumen (100 households), Semarang (50 households), Kendal (25 households), followed by the second phase with transmigrants from Ponorogo (50 households), Ngawi (25 households), and Blitar (75 households). The third phase welcomed transmigrants from Kebumen (100 households). In the period from 1981 to 1982, a total of 524 households participated in the transmigration program, including 10% from the local Dayak and Banjar communities. Each household received facilities such as housing, 1.5 years of living provisions, agricultural tools, rice and crop seeds, and more. This village is intended for agricultural purposes, mainly for rice cultivation.

2.2. Data Collection

Primary data is collected through observation and deep interview. Respondents were selected based on length of experience in farming, land ownership and willingness to be involved in research Collected information includes the time and frequency of land burning, the purpose of burning, administrative permits, positive and negative impacts of land burning, land area and ownership status, as well as land use before and after the policy. In addition, the data also includes changes in land use, revenue and cost of land use, as well as income from land use before and after the policy.

Secondary data used in this study includes the land use area of each respondent in 2014 and 2017. The 2014 data is used assuming that farmers were still practicing land burning for agricultural, plantation, or forestry activities. Meanwhile, the 2017 data is used assuming that land use decisions had been influenced by the land burning prohibition policy. These data were collected from the Statistical reports or agricultural data in the Pandih Batu District and in each village. The comparison of land use based on the types of farming and plantations due to the land burning prohibition policy is also part of the study.

2.3. Data Analysis

The data obtained is then analyzed descriptively using qualitative and quantitative methods. Qualitative descriptive analysis is carried out by data reduction, data presentation, and conclusion drawing. Meanwhile, income analysis is used to determine changes in farmers' income from land use before and after the land burning prohibition policy. The formula for calculating farmers' revenue is as follows:

$$NR = TR - TC$$

Where:
NR = Net revenue
TR = Total revenue
TC = Total cost

To account for the time difference between the data collected in 2014 and 2017, the values from 2014 are converted to constant prices in 2017 using the Indonesian GDP deflator published by BPS and the World Bank, as presented in Table 1.

Table 1. Indonesian GDP deflator figures

Year	GDP Deflator
2017	100,00
2016	104,26
2015	106,86
2014	111,20

Source: World Bank[15]

The income values from 2014 are converted to 2017 values using the following equation:

$$P1* = \frac{P1 \times \text{GDP deflator (2014)}}{100{,}00}$$

Where:
P1 = Revenue before the land burning prohibition policy (2014)
P1* = Revenue in 2014 measured based on 2017 prices

The income before and after the land burning prohibition policy can be determined using the following formula:

$$\Delta P = P2 - P1*$$

Where:
P1* = Revenue in 2014 measured based on 2017 prices
P2 = Revenue after the land burning prohibition policy (2017)
ΔP = Change in revenue (2017-2014)

A quantitative descriptive analysis is used to examine land use revenues. Land use revenue includes revenue from total land and revenue from productive land. The revenue from total land refers to the revenue from the total area owned by each farmer and includes the three types of land, namely agriculture, plantations and uncultivated land. On the other hand, the revenue from productive land is the revenue generated from the land used by each farmer. The period analyzed refers to the year 2017 and is measured in Rp/ha/year and Rp/ha/month. The formulas for analyzing the revenue from total land and productive land in Rp/ha/year are as follows:

$$\text{Revenue from total land} = \frac{\text{Revenue in 2017}}{\text{Total land owned}}$$

$$\text{Revenue from productive land} = \frac{\text{Revenue in 2017}}{\text{Utilized land area}}$$

In the meantime, the total monthly revenue from total land and the effective land in Rp/ha/month are calculated as follows:

$$\text{Monthly revenue from total land} = \frac{\text{Revenue from total land/year}}{\text{12 (months in a year)}}$$

$$\text{Monthly revenue from productive land} = \frac{\text{Revenue from productive land/year}}{\text{12 (months in a year)}}$$

3. Results and Discussion

3.1. Characteristics of Respondents

The respondents in this study totaled 30 farmers, with one village consisting of 15 farmers of varying ages. The age group of the farmers are presented in Table 2.

Table 2. Age group of farmers

Age (year)	Talio Muara (transmigrant village)		Pangkoh Hulu (native village)	
	Number of farmer	%	Number of farmer	%
20-30	1	7	-	-
31-40	4	27	3	20
41-50	2	13	5	33
51-60	8	53	7	47

Table 2 shows that the average age of transmigrant farmers is 20-30 years (7%), 31-40 years (27%), 41-50 years (13%), and 51-60 years (47%). Local farmers have a different age distribution, with 20% having 3 years of experience, 33% having 4-5 years of experience, and 47% having 5-6 years of experience. The two groups of farmers have different age distributions, with older farmers being more common in the local group. The age of the farmers has a significant impact on agricultural productivity. According to the interviews conducted in both locations, the local farmers' experience in agriculture is more experienced, with some farmers having up to 30 years of experience. Transmigrant farmers, on the other hand, have less experience in agriculture but have more experience in other sectors, which is likely to have a greater impact on their agricultural productivity. The experience in other sectors is also influenced by the implementation of land policies, which affects the use of land and the implementation of the policy of not burning the fields. The higher profitability of land use by local farmers compared to transmigrant farmers is influenced by the status of the land and their agricultural experience. Farmers with longer experience in managing the land will be more capable of managing their land more effectively, as they can influence the thinking of the farmers[16,17]. In addition to agriculture, farmers also have non-farming businesses to meet their needs and increase their income.

3.2. The Use of Fire in Agricultural Activities

Fires in Desa Talio Muara is only used once a year by the local farmers to clear the land. The burning period takes place during the dry season, namely in the months of May, June, July, August, September and October. The month of August is most frequently used for burning. The purposes and positive effects of burning include cleaning the soil, obtaining organic fertilizer, better and more fertile soils, reducing soil acidity, reducing pests, facilitating soil cleaning, improving crop quality, increasing land area, speeding up land preparation, and reducing labor and capital costs. The negative effects of burning land, on the other hand, include soil erosion, soil vulnerability, soil dehydration leading to crop failure, and air pollution. Out of the 15 farmers interviewed, 5 admitted that they burn their land together with neighboring landowners or farmer groups, while 10 farmers burn independently. Five farmers stated that there are no negative impacts of burning land.

In the village of Pangkoh Hulu, local farmers typically use fire for land clearing only once a year, during the dry season, particularly in the months of May, June, July, August, September, and October, with August being the most common month for burning. The positive impacts of burning include improving soil quality, rapid land clearing, reduced soil acidity, improved plant growth, easier land management, reduced costs, pest control, and minimizing the need for fertilizers. On the other hand, the negative impacts of burning are the spread of fire, damage to surrounding land, and health hazards. Out of 15 farmers interviewed, 11 admitted to burning land with neighboring landowners or farming groups, while 4 burned their land alone. Seven farmers stated that there were no negative impacts from burning the land.

The use of fire for land clearing by farmers is an inexpensive and fast method, especially for infertile land. Farmers who cultivate rice once a year burn the land to clear it after the harvest. Meanwhile, farmers who cultivate the land two or more times a year usually burn the land to grow horticultural crops, with the aim of eradicating weeds. This method helps improve soil fertility by increasing nutrient content and reducing acidity[18,19]. The slash-and-burn system used by farmers aims to increase soil fertility, eradicate weeds, reduce costs, reduce the emergence of pests and diseases, and increase food crop production. Land clearing using the slash-and-burn system has a positive effect on soil fertility[20,21]

3.3. Changes in Land Utilization due to the Prohibition on Land Burning

The changes in land utilization in the villages of Talio Muara and Pangkoh Hulu in 2014 and 2017 are shown in Figure 3. Total land area of the 15 farmers interviewed in the village of Talio

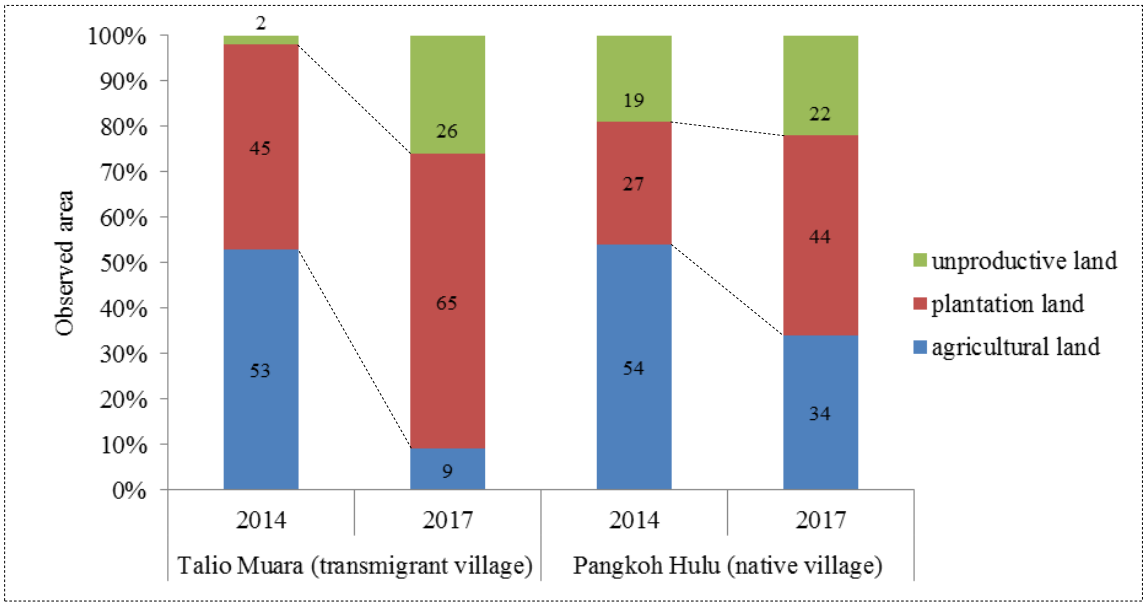

Figure 3. Changes in land utilization in the study area in 2014 and 2017

Muara is 53 hectares. The changes in land use are based on the assumptions of 2014 and 2017, which represent the period before and after the ban on land burning in 2015. The forms of land use have changed before and after the ban on land burning. In 2014, the land area for paddy fields and dry fields was 28 hectares or 53%, while in 2017 the agricultural land area was 4.75 hectares or 9%. This means that the use of agricultural land under the policy has decreased by 44% compared to 2014. The area under cultivation in 2014 was 24 hectares or 45% of the total area of 53 hectares, while in 2017 the area under cultivation increased to 34.5 hectares or 65%, an increase of 20% compared to 2014. Unmanaged land amounted to 1 hectare or 2% in 2014, while in 2017 it accounted for 13.75 hectares or 26% of the total area, an increase of 24% compared to 2014.

Farmers in the village have almost given up rice cultivation in the last 2-3 years. This is attributed to the ban on land burning imposed in 2016, which has led to crop failures. Reasons include the presence of tall or potential scrub, increased pest infestation of crops, high acidity and the need for larger amounts of medicines and fertilizers than before. Farmers felt burdened by the high costs, making crop maintenance with medicines and fertilizers suboptimal (Bani, 2018). These effects significantly reduced farmers' interest in cultivating agricultural land. It is mentioned that the difficulty in cultivating land arises from the fact that prior to the farmland preparation policy, burning was a common practice to quickly clear land for planting. This involved less cost and effort. As a result, the potential for fallow land increased over the years and the demand for plantation land also increased.

In addition, more and more plantations are being established, especially with sengon trees, because the undergrowth hardly affects the main plants and pest infestations are not too influential. Some interviewees mentioned that the focus of caring for plantation crops such as sengon and rubber is mainly in the initial phase of planting, about ± 3 months. The harvesting age of sengon is also not considered long, but it is still influenced by its maintenance system. With regular fertilization, some Sengon trees can be harvested at the age of 4-5 years. However, due to budget constraints, they do not fertilize consistently over the years and wait for the harvest results. This is supported by the fact that sengon is part of a government program that is growing with the establishment of a sengon factory in Pulang Pisau Regency. This has resulted in farmers increasing their interest in plantation land after the ban on burning compared to before.

Field observations indicate that the agricultural land, which is still cultivated on a small scale, was created by intercropping with plantation areas. A small portion of the land is dominated by unmanaged land, which is likely to be classified as plantation land over time. The income changes for

short-term or seasonal crops are significant and lower for these transmigrant farmers. Apart from farming to meet their needs before the income from the various crops, they also engage in other activities such as working as laborers, teachers, construction workers, BRG partners, cattle breeders, village officials, traders and start businesses such as making tofu, crackers and building swiftlets' nests. Farmers also mention that the number of migrants in this village has increased since 2016. Several farmers expressed hope to the researcher that the relevant government authorities would take more serious care of the farmers by providing subsidies for fertilizers, medicines and tractors for tillage. They would also like to see the reintroduction of burning permits specifically for agricultural purposes.

The increase in fallow land and the shift from agriculture to plantations are supported by farmers who state that December 2017 was a time of anxiety. The rains that should have nourished the rice stalks in the fields of Kapuas and Pulang Pisau residents seemed to rain indiscriminately. There were no more green paddy fields to be seen in the vastness. In fact, most of the fields were abandoned and overgrown with weeds. These uncultivated farmlands have begun and will eventually be converted into large-scale oil palm plantations. The Peat Restoration Agency (Badan Restorasi Gambut or BRG) states that the ban on burning in peatlands has caused many communities to complain because they can no longer optimize their land due to the ban on burning. Tilling land without burning is a challenge due to the accumulation of materials in the land which necessitates burning as a method. However, as time goes by, more and more people understand this and refrain from burning land. And as many communities' lands have now been converted into plantations, they are also more vigilant to the risk of land fires.

In Pangkoh Hulu, there were a total area of 56.5 hectares, which have undergone changes after the ban on land burning. In 2014, the agricultural area for paddy fields and dry fields was 30.5 hectares or 54%, while in 2017 it decreased to 19.25 hectares or 34%. This shows that the form of agricultural land use under the policy decreased by 20% compared to 2014. Plantation area in 2014 was 15 hectares or 27% of the total area of 56.5 hectares, while in 2017 it increased to 24.75 hectares or 44% of the total area, an increase of 17% compared to 2014. Fallow land covered 11 hectares or 19% in 2014, while in 2017 it increased to 12.2 hectares or 22% of the total area, an increase of 3% compared to 2014. From the survey results, it appears that the ban on land burning has influenced farmers' habits in clearing land for cultivation as it has become a common practice or tradition among local farmers in preparing land for planting.

Head of the farmers' group (Gapoktan) in Pangkoh Hulu village, Arsad, explained that rice farming remains the main focus of farmers in land utilization. This is because the land status in this village has long been converted from peat to paddy, which offers significant potential for income and demand. The percentage of land used for agriculture is declining, especially for crops such as maize, sweet potatoes and horticultural crops such as chili, peppers and beans, which are grown in open fields. Only a small proportion of paddy fields are lying fallow, due to rising costs and the inability to burn straw to improve soil fertility and reduce acidity.

Expansion of plantation land in Pangkoh Hulu comes from agricultural land (food and horticultural crops as well as upland rice grown on peatlands). The increase in unproductive land, including fields for food crops and horticulture, is derived from upland fields (food crops, horticulture) and paddy fields, which are affected by cost and maintenance. Most of the land is treated with tractors, and costs are rising for inputs such as medicines and fertilizers. Given these costs, not all farmers can afford to work their land with tractors. Some farmers clear the fields in the highlands manually by hoeing, cutting or waiting for rotting, while others use hoes. Local residents are no longer willing to burn their land in order to plant it, resulting in many fields being abandoned.

The prohibition of land burning also affects farmers' production in rice and upland farming/horticulture as well as food crops, as maintenance and fertilization are not optimal[22]. Pest control involves significant costs for manual land clearing, and sub-optimal work results in slightly lower

quality land. This is confirmed by the chairman of the Central Kalimantan Farmers' and Fishermen's Trust Group, who explains that the ban on land burning indirectly affects agricultural production. The focus of their main income is still on short-term or seasonal cultivation of rice fields. By changing rice varieties from local rice (harvested once a year) to high quality rice (harvested twice a year), farmers income in this village remained normal and even increased. Based on interviews with farmers, it is known that the main occupation in this village is farming, so interest in farming has not decreased significantly. The difference between these two villages is that the native farmers still focus on rice farming, while transmigrant farmers have almost given up rice farming. The factor that contributes to the agricultural area being larger in the local village than in the transmigration is the fact that the local farmers continue to use paddy fields sustainably, while the farmers in the transmigration use a smaller percentage of the land for food crops and horticulture.

3.4. Changes in Farmers' Income

Changes in farmers' revenue before and after the ban on slash-and-burn agriculture in the villages of Talio Muara and Pangkoh Hulu are shown in Table 3 and Table 4, respectively.

Table 3. Changes in farmer revenue in Talio Muara village

Respondent initial	Type of land use		Revenue (Rp/Year)			
	2014	2017	P1 (2014*)	P2 (2017)	ΔP: (P2-P1)	% ΔP
PWT	paddy, horticulture, rubber	rubber	16.346.400	9.800.000	-6.546.400	-40%
WNN	paddy, horticulture, rubber	paddy, rubber, sengon	28.800.800	8.000.000	-20.800.000	-72%
HSN	paddy, horticulture, rubber	rubber, sengon, horticulture, secondary crops	25.576.000	19.800.000	-5.776.000	-23%
TSR	paddy, horticulture, rubber	paddy, rubber, horticulture	26.910.400	13.700.000	-13.210.000	-49%
JMT	paddy, rubber	sengon, rubber	15.768.160	4.500.000	-11.268.160	-71%
STY	paddy, rubber, sengon	paddy, rubber, sengon	19.460.000	36.000.000	16.540.000	85%
SRJ	paddy, rubber, sengon	paddy, sengon, palm oil, rubber	16.124.000	43.500.000	27.376.000	170%
SPN	paddy, coconut, rubber	paddy, palm oil, rubber	22.662.560	17.750.000	-4.912.560	-22%
PRN	paddy, palm oil, rubber	paddy, palm oil, sengon, rubber	20.294.000	16.750.000	-3.544.000	-17%
RSK	coconut, paddy, horticulture	sengon, horticulture	8.601.320	4.500.000	-3.656.000	-45%
STM	paddy, horticulture, rubber	horticulture, secondary crops, rubber, sengon	14.344.800	13.000.000	-1.344.800	-9%
BSR	paddy, secondary crops, rubber	paddy, secondary crops, rubber, sengon	6.060.400	5.000.000	-1.060.000	-17%
SLM	rubber, paddy, horticulture	rice, rubber, secondary crops	11.342.400	16.000.000	4.657.600	41%
DWH	paddy, horticulture, rubber, palm oil	sengon, rubber, palm oil, paddy, secondary crops	12.232.000	11.770.000	-462.000	-4%
RSM	sengon, paddy, horticulture	sengon	9.452.000	14.000.000	4.548.000	48%
Total			253.975.240	234.070.000	-19.905.240	-8%

* Figures in 2014 have been converted into prices in 2017 using GDP Deflator

The total income of surveyed farmers in Talio Muara village from land utilization before the ban on land burning (2014) was Rp 253,975,240, while after the ban on land burning it was Rp 234,070,000, a decrease of Rp 19,905,240 or -8%. The number of farmers with increased income is 4

farmers (27%), while the number of farmers with decreased income is 11 people (73%). Based on the observations, the cultivation of paddy field in this village is not yet optimal and the status of paddy field is not permanent. Therefore, it can be said that the land is dry peat, resulting in poor drainage due to suboptimal cultivation.

One farmer interviewed stated that the ban on land burning in Talio Muara village, where the land is peat and the area of upland farming is larger than that of paddy fields, is significantly affecting the community's economy. This has led to a rise in unemployment and an increase in the number of migrants. Over the past three years, yields from both the rice fields and the upland farms have been less than satisfactory. The income from the utilization of the available land comes mainly from horticulture and the cultivation of food crops, with rice contributing only a small share. There is also production from rubber and sengon plantations.

Table 4. Changes in farmer revenue in Pangkoh Hulu village

Respondent initial	Type of land use		Revenue (Rp/Year)			
	2014	2017	P1 (2014*)	P2 (2017)	ΔP: (P2-P1)	% ΔP
DMN	paddy, sengon, horticulture	paddy, rubber, sengon	18.904.000	15.800.000	-3.104.000	-16%
NTR	paddy, horticulture	paddy, sengon	18.348.000	12.750.000	-5.598.000	-31%
MRH	paddy, horticulture	bare land	7.228.000	0	-7.228.000	-100%
HRA	paddy, rubber	paddy, rubber, sengon	27.800.000	30.000.000	2.200.000	8%
BYK	paddy, rubber	paddy, rubber, sengon	31.291.680	50.700.000	19.409.000	62%
ACN	paddy, vegetables	paddy, sengon	17.947.680	8.500.000	-9.447.000	-53%
SLH	paddy, secondary crops	paddy, secondary crops	6.727.600	6.250.000	-447.000	-7%
DBR	paddy, rubber	paddy, palm oil, rubber	22.240.000	21.500.000	-740.000	-3%
HMD	paddy, rubber	paddy, rubber, sengon	16.680.000	15.500.000	-1.180.000	-7%
KTI	paddy, secondary crops	paddy	13.566.400	10.500.000	-3.066.000	-23%
RTN	paddy	paddy, rubber	11.120.000	17.750.000	6.630.000	60%
JND	paddy, sengon, horticulture	paddy, rubber, sengon	10.564.000	27.500.000	16.936.000	160%
SDR	paddy, sengon	paddy, sengon	40.032.000	41.000.000	968.000	2%
BGN	paddy, sengon, secondary crops	paddy, sengon	10.008.000	25.500.000	15.492.000	155%
MSD	paddy, rubber	paddy, rubber, secondary crops	19.960.400	23.250.000	3.289.000	16%
Total			272.417.760	306.500.000	34.082.240	13%

* Figures in 2014 have been converted into prices in 2017 using GDP Deflator

Total income of farmers in Pangkoh Hulu village from land utilization before the ban on land burning (2014) was Rp 272,417,760, while after the ban on land burning it increased to Rp 306,500,000, an increase of Rp 34,082,240 or +13%. The number of farmers with increased income is 7 people (47%), while the number of farmers with decreased income is 8 people (53%). The increased income is largely due to the variety of paddy fields, which was influenced by the change of rice varieties under the Ministry of Environment and Forestry's program – from local rice (harvested once a year) to high quality rice (harvested twice a year). The special variety of rice grows in con-

stantly wet paddy fields, which fits well with the current condition of the farmers' paddy fields in Pangkoh Hulu. Some farmers earn a high income from selling sengon. The harvest is planned and organized annually according to the cultivation plan that has been introduced since the ban on land burning.

3.5. Revenue from Land Utilization

Farmers in Kalimantan, especially at the research site, usually have several plots or 1 large piece of land. Some of this land is cultivated and used for the family's livelihood. Other parts are left as is, due to limited manpower to cultivate it, limited working capital, or because they are saved for future needs. Land that is farmed and provides benefits to farmers is called productive land, while land that is not farmed is called unmanaged land. Total revenue is the income from all types of land owned by farmers, i.e. agricultural land, plantations and unused land. To better compare farmers' income from land use with other types of labour or with land use for non-agricultural activities, we present the data in units commonly used in society. Revenue from productive land use is the income that farmers earn from cultivating land for agricultural and plantation activities. The revenue from land use of the surveyed farmers in Talio Muara and Pangkoh Hulu villages is shown in Table 5.

Table 5. Revenue form land utilization in Talio Muara village and Pangkoh Hulu village in 2017

Item	Unit	Talio Muara village	Pangkoh Hulu village
Land size	ha	3,5	3,8
Productive land size*	ha	2,6	3,0
Total Revenue	Rp/year	15.604.667	20.433.333
Revenue from total land	Rp/ha/year	4.631.833	7.133.459
	Rp/ha/month	385.986	594.455
Revenue from productive land	Rp/ha/year	6.366.397	8.931.973
	Rp/ha/month	530.533	744.331

The key metrics examined in Table 5 include land size, productive land size, total revenue, revenue from total land, and revenue from productive land, which provide a detailed insight into the economic landscape of these villages. Talio Muara village shows a spectrum of land sizes among the respondents, ranging from 2 to 5 hectares. The size of productive land, i.e. practical and usable land, ranges from 1 to 4 hectares. The total revenue per year shows significant variability, with the lowest value at Rp 4.5 million and the highest at Rp 43.5 million. Revenue from total land ranges from Rp 750,000 to Rp 8,375,000. Revenue from productive land, i.e. the income from the effective land area, varies between Rp 62,500 and Rp 1,166,667. The average effective land area of the village is 2.6 hectares with an average total income of around Rp 15.6 million, an income from total land area of Rp 4,631,833 and an income from productive land of Rp 530,533.

In Pangkoh Hulu village, respondents also show a diverse of land sizes, ranging from 1 to 19 hectares. The size of productive land ranges from 1 to 13 hectares. Revenue from productive land varies from Rp 0 to Rp 2,125,000, reflecting the specific contributions of usable land areas. The average size of productive land in Pangkoh Hulu is 3.0 hectares with an average total revenue of about Rp 20.4 million. Revenue from total land amounts to Rp 7,133,459, and the revenue from productive land is reported at an average of Rp 744,331. These figures show the complicated financial web woven by land utilization in both villages in 2017.

Based on the provincial minimum wage (UMK) in Central Kalimantan, which refers to Governor Regulation No. 40 of 2017, the UMK in the agriculture, livestock, forestry, hunting and fishing sectors is Rp 2,294,126 per month. This finding is supported by the National Labor Force Survey (Sakernas) from 2016 and 2017, which shows that the wages of agricultural workers in Central Kalimantan are still well below the regional minimum wage (UMR) or considered low. Furthermore,

farmers' income from cultivating land for agricultural activities in Pangkoh Hulu village (a native village) is higher than farmers' income in Talio Muara village (a transmigration village), although both are still below the district/city UMR. This indicates that the cultivation of agricultural land and plantations is not sufficient to meet the basic needs of farming families, prompting all farmers to engage in non-agricultural activities.

Insufficiency of agricultural land and plantation cultivation to meet the basic needs of farming families is a complex problem that can be observed in different regions of the country and has multiple implications[23,24]. This challenge can be attributed to interrelated factors rooted in the socio-economic and environmental landscape. First, agricultural productivity and subsistence farming play an important role. In many cases, the productivity of agricultural land is low due to factors such as outdated farming methods, limited access to modern agricultural technologies and inadequate irrigation infrastructure[25–27].

Secondly, there are limited sources of income. Farmers in rural areas are accustomed to relying on nature to meet their needs[28,29]. They are not used to technology and intensive farming. Consequently, when farming methods change, many farmers find it difficult to adapt. Nevertheless, this study shows that local farmers are more adaptive to the ban on the use of fire in agriculture. This is because these farmers lack skills other than farming[30]. Despite the obstacles they face, they continue to strive to turn agricultural land into a source of income. On the other hand, transmigrant farmers have more skills beyond farming, allowing them to change occupations when farming is no longer considered profitable.

4. Conclusion

The implementation of the no-burning policy has significantly affected land utilization patterns in study villages. The examination of land distribution in Talio Muara and Pangkoh Hulu reveals significant changes from 2014 to 2017. In Talio Muara, a remarkable shift occurred with a -44% reduction in agricultural land, a 20% rise in plantation land, and a 24% increase in fallow land, indicating a clear influence of the burning ban. Similarly, in Pangkoh Hulu, there was a -20% decline in agricultural land, a 17% surge in plantation land, and a 3% increase in unmanaged land, underscoring the tangible impact of the burning prohibition policy on land utilization in both villages during the specified period.

The analysis of revenue data from land utilization in both villages provides a detailed insight into the economic dynamics of these regions. Talio Muara showcases diverse land sizes, ranging from 2 to 5 hectares, and productive land from 1 to 4 hectares. The total revenue spans a wide spectrum, emphasizing economic diversity. Similarly, Pangkoh Hulu village exhibits a range of land sizes and productive land, with an average total revenue of approximately Rp 20.4 million. Comparing these findings to the provincial minimum wage (UMK) in Central Kalimantan, agricultural workers' wages in the region remain notably below the UMK. Moreover, the income from cultivating land for agriculture in Pangkoh Hulu surpasses that of Talio Muara, although both fall below the city UMR. This highlights the challenge where agricultural land and plantations inadequately meet farming families' basic needs, prompting reliance on non-agricultural income.

The insufficiency of agricultural land and plantation cultivation to meet basic needs is a multifaceted issue rooted in socio-economic and environmental factors. Low productivity, outdated methods, and limited access to technology pose significant obstacles. The reliance on nature as a primary income source in rural areas complicates adaptation to changes in farming practices. Local farmers exhibit adaptability to the ban on using fire, demonstrating resilience in transforming agricultural land into income sources. In contrast, transmigrant farmers, possessing diverse skills, can transition to alternative occupations when agriculture becomes economically unviable. This study underscores the complex challenges faced by farming communities and the varied strategies employed to navigate them.

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