

Article

Dynamics of Rural Economy: A Socio-Economic Understanding of Oil Palm Expansion and Landscape Changes in East Kalimantan, Indonesia

Arya Hadi Dharmawan ^{1,*}, Dyah Ita Mardiyansih ², Heru Komarudin ³, Jaboury Ghazoul ⁴, Pablo Pacheco ³ and Faris Rahmadian ²

¹ Department of Communication and Community Development Sciences, Bogor Agricultural University, Bogor 16680, Indonesia

² Center for Agricultural and Rural Development Studies, Bogor Agricultural University, Bogor 16129, Indonesia; dyahita@apps.ipb.ac.id (D.I.M.); faris_rahmadian@apps.ipb.ac.id (F.R.)

³ Center for International Forestry Research (CIFOR), Bogor 16115, Indonesia; h.komarudin@cgiar.org (H.K.); P.Pacheco@cgiar.org (P.P.)

⁴ Department of Environmental Systems Science, ETH Zurich, 8092 Zurich, Switzerland; jaboury.ghazoul@env.ethz.ch

* Correspondence: adharma@apps.ipb.ac.id

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Abstract: The fast-growing palm oil economy has stimulated a significant expansion of oil palm plantations in Indonesia. The uncontrolled development of large oil palm plantations has raised complex socio-ecological issues, including changes of ecological landscapes, organization of production, and farming household livelihood systems. For two oil palm villages with different ecological settings, this article describes changes in land cover, how production is organized, and the income structure changes due to rural economic development. The research used survey approaches and analysis of earth maps, assisted by data obtained from satellite imagery. A qualitative approach was also used to support a survey via in-depth interviews. The research was carried out in two oil palm economy-based villages of Kutai Kartanegara District, of the Province of East Kalimantan of Indonesia. The first village is located very close to the center of regional administration and has evolved into a non-farming economy. In contrast, the other village is more isolated and solely relies on farming activities. The study found that changes of land cover caused by oil palm expansion could be categorized into two types, concentrated and spotted, following the influence of oil palm investment activities. It was also found that organization of the production of most smallholders existed in two types of arrangements, partial and total integration of production. From the perspective of livelihood, two different types of income structures emerged, diversified and uniform. This article concludes that responses of smallholders to palm oil spread varied depending on the ecological setting, the existence of the already established plantation economy in the region, the capacity of the smallholders to diversify economic activities based on palm oil, and the exposure to external economic activities.

Keywords: oil palm expansion; organization of production; land-cover changes; income structure change; farming households

1. Introduction

1.1. Background

The high economic value of palm oil in the international market has led to vigorous growth in the palm oil sector in producing countries, encouraging investment and generating benefits via

fiscal earnings and regular income streams for a large number of large- and small-scale growers [1]. However, the development and uncontrolled expansion of oil palm plantations have often come at the expense of forests and local communities [2,3].

In Indonesia, oil palm plantation areas were first developed during the 1970s, although only during the past ten years have they expanded at a relatively faster rate, resulting in ecological and socio-economic impacts [4–6]. In a dynamic and gradual process, the development of this crop began when the government, during the 1970s and 1980s, issued policies to encourage investments in large-scale agriculture plantations, further boosting local development and opening up isolated areas [7]. Combined with community development, the nucleus of the oil palm estate and transmigration programs was introduced in 1986. Plantation expansion was further driven by other policies issued in 1999 and 2002 that increased the area that one company or group of companies was able to control in a single province from 1000 to 20,000 ha. In the 20-year period from 1990 to 2010, palm oil plantations have grown from around 1.1 million to 8 million ha [8], and reached 12.3 million ha in 2017 [9]. Initially concentrated in Sumatra, palm oil plantations have subsequently expanded to Kalimantan.

In recent decades, palm oil plantation development has become the meeting point of development approaches for rural development, rural economic development, and strengthening of rural community livelihood systems. The development of oil palm plantations is part of a significant policy for rural development implemented by the Government of Indonesia, with the main strategy aim of an export-oriented plantation sector under contracted farming arrangements. The strategy involves both large-scale plantations and smallholders in a single organization of production, with the goal to provide benefits to family farm businesses, mainly in Sumatra and Kalimantan [10–12]. This policy increases risks associated with landscape and land-cover changes, leading to problems of forest loss, biodiversity loss, and agrarian conflict. In many cases, rural regional development based on the plantation development approach—in this case, using palm oil—has led to spatial conflict between the forestry and agriculture sectors, and has raised questions about ecosystem sustainability, particularly in regard to its social and ecological aspects [13,14]. The development of palm oil plantations as a rural and regional development strategy is believed to have succeeded in strengthening the economic and livelihood systems of rural–agricultural communities, but at the expense of changing social structures and ecologies in the affected regions [15,16].

The debate over the significant role of palm oil in Indonesia’s national economy, and the need to conserve forests and the environment, has intensified and shaped the narratives for the country’s palm oil sector, paving ways for reconciling environmental and economic interests [17]. There is potential for palm oil to benefit smallholders and to contribute to poverty reduction, although urgent and substantial efforts are needed to evaluate existing development models and establish smallholder-friendly production regimes to avoid unsustainable livelihoods, socioeconomic disparity, and environmental damage [11,18].

1.2. Problem Setting

The risks associated with the expansion of oil palm plantations for the environment are remarkable. This expansion, which has occurred either legally or illegally, has led to deforestation, biodiversity losses, increased carbon emissions, and fragmented landscapes [19,20]. Furthermore, it has brought about changes in the functioning of forest ecosystems, ecosystem services, hydrology, and carbon stocks [3,21–24].

Meanwhile, the expansion of palm oil plantations has also resulted in substantial land-cover change across the country. Positive expectations about profits from traded vegetable oil have strongly encouraged smallholders to convert land into oil palm [6,23,25]. While private enterprises are responsible for the bulk of the environmental impacts, smallholders exhibit higher annual rates of expansion compared to private enterprises [5].

Earlier studies have demonstrated the impacts of oil palm plantation expansion on socio-economic factors, as well as on palm oil’s organization of production. Social impacts of palm oil plantations

are not uniformly positive, nor negative, and have varied systematically with biophysical locations and baseline socioeconomic conditions [18]. Oil palm is a financially lucrative land use option for smallholders that improves household living standards and nutrition, and it significantly and positively affects the entire expenditure distribution. However, the net livelihood outcome of oil palm adoption varies depending on household attributes [26].

Oil palm development, together with the arrival of more intensive, capital-dependent, modern, and permanently settled cropping systems, has also adversely impacted the local culture, local livelihoods, and social structure of rural communities and indigenous people. The combination of these factors has caused traditional farming and traditional agriculture practices to disappear [26–28] and led to changes in the organization of society. Most farming communities and agricultural indigenous people have been unable to adapt to industrial agriculture due to the different methods of organizing production and resources, forcing them to be isolated or marginalized from the plantation economic system [29,30].

Changes in land use and local agrarian structures have led to agrarian conflicts, land disputes, and/or livelihood clashes involving different interest groups [11,31,32]. Land use changes often result in a change in traditional livelihoods and socio-ecological systems across rural landscapes [18,33] and at different scales, including the landscape, household, and village scales [34,35].

Household livelihood systems of smallholders tend to depend more on a single source of income. Household income diversity is decreasing and becoming subtler. Livelihood uniformity is expected to reduce livelihood resilience and increase vulnerability [21,29,36]. The impacts of oil palm expansion may be said to create issues relating to landscape change, organization of production, and livelihood, as outlined in Figure 1.

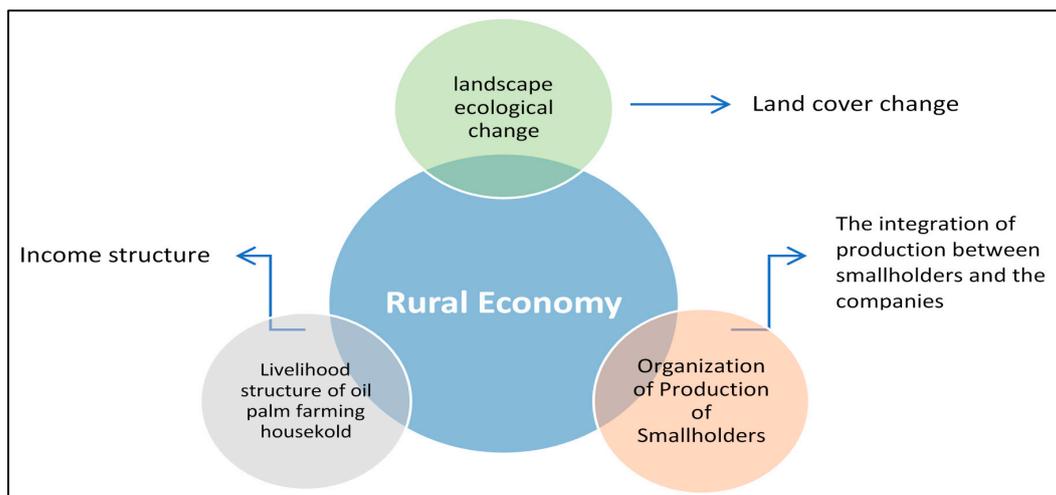


Figure 1. The rural economy and changes in landscape, organization of production, and livelihood.

The dramatic changes undergone by rural economies, and the impacts of oil palm expansion on landscape ecology and forest cover, as well as rural socioeconomic systems, have been extensively examined by numerous scholars in recent years [11,18,26,27,33,37]. Therefore, this paper aims to examine how oil palm plantations and their expansion stimulate socio-ecological (land-cover change) and socio-economic (organization of production and livelihood changes) factors in rural areas.

2. Methods

The research was conducted in Kutai Kartanegara district, East Kalimantan province, with two villages selected as case studies: Muara Kaman Ulu in Muara Kaman sub-district and Long Beleh Haloq in Kembang Janggut sub-district. Both sub-districts are located relatively far from the center of Kutai Kartanegara Regency (Tenggarong). The distance from Tenggarong to Muara Kaman Ulu is 56.6 kilometers, and from Tenggarong to Kembang Janggut is 188.1 kilometers. These villages

were selected because they represent two different socio-economic environments with respect to oil palm plantations.

Muara Kaman Ulu is characterized by rural communities with a heterogeneous economy. The rural households of Muara Kaman Ulu have long participated in the non-farm economy (logging, mining, fish processing, etc.). Muara Kaman Ulu has an area of 339.86 square kilometers and is located in the center of Muara Kaman District. The village is dominated by ethnic Kutai (Malay) with a population of 3609 people (932 households). The village has a relatively dense population of 10.6 people/square kilometer because most of the settlements are collected along the Mahakam River and its tributaries. In the Muara Kaman sub-district there are several large-scale oil palm companies, as well as numerous smallholder plantations which, as at 2018, comprised a total of 712 hectares owned by 206 families. A small portion of the oil palm plantation area is located in the village of Muara Kaman Ulu, comprising of 34.5 hectares owned by 15 farmers [38].

Long Beleh Haloq, which is somewhat isolated from regional economic growth, is located 65 kilometers from the center of the Kembang Janggut sub-district. The village represents a structurally homogeneous community with a high dependence on local natural resources as a basis of making a living. With an area of 673.60 square kilometers and a population of 3599 people (1019 households), Long Beleh Haloq is one of the two most sparsely populated villages in Kembang Janggut sub-district (five people/square kilometer). The village is mostly inhabited by the Modang Dayak ethnic group, and oil palm and dry rice field farming activities dominate. The village location is part of two oil palm plantation companies which, in Kembang Janggut sub-district, cover an area of 34,932 hectares. The existence of these two companies encouraged the development of community oil palm plantations which, as at 2018, reached 5382 hectares owned by 1442 farmers, including those from Long Beleh Village, Haloq [39]. Oil palm is a substantial driver of the economy for Long Beleh Haloq.

This research combined qualitative and quantitative approaches. In the qualitative approach, a case study strategy used in-depth interviews to collect perspectives or ideas from the key informants, including five formal leaders (government administration at the district, sub-district, and village levels, head of the village, and a cooperative), six informal leaders (customary leaders and community leaders), and three private representatives (staff of oil palm companies). This approach was used to obtain information about the village history, smallholders' organization of production, and their unique livelihood systems, particularly in relation to changes resulting from oil palm plantation development.

The quantitative approach used a survey method at the household level, involving 51 household respondents in Muara Kaman Ulu and 48 household respondents in Long Beleh Haloq. The survey was conducted between September 2016 and March 2017. The primary data from the survey were used to develop an index of diversity of income sources. This index was measured to understand the complexity of rural socio-economic changes or impacts due to oil palm expansion in the region. The diversity index for household livelihood income sources was measured using the Simpson diversity index with the following formula:

$$\text{Simpson diversity index} = 1 - (\sum(n/N)^2) \quad (1)$$

where n is income derived from one source and N is total household income. The livelihood diversity index has a value between 0 and 1; index values of 0 signify no diversity in household income sources, while index values of 1 signify an infinite diversity of household income sources. Thus, as the value of the diversity index increases, the diversity of household income sources increases.

To understand land-cover change, Landsat images covering Kutai Kartanegara district were also used. The method was the same approach used as the national method for land-cover analysis, namely, SNI 764,591:2014, the method used formally by the Ministry of Environment and Forestry and the Geospatial Information Agency of the Republic of Indonesia. The classification method is based on 23 land-cover classes, and was used in this research to examine spatial patterns of expansion and land-cover changes between 1990 and 2015. Other secondary data analyzed and superimposed on the interpreted map included land-cover and forestland maps produced by the Ministry of Environment

and Forestry of the Republic of Indonesia, specifying different forest zones in East Kalimantan. We also used administrative boundaries and a base map at the scale of 1:50,000 to guide our analysis.

3. Results

3.1. Oil Palm-Driven Land-Cover Change

The expansion of oil palm plantations in Indonesia has been a dynamic and gradual process. The development of oil palm plantations began when the government, during the 1970s and 1980s, issued policies to encourage investment and utilize forestlands for other land uses, including agriculture plantations. Aiming to further boost local development and open isolated areas, the government then promoted the development of plantations, combined with community development, through nucleus estate and transmigration programs in 1986. Plantation expansion was further fueled by other policies issued in 1999 and 2002, increasing the area that one company or group of companies may control in one province from 1000 to 20,000 ha. In the 20-year period from 1990 to 2010, oil palm plantations have grown from around 1,126,677 to 8,075,000 ha [8], reaching 12,298,450 ha in 2017 [9].

Initially, 70% of Indonesia's oil palm plantations were concentrated in Sumatra, with the remainder in Kalimantan. Although not as significant as in West Kalimantan or Central Kalimantan, the development of oil palm plantations has been slowly increasing in East Kalimantan since the 1990s and is now widespread. In East Kalimantan, the fastest development of oil palm plantations is in Kutai Kartanegara district, which ranks second for the area of oil palm plantations after the East Kutai district. In 2017, Kutai Kartanegara district had an oil palm plantation area of up to 217,000 ha [40].

Oil palm plantations in Kutai Kartanegara district began to develop in the 1990s. They were concentrated in two sub-districts, namely, Muara Kaman and Kembang Janggut. Within 25 years, there was a significant increase in the area of oil palm plantations. This was marked by changes in land cover, especially from forests to plantation areas (Figure 2).

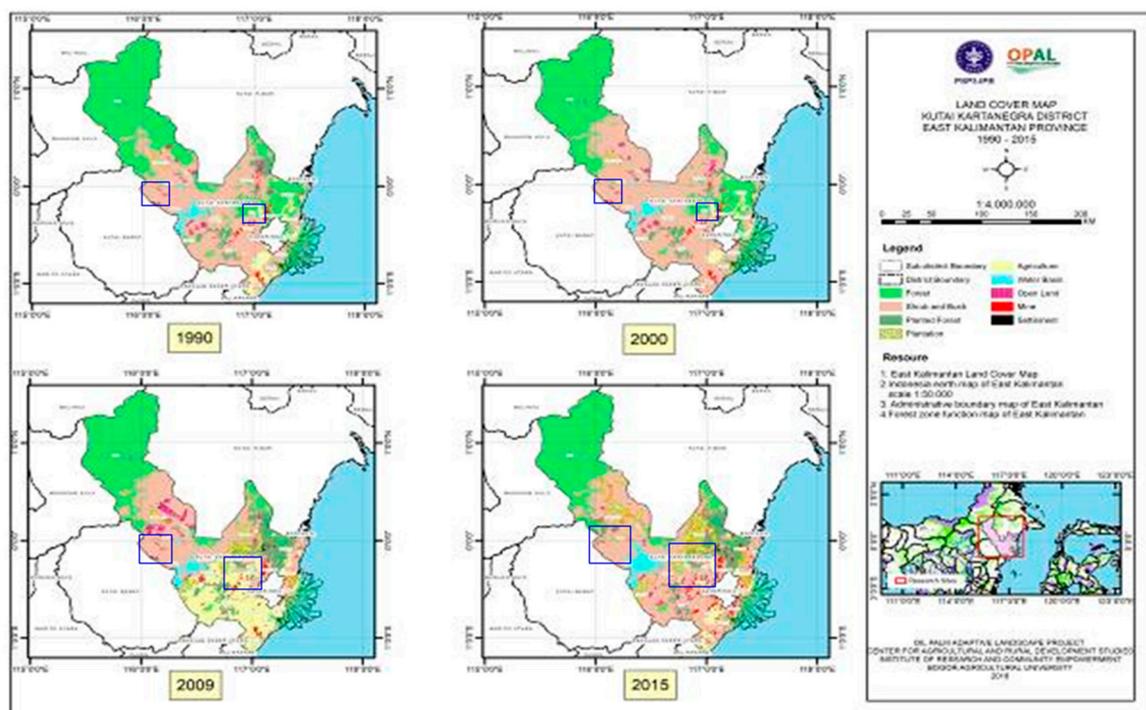


Figure 2. Land-cover changes in Kutai Kartanegara district from 1990 to 2015. Source: Secondary data, processed, 2018.

As illustrated in Figure 2, the land-cover change towards oil palm plantations took place gradually. The land was converted from primary forest into secondary forest or shrubs and bushes after being abandoned by logging companies once their concessions expired. Secondary forests and bushes were usually turned into open land or cropland, which were then converted into plantation land.

The rate of land clearing from forests to plantations was considered slow between the 1990s and 2000s. During this period, there was an obvious decrease in forest that became bush and open land. Landscapes with open land emerged more extensively between 2000 and 2009, while land covered with plantations increased rapidly between 2009 and 2015. The types of plantation commodities in Kutai Kartanegara district were relatively diverse (oil palm, pepper, cocoa, coconut, etc.). However, the area of palm oil reached more than 85% of the total area of plantations in the district in 2015. Thus, it can be said that the increase in overall plantation area means an increase in the area of oil palm plantations.

In Indonesia, the palm oil commodity boomed in the 2000s. This led to a massive expansion of land covered by oil palm in Kutai Kartanegara district between 2000 and 2009. Crude palm oil (CPO) prices, which peaked in 2011, strongly encouraged expansion of oil palm plantations between 2009 and 2015. The consequent rapid and massive development in Muara Kaman and Kembang Janggut sub-districts was the starting point of oil palm plantations in Kutai Kartanegara district (Figures 3 and 4).

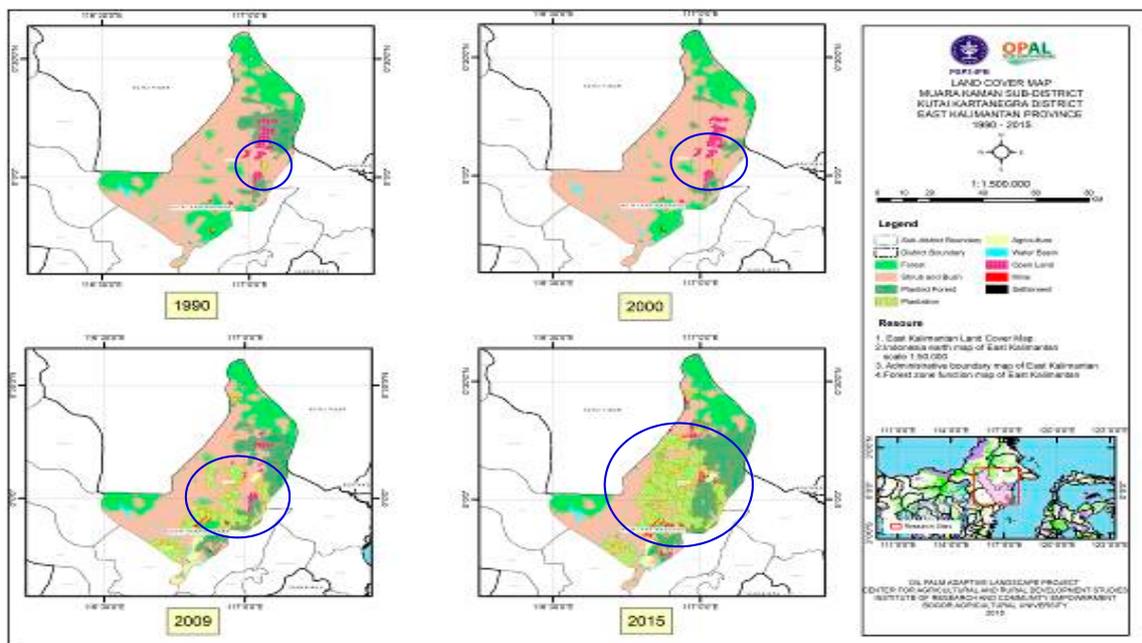


Figure 3. Land-cover changes in Muara Kaman sub-district between 1990 and 2015. Source: Secondary data, processed, 2018.

In Kutai Kartanegara District, two main sets of actors played significant roles in driving the expansion. First, large-scale companies expanded plantation areas up to as much as 159,000 ha in 2015. Second, independent smallholders expanded their plantations up to 21,000 ha in 2015, doubling the smallholder oil palm plantation area compared to 2009. Smallholders who built the oil palm plantations outside the nucleus estate scheme area were the first to develop independent oil palm plantations. In general, farmers started planting oil palm commodities after recognizing the economic potential of oil palm fruit. Farmers gained their knowledge from experience as laborers in an oil palm plantation company or as part of a nucleus estate partnership between the company and smallholders.

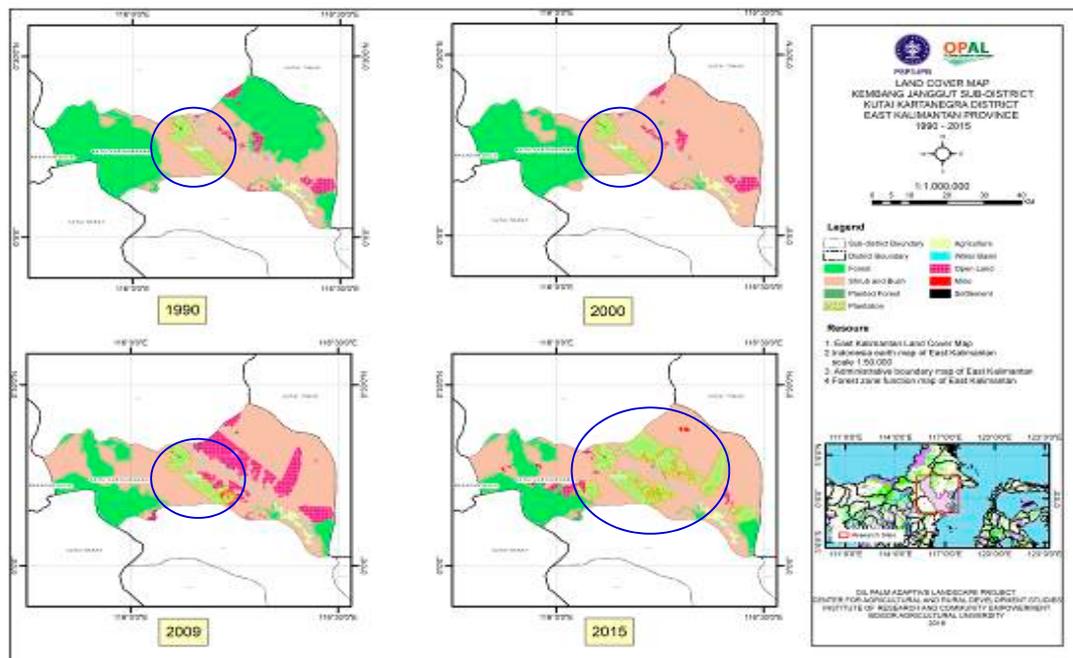


Figure 4. Land-cover changes in the Kembang Janggut sub-district between 1990 and 2015. Source: Secondary data, processed, 2018.

However, a lack of financial capital has been a serious obstacle for smallholders to use land legally and to provide the plantation with certified seeds. Furthermore, independent smallholders struggle to expand oil palm plantations because the expansion encroaches on conservation areas, peat deposits, and forests, causing agrarian conflicts. Independent smallholders usually plant on land illegally (in forest land area) and use non-certified seeds, which undermine sustainability principles [41,42].

Expanding oil palm plantations directly or indirectly encourages changes in ecological and livelihood systems in rural areas. Changes in the ecology of forests, as a result of the introduction of monoculture plantations, reduce flora and fauna diversity, and also eliminate livelihoods for rural households.

3.2. Dynamics of Rural Landscape

Smallholders in Muara Kaman and Kembang Janggut sub-districts expanded oil palm plantations and replicated production modes in two different ways. First, via concentrated expansion, which occurred between 1990 and 2015, and started from a single point and then spread throughout the entire area (see Figures 3 and 4). During this period, individual smallholders grew oil palm crops by adopting monoculture systems that large-scale oil palm plantation companies nearby were already developing. Smallholders simply replicated the method of production practiced by the companies on a small plot of land. The second type of expansion can be classified as spotted expansion, which occurred after concentrated expansion ended in 2015. This type of expansion was characterized by oil palm plantation development being randomly scattered across the district (see Figure 2).

The changes in land use and cover due to plantation expansion were also obvious. The expansion of oil palm plantations in Muara Kaman and Kembang Janggut sub-districts shows strong characteristics of evolutionary change from one land-cover type to another between 1990 and 2015. Between 1990 and 2000, landscapes in the area were mostly dominated by shrubs and bushes. During this period, oil palm had not yet expanded significantly. This finding confirms earlier studies indicating that the largest sources of land for new plantations were actually from shrubs and grassland, accounting for 48% of all oil palm plantation areas [43]. Between 2000 and 2015, oil palm plantations expanded onto land previously covered by shrubs and bushes. Thus, the landscape changed to oil palm plantations at

the expense of shrubs and bushes, as well as of forests (Figures 3 and 4). The landscape experienced evolutionary changes from one land-cover type to another via different pathways:

- (1) Primary forest, dominated by a largely continuous tree canopy cover, changed into secondary forest, land with reduced land-cover density, or logged-over forests, as a result of earlier timber-logging activities. When forest concessions were no longer effective, either due to mismanagement of forest resources or other reasons, forests or logged-over areas were left unattended and degraded. Such areas became subject to conversion to non-forest lands (other land uses). Pursued by large-scale investors as key actors and enabled by regulation, they then turned into large-scale oil palm plantations, which led unavoidably to deforestation. Land-cover change was strongly driven by large scale companies controlling substantial amounts of capital for investment.
- (2) Former cropland (upland rice fields or horticultural areas) was converted into small oil palm plantations. This pathway did not necessarily involve formal or administrative procedures with the land authority or the government, and was usually followed by independent smallholders as key actors involved in the oil palm expansion. Land-cover change happened as an increasing number of farming households converted the land use.
- (3) Former secondary forests, long left unmanaged and already converted to shrubs and bushes, were taken up for cultivation without permission from the land authority or the government, becoming cropland in support of basic food security needs via direct encroachment. Eventually, the cropland was converted into oil palm plantations. This pathway generally applied to smallholders who took over the forest land surrounding their place of residence. Land-cover change took place due to oil palm smallholders expanding their land under oil palm cultivation.

Two types of expansion of smallholder oil palm plantations can thus be identified: spotted and concentrated oil palm expansions. Spotted expansion refers to the development of plots of plantation that were scattered across a large area. Concentrated expansion refers to oil palm plantation development by smallholders undertaken in collaboration with or adjacent to large-scale estate companies. Under the concentrated type of expansion, oil palm production and processing were much more easily organized. In contrast, under spotted expansion, production was more difficult to organize, and was only made easier with the use of middlemen.

The study of these two sub districts reveals a meaningful lesson about the typology of the expansion of oil palm plantations in East Kalimantan. The pattern of land-cover change indicates not only the trajectory of landscape change, but also the primary actors and the resulting socio-economic consequences. The reverse is also true: land-cover change caused by oil palm expansion can indicate what socio-economic factors contributed to that change. With this typology, it is understood that no single type of oil palm expansion occurred in East Kalimantan.

3.3. Oil Palm-Driven Rural Economy Changes

3.3.1. Changes in Oil Palm Organization of Production

The expansion of oil palm plantations in the Kutai Kartanegara district since the 1990s has brought about not only physical landscape or ecosystem changes, but has also created social change in rural areas. The change began from the large-scale companies, which invested significant amounts of money to build processing plants and to develop the oil palm plantation area from 1000 to 10,000 ha for each individual business unit. Large-scale companies involved plasma smallholders to create an integrated self-contained production system.

In Long Beleh Haloq village, this specific organization of production became prevalent. Smallholders and large-scale companies established a single entity business unit for production at the beginning of the plantation initiative. Both sides had a common understanding of how to run and manage an integrated business model for an oil palm plantation, which is generally known as a nucleus

estate and smallholder (NES) scheme (Perusahaan Inti Rakyat, PIR). This is one of the contracted farming typologies classified by [44–47]. In this context, a nucleus is a large-scale company that plays a role as a processing and marketing unit in which its existence is partly or entirely dependent on smallholders, i.e., independent plasma smallholders.

Thus, two important players in oil palm partnership production were present, i.e., the large-scale oil palm companies and the independent plasma smallholders. Large scale oil palm companies were capital intensive business units, which operated processing plants of CPO supported by a large-scale plantation estate of a specific region. The independent plasma smallholders usually operated two to five hectares of oil palm plantation at each individual smallholder business unit. They supplied raw materials to the large-scale company in the form of palm oil fresh fruit bunches (FFB). Under the principles of the nucleus estate and smallholder partnership, both players were linked interdependently to support a forceful integrated organization of the production of CPO. The independent plasma smallholders ensured sufficient amounts of raw material were supplied to the company to run the CPO processing plant. In exchange, the smallholders received money to ensure their livelihoods.

Despite its solidity, some critical issues of the oil palm partnership system often occurred on the ground. Communication gaps between the participating partners and financial transparency over FFB, as well as insufficient technical support received by independent plasma smallholders from the company, were dominant challenges. In many cases, some issues were not resolved, resulting in prolonged disputes between the two sides.

In addition, there was also another type of smallholder, i.e., independent smallholders, who worked autonomously against large-scale companies. They developed oil palm plantations without any help from others involved in the oil palm sector. The smallholders managed their own plantations individually but coordinated production in a farming group. The independent smallholders organized labor and activities ranging from planting to harvesting. They shouldered the risk of any costs incurred in relation to cultivation. Due to a lack of financial capital and technical skills, most independent smallholders were pushed to cooperate with large-scale companies via local middlemen. In contrast to independent plasma smallholders, this type of organization of production might be considered as a partial integration management system. They were not in direct control of large-scale oil palm companies.

3.3.2. Changes in Income Structure of Oil Palm Farming Households

Increased investment in land encourages changes in rural livelihood systems, particularly for those that depend on natural resources such as forests, upland farming, and agriculture [48]. These findings hold true for both Muara Kaman Ulu and Long Beleh Haloq villages, whose communities depended on forests and rivers as the main sources of their livelihoods. Ecological changes were particularly pronounced in Muara Kaman Ulu, with the emergence of lake and river pollution from land clearing for oil palm plantations. As stated by community leaders in Muara Kaman Ulu (Pak PY, 53 years old):

“People here all rely on rivers. Men generally take the fish, and women process the fish. We all work together because that is what nature has given to Muara Kaman Ulu, and that has been done hundreds of years since our ancestors first came to Muara Kaman Ulu. In fact, these conditions did not even change during the massive logging era in Kutai Kartanegara Regency. However, when oil palm companies began operating here, people can no longer rely on rivers. Rivers are changing, fish are getting harder and harder to find, and people need other alternative source of income.”

In total, 90% of households that formerly relied on fisheries switched their livelihoods to other activities. However, the livelihood transition at Muara Kaman Ulu is quite dynamic and diverse. In general, many male residents began working with the independent and/or plasma oil palm plantations, but also continued to work in natural resources extraction activities such as fisheries and agriculture (cassava, langsat, etc.). By comparison, many female residents worked as oil palm company laborers and started small-scale grocery businesses in the village and sub-district [49].

Ecological change associated with oil palm plantation expansion has affected household livelihood systems in rural areas. Smallholder households have become highly dependent on livelihoods sourced from oil palm, making them more vulnerable to rural shocks, e.g., a drop in the price of FFB. As stated by the head of the village in Long Beleh Haloq (Pak MSR, 56 years old),

“In the past, people went to the fields in the morning, went to the river in the afternoon, and cooked all the items they collected from the fields and rivers at night. Now, we only go to oil palm plantations and eat the food we buy from the grocery stalls for almost every day. In the current situation, oil palm is the only solution. Our village is surrounded by oil palm plantations, there is no market for pepper, fruits plant is almost worthless, and we all end up planting oil palm.”

People in Long Beleh Haloq no longer have the power to make choices about their livelihoods, and have become dependent on a single source of income with high uncertainty: when the global price of FFB goes down, their income also linearly decreases. To neutralize the negative impacts of relying on a single income stream, Frank Ellis argued that households should develop a strategy to diversify their livelihoods [50].

According to Ellis [50], livelihood strategies are distinguished by their reliance on natural resources. Livelihoods based on natural resources include extraction of natural resources, agriculture, fisheries, and animal husbandry. These contrast with livelihoods not based on natural resources, such as trade, services, business, and transfer payments. Scoones [51] distinguishes between three types of livelihood strategies: intensification and intensification of agriculture; diversification of livelihoods; and migration. Ellis [50] defines livelihood diversification as a process whereby rural households build an increasingly diverse portfolio of activities and assets to survive and to improve their standard of living.

Learning from the study of Scoones, Ellis, Ellis and Freeman, and Dharmawan [50–53], this research result categorizes somewhat different findings into four dominant types of sources of livelihood, i.e., forest and environmental services, agriculture, oil-palm related economic activities, and non-farm economic activities. These sources comprise a diversified livelihood strategy in oil palm farming households. With these four livelihood sources, regions developed a diversification strategy used to adapt to rural shocks, seasonality, and crises faced by rural households [54–57].

There are two theses related to livelihood strategies undertaken by farming households. In the first, increasingly diversified farming households are considered to be wealthier. This relates to the accumulation of assets enabling rich farming households to develop new sources of livelihoods. In this context, the households choose to use their assets to increase income by diversifying livelihoods [50].

In the second case, poorer farming households have diversified their income sources since they lack income to support the household's survival. In this context, households do not view diversification as a positive choice. Instead, they are enforced to adopt diversification as a survival strategy to meet their essential needs (see [50]).

The expansion of oil palm plantations by companies and communities has driven changes in the livelihood system of oil palm-based rural areas. Even so, the changes that occur might differ from one community to another. Oil palm plantations expanded massively in the Kutai Kartanegara district, as shown in Figures 3 and 4. However, most small-scale farming households living in the Muara Kaman Ulu village did not respond the arrival of oil palm so enthusiastically. They preferred to keep the oil palm solely as an additional source of income to diversify the sources of their livelihoods. This was somewhat different to the experience of Long Beleh Haloq village. Most small-scale farming households in this area did not have any other choice regarding the source of income. The only land resources available forced them to take up oil palm as the only income source (Figure 5 and Table 1). As seen in Figure 5, farming households of all strata living in Muara Kaman Ulu diversified their sources of income. They did not rely only on a single source of income. Oil palm was simply an additional income source within the total farming household livelihood system. The situation was totally different with Long Beleh Haloq, whereby only small-scale farming households of lower stratum

had strong multiple sources of income. The contribution of oil palm was dominant in its support of the income structure of small-scale farming households in the middle and upper strata of Long Beleh Haloq. This showed that the arrival of the oil palm economy impacted the income structure of most farming households in the area where palm oil has played major role.

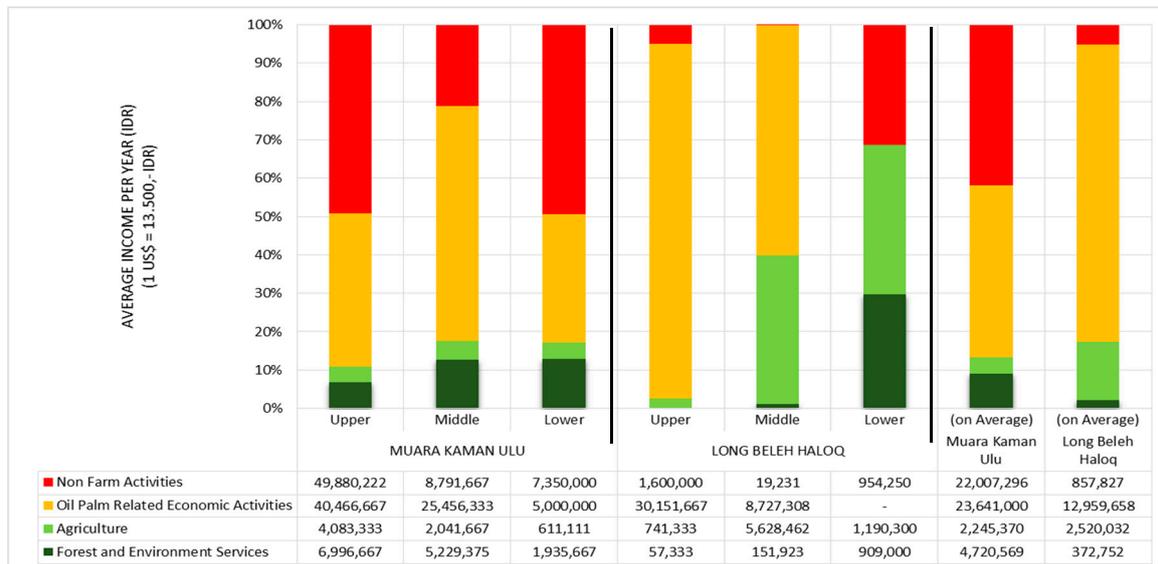


Figure 5. The income structure by strata in the villages of Muara Kaman Ulu and Long Beleh Haloq. (Source: primary data, 2016).

Table 1. Index of household income diversity in Muara Kaman Ulu and Long Beleh Haloq villages, 2017.

No.	Research Locations (villages)	Simpson Diversity Index According to Income Structure of Farming Households of Different Strata, Counted in Indonesian Rupiah (IDR Per Year)		
		Upper (> 58,739,542)	Middle (24,543,099–58,739,542)	Lower (< 24,543,099)
1.	Muara Kaman Ulu	0.29 (n = 9)	0.24 (n = 24)	0.26 (n = 18)
2.	Long Beleh Haloq	0.03 (n = 15)	0.02 (n = 13)	0.14 (n = 20)

Source: Primary data, 2016.

The income structure dynamics triggered by the oil palm economy were clearly different for the two villages. Different rural communities responded very differently to the arrival or expansion of oil palm in their livelihood system. Small-scale farming households of Long Beleh Haloq were very responsive. In contrast, small-scale farming households of Muara Kaman Ulu were relatively unresponsive, as they were already benefitting from non-oil palm sources of income.

The rural economy has grown very rapidly due to the expansive investment of oil palm plantations. This investment helped drive the growth of the oil palm-based household economy in the region. However, oil palm was not the only factor that contributed to rural economic growth. The spatial location of plantations is also an important factor to take into account. Table 1 provides data relating to the diversity of the economies in both research villages. Compared to Long Beleh Haloq, Table 1 shows that the farming household income diversity index is relatively high in Muara Kaman Ulu, with scores ranging from 0.24 to 0.29. In Muara Kaman Ulu, the income structure is quite diversified. This indicates that, although oil palm expansion has contributed to rural economic growth, the oil palm economy is not the only impetus of growth in the region. The dependency of farming households on the oil palm economy can be considered to be low where the dependency on other sources of income was higher. This means that small-scale farming households in Muara Kaman Ulu village have more than one

source of income, enabling them to withstand any potential and unexpected shocks that they might experience. They are more stable since there are diverse sources of income in their livelihood system.

On the contrary, small-scale farming households of Long Beleh Haloq appear to be more vulnerable since their Simpson income diversity indexes ranged from 0.02–0.03 to 0.14. Here, income derived from the oil palm economy is dominant. Even in upper-class households, more than 90% of total household income comes from oil palm plantation activities. This income is mainly derived from earnings related to oil palm production, and particularly production under the integration system of the NES-based oil palm plantations. Oil palm income also dominates in middle-stratum households, although earnings from oil palm were almost equal to contributions from other agricultural (non-oil palm) production. The small-scale farming households of lower stratum in Long Beleh Haloq appear to be the only stratum with a relatively diverse income structure in the region. This diversification involves employment in both the agriculture and non-agriculture economies, thus providing a better basis for survival (see [57,58]). The relatively uniform structure of the sources of income in Long Beleh Haloq may be associated with the problem of spatial remoteness. Under such circumstances, few economic opportunities are able to be created.

The development of oil palm plantations has created economic growth for the rural region, in turn stimulating the creation of new income sources in the structure of the livelihood system of farming households. However, the growth of economic opportunity is also location specific. The number and variety of economic opportunities created in the region highly depends on the distance of each village to the center of economic growth. The closer to the center of growth, and the more accessible this is, the larger the available economic opportunities for farming households. On the contrary, in remote areas the number and variety of economic opportunities will be more limited. In short, oil palm development and expansion have changed the income structure underpinning the livelihoods of almost all farming household strata. However, the speed of development and the diversity of income sources are strongly controlled by the presence of oil palm investment, the availability of other economic opportunities, and the location factor. These conclusions correspond to the findings of Bleyer et al., Ellis, Gautam and Andersen, Martin and Lorenzen, Cramb and Sujang [48,50,56,57,59].

4. Discussion

The study provides information on changes in land cover and the evolution of landscape types over the long run, from forests to monoculture oil palm plantations. This change mainly occurred in areas managed by small-scale farming households. The changing landscapes do not only involve changes in land cover, but can result in complex socio-economic dynamics that involve changes in land status, organization of production, and livelihood systems of rural communities.

Historically, agriculture in East Kalimantan has been dominated by an upland farming system, in which oil palm cultivation was previously unknown. For small-scale farming households that previously carried out traditional economic activities (natural resource extraction, simple agriculture, or shifting cultivation), and that come into contact with the modern large-scale agricultural economic system that is now present in the region, it took at least 10 years to become familiar with the oil palm cultivation system.

In the Kutai Kartanegara district, East Kalimantan, the history of regional change driven by the presence of oil palm plantations can be divided into three phases, namely before 1990, between 1990 and 2000, and between 2000 and 2015, as shown in Figure 6. Prior to 1990, the East Kalimantan economy depended heavily on logging and the operation of natural forest concessions. The livelihoods of local people around the concessions were characterized by forest resource extractive activities and shifting cultivation. Farmers mostly used dry-land agriculture to fulfil their household subsistence needs. From 1999 to 2000, large-scale investment in palm oil began to proliferate, and the oil palm companies made use of lands previously used by forest concessions to establish plantations. During that period, a limited number of households, primarily those engaged in NES schemes, became more familiar with this crop. While a large number of community groups continued to depend on dry land agriculture

practices, few smallholders started to grow palm crops around the estate plantations. This explains why concentrated expansion of oil palm cultivation began to occur during this time.

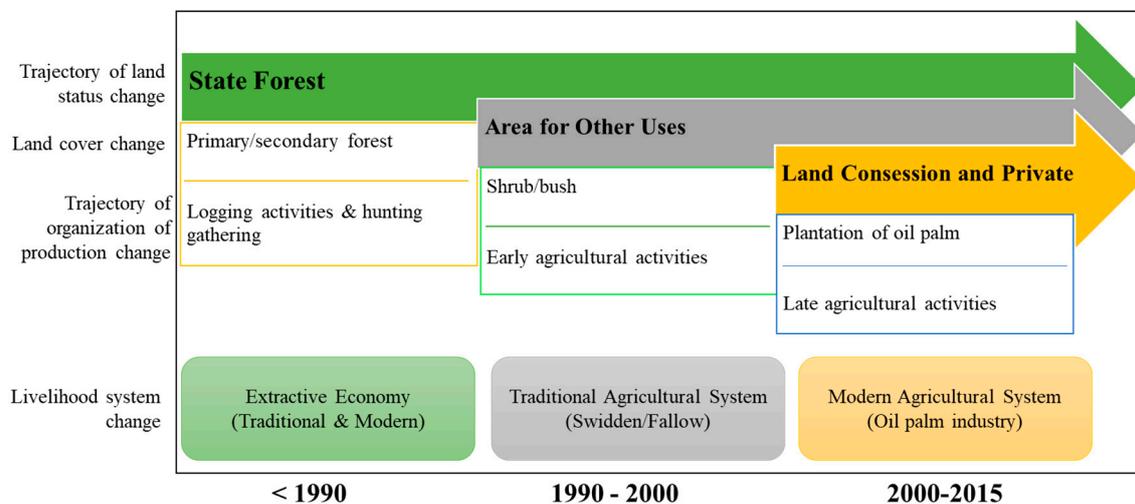


Figure 6. The evolution of land-use change from primary forest to oil palm plantation in the Kutai Kartanegara district, 1990–2015.

The economic growth of oil palm during the past 10 years shows a positive trend, as characterized by the rapid development of plantations during 2000–2015, driven by large- and small-scale actors. During this period, large-scale land-based investments were boosted by government policies aiming to convert production forests into development and production areas, including oil palm [18,25]. Many small-scale farming households, driven by the government programs and their own motivation to do business in this crop, began to expand oil palm plantations not only around large-scale oil palm plantations, but also beyond. This was when spotted expansion of oil palm cultivation began.

The concentrated mode of expansion, dominating from 1999 to 2000, indicates that smallholders' investment in the oil palm crop depended on whether oil palm companies existed around them. The companies helped encourage smallholder investment, bought fresh fruit bunches, and secured a market for farmers. On the other hand, the spotted mode of expansion occurred when smallholders grew oil palm motivated by their independent interest in doing business in this crop. Government policies to empower rural communities through various programs, such as the nucleus estate and smallholder scheme, as well as transmigration programs, and to oblige companies to facilitate the establishment of farms for nearby communities, as stipulated in the Ministry of Agriculture regulation in 2013, also drove the spotted expansion of oil palm plantations.

The various statuses of independent smallholders, characterized by socio-economic systems, portfolios, and assets, as well as by their strategies and capabilities in oil palm practices [42], have also influenced the ways in which they established their plantations. Having acquired technical knowledge through working in company plantations and ownership of smallholdings under NES schemes, retiring laborers reportedly established farms independently on cheap land, away from company plantations. Schoneveld et al. [42] also found that already established independent plasma smallholders, who owned multiple plasma plots, as well as better-resourced smallholders, were found to be buying others' plasma plots. Thus, the plasma form of ownership consists of economic actors who expand, when possible, the size of their oil palm plantations. With resource capacity and more speculative livelihood strategies, these groups of independent smallholders also tended to widely establish plantations on cheap land, state forestland, and peatland.

In other words, the concentrated and spotted expansion types went hand in hand during the 2000–2015 phase. Identifying these two distinct types of expansion is a new contribution to the research

and provides an understanding of the expansion patterns of oil palm plantations in Southeast Asia that has not been discussed in previous oil palm expansion studies [60–62].

The second finding of the study, as shown in Table 2, is the existence of a logical relationship between the types of expansion of oil palm plantation by small-scale farming households and livelihood systems [3,33,63]. This study found that concentrated expansion tended to be characterized by low diversity of household livelihoods. In fact, for most small-scale oil palm farming households participating in concentrated expansion, the main source of income was from working as laborers in an oil palm plantation company, or an independent oil palm cultivation business and NES scheme. In the context of a single livelihood system, oil palm economic activity was the main driver and sustained the economic development of the region and rural households.

Table 2. Relationship between types of oil palm plantation expansion and household income diversity index.

Household Income Diversity Index	High Diversity of Income Sources	Low Diversity of Income Sources
	Type of Oil Palm Expansion	
Spotted expansion (e.g., oil palm expansion that is done by farming households of transmigration programs and independent smallholders).	√	-
Concentrated expansion (e.g., oil palm expansion that is done by independent plasma smallholders or NES smallholders).	-	√

Small-scale oil palm farming households participating in spotted expansion had a higher diversity of livelihood sources, which shows that their income from the oil palm economy was only one of a variety of livelihoods cultivated by farming household members. For small-scale farming households that participated in spotted expansion, capital accumulation from sources of income other than oil palm was an important asset, which allowed the expansion to take place. Conversely, oil palm business revenues often also drove business investment outside oil palm.

The expansion of oil palm plantations, which were facilitated and supported by government policies, or expansions carried out solely by smallholders, led to dramatic land-cover change in the research area. Neither the concentrated nor spotted patterns of expansion were undertaken in consideration of the consequences for the changing landscape and agrarian structures of farming households controlling the lands. The expansion of oil palm plantations was both more extensive and more intensive as the desire to increase benefits grew among the farming households. As a result, land acquisition by farming households has been undertaken with a lack of control. In many cases, oil palm plantations expanded into areas that were ecologically and legally not intended for plantation. Illegal land acquisition has raised an issue of the pressures on the natural landscape, resulting in ecosystem instability for the region. This has led to a situation where all FFB from the regions (especially for Long Beleh Haloq village) must be associated with poor governance practices and traceability. In turn, poor governance will bring about weaker credibility for palm oil products supplied from that region.

Sustainability has become a serious issue for rural economic development driven by the spread of oil palm in the research area. Although the palm oil economy has helped fuel rural economic growth and employment opportunities, as well as an increasing quality of rural livelihoods, the negative effects of oil palm expansion associated with the issues of land conflict and forest ecological degradation have significantly undermined its credibility in the international market. The oil palm plantation remains subject to a strong criticism from many sides.

In order to address negative sentiment to palm oil, a policy needs to be introduced. An environmental governance policy being promoted to address the negative impacts of oil palm plantation expansion is the so-called Indonesia Sustainable Palm Oil (ISPO) policy. This environmental

governance policy was initiated by the Government of Indonesia in 2011 and substantially renewed in 2015.

To date, the ISPO has not been effective in containing oil palm expansion for a number of reasons. First, ISPO certification is voluntary, so smallholders or farming households assume that there is no obligation for them to certify their plantations. Second, independent smallholders do not have enough knowledge or sufficient funds to apply for certification processes. Moreover, they do not understand what the incentives of ISPO certification. Third, only smallholders who have a total integration pattern of organization of production with large-scale plantations or companies are able to carry out ISPO certification. Fourth, the consequence of the ISPO is termination of a person's plantation operation if it is found that the plantation is located inside a forest or conservation area. Fifth, smallholders whose livelihood structures highly depend on the palm oil economy worry that the economic resilience of their households will be disrupted if illegal areas of their farm businesses are reduced due to ISPO enforcement.

5. Conclusions

This article concludes that the responses of smallholders to the spread of palm oil have varied depending on the ecological setting, the existence of an already established plantation economy in the region, and the capacity of the smallholders to adjust their economic activities based on palm oil, as well as on the exposure of external economic activities.

The study concludes that the rural economy is changing rapidly as the expansion of oil palm plantations continues. Thus, the expansion of oil palm has significantly stimulated change in the structure of the rural economy. Three parameters observed relating to the structure of the rural economy are (1) the socio-spatial aspect of the ecological landscape of rural land; (2) the organization of production of communities comprising oil palm small-scale farming households; (3) the income structure of small-scale farming households. The study analysis concludes as follows.

Firstly, the rural ecological landscape has experienced structural change with different speeds and patterns depending on the period of time, the size of the oil palm investment, and the regional agrarian and agricultural development programs delivered by the government. Oil palm development and expansion has formed specific patterns of land-cover changes in the rural ecological landscape, namely, the concentrated mode of expansion and the spotted mode of expansion. The concentrated mode of expansion occurs when large-scale investment in oil palm takes place, followed by the development of plasma smallholders (NES) and independent smallholder plantations. The spread of plantations is concentrated in a certain location where the company plays a major role as the FFB processing unit for smallholders. The spotted expansion takes place where plantations are located in scattered areas, are unorganized, and have no specific organization of production involved. Spotted expansion is usually undertaken by independent smallholders planting the landscape via purchases of cheap land, encroachment on state forest land, or occupation of other conservation zones. It is difficult to control the spread of spotted oil palm expansion. Socio-economically, both concentrated or spotted expansion has dynamic consequences for the rural economy as the ecological landscape changes dramatically.

Secondly, the integration of smallholders or small-scale oil palm farming households into the organization of production of large-scale oil palm companies is unavoidable. In order to receive income, smallholders must sell their FFB to the companies. In exchange, the company requires FFB for processing into CPO. This study found that two types of integration of production between companies and smallholders exist, i.e., total integration of organization of production and partial integration of the organization of production. The first type applies to the NES partnership system, while the second type applies to the partnership between large scale companies and independent smallholders. The term partial integration is used because the arrangement relates to selling and buying FFB, without any obligation for the company to provide technical assistance, financial credit, or land maintenance to smallholders, which usually apply in the total integration system.

Thirdly, the expansion of oil palm plantations leads to different responses for small-scale oil palm farming households regarding the development of the income source for their livelihoods. Those living close to the center of the economy (i.e., the city), who have adapted to other economic activities and are exposed to the non-farm economy, have moderate reactions. The oil palm economy is seen as only one part of their multiple economic activities. In this first type of response to the income structure, the oil palm economy has a less important influence on the livelihood system of small-scale oil palm farming households because income sources have been highly diversified. The second type of response applies to the rural communities that are relatively remote. In such cases, oil palm dominates the income source structure in the livelihood system. Almost no diversification of income has been made. Under such a situation, the livelihood system of the small-scale oil palm farming households is vulnerable to shocks, crises, and economic uncertainty.

The expansion of oil palm plantations undertaken as part of an intentional rural economic development strategy could result in complex social and environmental issues, particularly oil palm expansion undertaken by smallholders. This study found diverse characteristics of changes stimulated by oil palm expansion. Three areas of concern are land-cover change, patterns of economic integration of smallholders with large-scale plantation companies, and changes in livelihood systems. Due to the complexity of the impacts of oil palm expansion, a single solution to contain the issues associated with oil palm expansion cannot be provided. Oil palm policy intervention through the ISPO may not be effective if it is not accompanied by other policies that are supportive to such a governance system. This study suggests further research should be conducted to investigate the role and influence of large-scale agricultural investment and expansion on rural social and ecological change. Further research should not be limited to the oil palm commodity, but should also cover other agricultural commercial crops, particularly agricultural crops with a strong relationship to the international market and related to the issue of rural sustainability.

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