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Conversion of Rubber Land Into Palm Oil and Its Effect on Production in North Sumatra

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Abstract: This study aims to analyze the conversion of rubber land to oil palm and its effect on production in North Sumatra. Today many rubber farmers are turning their land into oil palm plantations. So that the famous commodity from North Sumatra, namely, palm oil, is no longer rubber. Whereas previously the rubber plant (Hevea brasiliensis) as a plantation plant that was integrated with the culture of the people of North Sumatra Province had environmentally friendly properties. This study uses descriptive qualitative research methods. Data were collected by observation, interviews, literature study, and document analysis. The results show that smallholder rubber plantations have been the mainstay of the economy of North Sumatra Province since a century ago. Although there has been a change from Rubber Land to Palm Oil Land, currently North Sumatra accounts for 33% of the total national natural rubber production. North Sumatra is the second largest natural rubber producer after South Sumatra.

Keywords: Land Conversion; North Sumatra; Oil palm plantations; Rubber plantations

Introduction

The proliferation of oil palm and rubber is the main contributor to the widespread deforestation of tropical forests in Southeast Asia, especially Indonesia. Replacing forests with rubber and oil palm monoculture plantations reduces biodiversity and carbon stocks, but also changes canopy structure, which is an important determinant of microclimate (Hermiati et al., 2003; Mara & Sativa, 2022). North Sumatra as one of the centers of oil palm plantations in Indonesia produces an average of 1.7 million tons of CPO per year. This amount is equivalent to 8.23% of the total national CPO production per year. The area of oil palm plantations in North Sumatra is increasing every year. This extensive growth was caused by the conversion of land use, especially paddy fields, especially in the Langkat, Serdang Bedaga, and Labuhanbatu areas. North Sumatra Province with an area of 72,981 km² and a population of 13,987 million people is engaged in agriculture in the region because most of the population lives in the agricultural sector.

The oil palm business, which used to be a plantation managed by the private sector and the government, is now also managed by the community (Qibtiyah, 2017). This is because this palm oil product has received a lot of attention from the provincial government (Wantu et al., 2021). Small farmers were the mainstay of the economy of North Sumatra province a hundred years ago. This is reflected in the expansion of plantations and the large number of farmers who depend on these commodities. In 2019, the area of rubber plantations in this province is 557,644 hectares with a total of 263,583 farmers. Rubber is the sap produced by the rubber tree (Hevea brasiliensis) which is sold in pieces (Rubiyanti et al., 2019).

Planting that is integrated with the culture of the people of North Sumatra has ecological characteristics. Although this rubber plant is included in the category of forest plants that are suitable for the development of forest areas and other areas, rubber plants are also suitable for reforestation and forest restoration purposes (Afnaria & Nurhayati, 2021; Anwar & Suwarto, 2016). The facts show that the gross domestic product (Gross Regional Domestic Product) per capita in an area that mostly consists of rubber plantations is lower compared to other regions whose main income is not rubber. Land

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conversion is a change in part or all of the function of a land area from its original function to another function (Weng et al., 2014). Land conversion is a specific change from agricultural to non-agricultural use (Sucihatiningsih, 2014). Conversion often occurs on agricultural land, e.g. Conversion of food crops into plantation crops, estate crops into food crops, estate crops into yard crops, and estate crops into livestock crops.

The application of the right technology is very important to maintain the harvest season and optimize crop productivity (Iswanto et al., 2021). These efforts can be carried out through cultivation, planting on time, using large planting holes, proper and balanced fertilization, and disease control. One of the causes of low rubber productivity in plantations is usually the use of inappropriate cloning controls (Williams et al., 2001). Therefore, optimizing crop productivity can be achieved by selecting better clones, adjusting the composition of the clones in the garden, and placing the clones in the appropriate agroecosystem (Ali et al., 2020). In the last 10 years, the price of rubber at the farm level has fallen drastically, the price is only IDR 4,500-5,000/kg. This situation reduces the enthusiasm of farmers in managing their rubber plantations. Based on the information received, financial factors are the main factor in conversion (Wijaya & Budhi, 2015). Low rubber prices make it difficult for farmers (Ginting et al., 2015). At 50 percent of income: 50, low rubber yields and low selling prices, tappers only get IDR 150,000 to IDR 200,000 per week from one hectare of rubber land. Workers prefer other jobs such as oil palm laborers or working at oil refineries or oil palm plantations in North Sumatra. Rubber plantations are converted to oil palm, especially with the government's oil palm rejuvenation program for the last 2 years. The conversion of rubber to palm oil is expected to be more profitable for farmers in the future. This is because the price of fresh packaged palm fruit (FFB) continues to increase (the current FFB price is IDR 1,800/kg) and there is no need to harvest FFB every day. As a result of this conversion, the area of rubber plantations decreased in line with the extraction capacity of the farmers.

Farmers carry out a direct conversion pattern with an oil palm regeneration program (Wahyuni & Barus, 2021). This program has been implemented since 2019. Farmers who wish to convert their plantations become registered palm oil conversion participants. The replanting cost of IDR 33 million per hectare is very profitable for the farmers because they immediately switch from rubber to oil palm. The direct model is carried out using capital owners buying rubber land from the community. Buyers of rubber plantation land from outside the village converted it into oil palm plantations. Based on information from the rubber plantation of Air Manganyau Village covering an area of 1,600 hectares, buyers from outside the village (owners) have converted around 320 hectares or 20% into oil palm.

The gradual pattern is adapted to plant conditions (Matondang & Nurhayati, 2022). Oil palm seeds are obtained by buying sprouts and sowing them in polybags, buying ready-to-plant seeds, and sowing some of the seeds that fall under the trees in polybags (Fellica et al., 2019). Independent smallholders are slowly making the transition, replacing rubber plantations with oil palm. Farmers with limited capital make changes gradually by cutting rubber stems to replace oil palm plants depending on the farmer's capital capability. Therefore, farmers do not lose income from their rubber plantations. Commodity prices have a strong impact on land conversion (Murdy & Nainggolan, 2020). Based on information from Air Manganyau Village, the factor causing these changes was the economy, according to the information provided by extension workers. The low price of rubber makes it difficult for farmers. Air Manganyau Village workers prefer other jobs, such as harvesting palm oil or working in a palm oil processing factory. Price volatility which tends to decrease is the cause of farmers converting rubber into palm oil. Conversion farmers see oil palm as more profitable than rubber because rubber prices are falling (Vinolina et al., 2019).

Method

This study uses a qualitative descriptive research type to analyze the conversion of rubber land to oil palm and its impact on production in North Sumatra. Descriptive design is a flexible and explorative approach to qualitative research. Descriptive models in the literature are general, generic, basic, traditional, interpretive, and pragmatic, along with other names (Creswell, 2016). Descriptive research collects data describing events and organizes, tabulates, describes, and collects data. It often uses visual aids such as charts and graphs to help readers understand the distribution of information (Creswell & Creswell, 2018). Since the human mind cannot fully process large amounts of raw data, descriptive statistics are essential for reducing data into a manageable form. When containing narrative descriptions of a small number of cases, research uses the descriptions as a means of organizing the data into patterns that emerge during analysis. These models help the mind to understand research and how it interacts (Rijali, 2019).

Descriptive design is an acceptable research design for other strong scientific research, which has found mixed acceptance in the academic community (Fikri & Hasudungan, 2022). However, since the early 2000s, descriptive design has become popular because it is suitable for studies that do not belong to higher-order genres (Sugiyono, 2017). In contrast, the descriptive model "borrows" the appropriate proposed research method from other models. Due to the exploratory nature of the descriptive design, triangulation of different data sources is often used to gain insight into this phenomenon, in the context of the conversion of rubber plantations to oil palm plantations and their impact on production in North Sumatra. The data that can be used in descriptive research is similar to that that can be used in other qualitative designs and includes interviews, focus groups, documents, artifacts, and observations (Hasanah, 2017).

Result and Discussion

Agricultural expansion is the most important factor affecting deforestation in Indonesia (Fatkhullah et al., 2021). Specially enhanced to develop of cash crops, particularly rubber. The Indonesian Rubber Association (Apkarindo) in West Java is worried that the high conversion of land which makes rubber the main raw material for the area is threatened with shrinking. West Java Apkarindo board member, Iyus Supriyatna, said the government must immediately open up land conversion by reopening rubber in a safe place. According to him, land conversion in an area of almost one hectare per year threatens rubber production. In particular, the expansion of tree crops had a greater impact than the expansion of subsistence farming (Chaudhary & Kastner, 2016). Indonesia's staple crops, with more than one million hectares planted, are rubber, coconut, oil palm and coffee (Miyamoto, 2006). In 1999, when our survey was conducted, rubber covered 3,632,000 ha, coconut 3,680,000 ha, oil palm 3,436,000 ha and coffee 1,122,000 ha (Fuglie, 2010). The factors that affect land conversion are as follows:

Economic Aspect (Price Level and Profit Rate)

Price Level

One of the factors causing the municipal government to change land operations is the price level, rubber prices have decreased, see Figure 1.

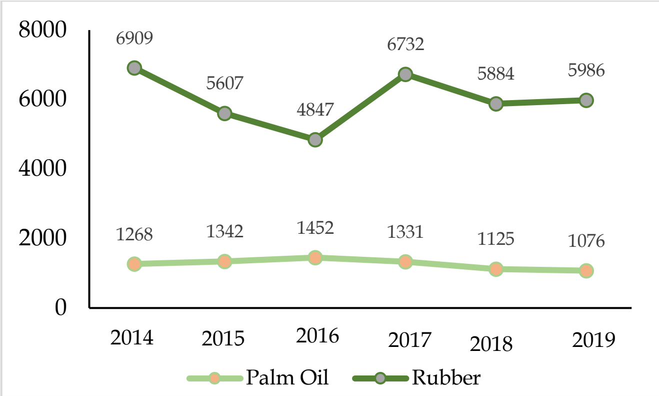

Figure 1. Comparison of Rubber and Palm Oil Prices for 2014-2019 (in rupiah)

Compared to rubber farmers who need longer time to harvest or scrub, rubber farmers have 3 days to harvest or scrub, and farmers have to complete screwing for 3 days, only on the fourth day farmers harvest. Chewing gum that has been tapped for 3 days and after that can only be sold to the Chewing Gum Shop. The harvest season for oil palm is shorter than the harvest season for rubber tapping. Harvesting oil palm takes 1-2 days, while milkfish takes 2-3 days.

Profit Rate

In Indonesia, most tree crops are mostly grown by smallholders and not by large companies (Scherr, 2004). For example, in 1999, 85% rubber, 97% coconut and 94% coffee were grown by smallholders. Palm oil is a big company and 67%. Therefore, this paper focuses on rubber as the most important staple food for farmers (Euler et al., 2016). Workers in the family (1 rubber farmer) can cut down a maximum of 1 hectare of rubber plantations. With an area of more than 1 hectare, rubber farmers cannot tap on their own because the tapping capacity is only 2-3 hours in one day. So if farmers own more than 1 hectare of land, they need to work from outside the family. The time needed to tap rubber is 2-3 days, and harvesting oil palm takes 1-2 days. Harvesting oil palm takes less time than extracting rubber. With less time and better production results, it is more profitable because it reduces labour costs. It is difficult to find work because there is competition with oil palm FFB repair jobs. The daily wage of a Batik Nau district worker is Rp. 120,000 NOK per day. The daily wage for rubber workers is only around Rp. 50,000 NOK per day. The conditions for farmers are more favourable if they do it themselves on limited land, so farmers with an area of more than 1 hectare switch to oil palm plantations because it is more profitable (Lee et al., 2014).

Figure 2. The pattern of direct conversion of rubber to palm


Figure 3. The pattern of gradual conversion from rubber to palm

The conversion of rubber land into oil palm can be divided into two types, namely: 1) gradually/occurring randomly/dispersed, carried out by individuals, 2) massive (immediately), occurring over a large area. This is caused by unstable price fluctuations, downward trends, poor quality, and the productivity of rubber factories. However, there is little quantitative information on the impact of these land changes on the microclimate. Meijide et al. (2018) reported the first observations of sub-canopy microclimates (air temperature, relative humidity, vapor pressure deficit, and soil temperature) in forests, forest rubber plantations, oil palm plantations, and rubber monoculture plantations in Sumatra/Indonesia. The data covers a period of about three years (2013-2016) and includes one of the strongest El Niño-Southern Oscillations (ENSO) in recent decades. Forest temperatures are 2.3 and 2.2 °C cooler than oil palm and rubber monocultures. Monocultures are also drier (11.9 ± 12.8% less for oil palm and rubber) and have highervapour pressure deficits (632 Pa and 665 Pa higher for oil palm and rubber), while the difference in soil temperature is not that great.

The shift from forest to other land uses, especially monocultures, also increased the daily intervals of all microclimate variables studied. Metsäkumi is characterized by a modified land use system that maintains more stable microclimatic conditions (Nasution, 2019). Our results show that the canopy is a key factor in the under-canopy microclimate (Meijide et al., 2018) and can therefore be used in climate models to improve oil palm land use change and climate change. The 2015 ENSO events resulted in warmer and drier conditions than the previous two years across all land-use systems, especially forests (up to 2.3 °C warmer, 8.9% drier, and up to 351 Pa more during ENSO) (Anamulai et al., 2019).

The relative impact of ENSO is lower in monoculture plantations where the microclimate under the roof is generally similar to that outside. Forests show the greatest differences from the years before ENSO, but continue to exhibit more stable microclimatic conditions (lower temperatures and higher vapor pressures, and relative humidity deficits) due to their higher climate regulation capacities. During ENSO, forest microclimatic conditions were comparable to monocultures, suggesting that forest sap may have increased its buffering capacity to extreme levels with increasing forest temperature. This extreme climate storage capacity must be considered when assessing the impact of land use change. However, there is little quantitative information on the impact of these land changes on the microclimate. Meijide et al. (2018) reported the first observations of attic microclimates (air temperature, relative humidity, vapor pressure deficit, and soil temperature) in forests, forest rubber plantations, oil palm plantations, and rubber monocultures in Sumatra/Indonesia. The data covers a period of about three years (2013-2016) and includes one of the strongest El Niño-Southern Oscillations (ENSO) in recent decades. Forest temperatures are 2.3 and 2.2 °C cooler than oil palm and rubber monocultures. Monocultures are also drier (11.9 ± 12.8% less for oil palm and rubber) and have higher vapor pressure deficits (632 Pa and 665 Pa higher for oil palm and rubber), while the difference in soil temperature is not that great.

Environmental Aspect (Weather Condition and Labor)

Weather conditions

The minimum rainfall for rubber plantations is 1500 - 3000 mm/year with even distribution. Excessive rainfall can interfere with tapir activity and increase disease attacks. Cases of severe leaf fall occur when rainfall exceeds 3000 mm/year. Meanwhile, oil palm plants can grow well throughout the year at a temperature of 27ºC and a maximum temperature of 33ºC and a minimum temperature of 22ºC. Rainfall suitable for the growth of oil palm varies from 1,250 to 3,000 mm evenly throughout the year, and optimal rainfall is 1,750 to 2,500 mm. In Southeast Asia, and especially in Indonesia, oil palm and rubber plantations are spread over a large area and most of them cover heterogeneous areas. Most of Southeast Asia's lowlands are not flat but hilly and are divided into plateaus and valleys. This causes climatic differences in soil moisture:

During low rainfall, soil moisture availability for plants in the valley areas is higher. During predominant heavy rain events, facilities in the valley and riparian areas were frequently inundated for varying periods, whereas facilities in the higher elevation areas were less prone to flooding.

In North America, mountain–wetland gradients have been analyzed by measurements of sap flow associated with vegetation and tree evaporation. Significant differences in tree transpiration observed between site and site are necessary to include plots at different topographical sites for landscape-level analysis or transpiration modelling. Streams of sticky sap and evaporation from Japanese cypress (Chamaecyparis obtuse) were much higher in the valley than in the surrounding areas, whereas for Japanese cedar (Cryptomeria japonica) it was similar at both sites. Few such studies exist for tropical rainforests, but the influence of air tables on specific species has been analyzed in northern Australia and Hawaii. Air has been reported to reduce transpiration in some species, but other species are adaptable to these conditions and are therefore not affected. In tropical rainforests, the tree species composition often varies among mountainous areas and sometimes along rivers. High-stemmed or intermittently wet species (eg, Melaleuca argentea W. Fitzg. and Corymbia bella Hill) may occur in large numbers even during floods due to adaptation.

Rubber and oil palm plantations cover most of Sumatra's lowlands (Rianti & Garsetiasih, 2017) where they develop highly diverse natural forests. However, the post-agricultural landscape exhibits more heterogeneous transpiration patterns than expected. This heterogeneity is partly explained by the age structure of the landscape and differences between species in the environment, including the occasional drop of gum. The extent to which different management systems also have an impact requires further investigation. The model shows that high fertilizer applications, such as on large farms, lead to higher evaporation rates than on less intensively managed small farms. This study adds a new dimension to the plantation landscape by demonstrating that topography and flooding are also strong factors influencing the heterogeneity of landscape-scale transpiration patterns. Similarly, a study of North American mountainous wetland landscapes also found significant differences in tree evaporation and determined that there was a need to include the topography of the site for analysis or modelling.

Secretary General of the North Sumatra Branch of the Association of Indonesian Rubber Entrepreneurs, Eddy Irwansyah, said the decline in commodity prices was due to falling commodity prices on the international market. In fact, many farmers cut down their rubber trees to replace them with more profitable crops, said Eddy in Jakarta, Saturday. He said the price of natural rubber was only $1.17 per kilogram on the international market and around Rs 13,000 per kilogram in refineries. He estimates that rubber prices will continue to fall after the drop in oil prices. Gapkindo said, with this trend, farmers have no interest in growing rubber. "As a result, there is concern that domestic rubber production will shrink again in 2016.

Currently, North Sumatra controls 33 per cent of national natural rubber production. North Sumatra is the second largest natural rubber producer after South Sumatra. Parlindungan Purba, Secretary of the North Sumatra Indonesian Entrepreneurs Confederation (Apindo), said that the drop in rubber and crude palm oil (CPO) prices this year has caused a decline in the province's export revenue. Rubber and CPO are North Sumatra's two main exports. Throughout the third quarter of 2015, North Sumatra's export revenue fell 18.31 per cent year-on-year from US$7.099 billion in the first nine months of 2014 to US$5.799 billion in the same period this year. At the end of the 19th century, forests covered almost the entire island of Sumatra. The first appreciation was for hunting and natural resources, followed by a shift to rice cultivation in the highlands. The industrial revolution in Europe and North America in the 1950s led to an increasing demand for rubber. Responding to this new market opportunity, farmers planted rubber seeds in their fields among the paddy fields in the mountains. So they found a new farming system, namely rubber farming. Due to the increasing demand for rubber from the growing industry, rubber plantations spread over the eastern plains of Sumatra until the 1990s. Converting forests to agroforests provides high biodiversity security and agroforests act as buffer zones around national parks (Sawitri & Subiandono, 2011). But due to demographic pressures, market integration and domestic needs, agroforestry is on the verge of extinction. The emergence of new farming systems that challenge the dominant position of agroforestry in the landscape. Monospecific rubber plantations have been competing for land since the mid-20th century, with arguably higher profits than agroforestry. Recently, oil palm plantations spread across the island and are fast becoming a new challenger to rubber plantations. However, the international community is interested in protecting forests and biodiversity. Forest cover in Jambi Province has almost disappeared in the last 30 years. The only way to save forest remnants and agroforestry are to create market incentives through conservation programs such as reducing emissions from deforestation and land degradation.

Although global policies and markets are often blamed for accelerating regional deforestation, local knowledge tends to produce positive conservation outcomes overall (Feintrenie & Levang, 2009). Also in primary forest conversion, local people are often shown to be the best managers in coordinating protection and development. There are many examples of the conversion of old-growth forests to small-scale rural agroforestry in Southeast Asia, and particularly in Indonesia, where extensive deforestation has occurred over the last three decades. Agroforestry is small-scale farming that combines annual cash crops such as rubber with crops such as timber and fruit trees, food crops, building materials and crafts (oil palm, rattan and bamboo), and medicinal plants. Agroforestry to some extent mimics natural forests. Pioneer, successor, and late-stage species in natural forests successively feed on similar plants with different light requirements. The first phase after a burn should replace the pioneer phase with a cultivation phase with similar characteristics: fast-growing halophilic crops (rice, vegetables, bananas, and papayas) activate natural pioneers and suppress weed growth (Robinson et al., 2014).

This cultivation phase creates a shady environment and moist microclimate on the earth's surface, which supports the development of young forest species (rubber, fruit trees, palms and trees). The post-pioneering phase, dominated by rapid growth that is produced after 4-8 years (e.g., coffee, pepper, coffee and cinnamon), maintains the biophysical environment of the plant that supports seedling growth and benefits from maintenance (pruning, weeding, fertilization). is aimed at mainstream culture. In 15 to 20 years, agroforestry will become a complex forest structure with a high closed canopy, in which many forest species will grow independently. In addition, the increase in the production structure is based on the death or fall of trees, which makes way for new generations of crops. Thanks to the constant and spontaneous regeneration of many species, rubber plantations have a forest structure that is representative of trees of all ages.

Sumatra rubber plantations, which still cover more than 3 million hectares in the island's eastern highlands, are often presented as small rural forests or adat forests, models of traditional and sustainable forest resource management. Deforestation caused by logging and the spread of plants leads to landscape degradation, loss of biodiversity, extinction of animals, plants and forests, change of forests, many plants and most of the ecological functions of forests. In North Sumatra Province, rubber plantations have a strong position in the lowlands from the east coast to the foot of Mount Barisan. They are often mixed with remnants of natural forest and secondary forest growth. But plantations are also under threat of extinction today, as their owners often opt for monospecific conversion to rubber or oil palm plantations. The Birth of a Rubber Plantation.

Innovative Responses to New Market Stimulation Until the late 19th century, Sumatra's eastern Tanjung Plains were primarily a forest treasure. Self-sufficiency in the production of staple foods was achieved through rapid cultivation, hard work and major improvements in people's diets. The population density is low (less than 5 people/km^2) and only a small part of the landscape in Ladang Ladang is cultivated. Paddy fields or fields are cultivated for one or two successive years and then vacated for 15-20 years. Cash needs were met by collecting and selling forest products such as resin, latex and rattan to Malay and Chinese traders. This Swiss system of growing and harvesting forest products is ecologically and economically sustainable.

Labor

The task of the workers is to direct or carry out the production process at will, there are more oil palm workers than rubber workers. In the study area, oil palm plantations require 2 workers per hectare, while rubber plantations only require one worker per hectare. With the industrial revolutions in Europe and North America in the second half of the 19th century, the demand for natural resources such as resins and latex exploded (Altman, 2021). In Sumatra, natural rubber - especially Palaquium spp. and Dyera costulata gum and Ficus elastica gum - causes local collectors to exhaust their resources. Facing rising production costs, shifting farmers found a solution to their problem by introducing Sedum (Hevea brasiliensis), which was introduced to large plantations in Sumatra in the early 20th century. With a little effort, the rubber seedlings were brought to the latang in the middle of the highland rice fields. After the second rice harvest, the plots were left empty and the rubber seedlings survived among the secondary forest regrowth. Ten years later, when the new rubber trees were ready to be tapped, farmers opened several harvesting lines, freeing up space around the trees for tapping. A new "traditional" farming system emerged, namely rubber plantations.

Technical Aspect: Cultivation Techniques

Cultivation techniques are also a supporting factor in agricultural activities, in this case cultivation, because according to good nurseries and simpler cultivation methods, the application of good and correct cultivation techniques is a determining factor for agricultural success. Seeds or seedlings sourced from farmers are certified seeds, and seeds or seedlings sourced from farmers are still seeds. Good seeds or seedlings guarantee good growth and high production, for oil palm production time is 3-5 years, while rubber production time is 4 years. Another reason cited in the qualitative interviews for oil palm cultivation is the different stages of immaturity. Oil palms become productive four years after planting, after which they are used for around 20 years. Farmers start tapping rubber trees about seven years after planting, and trees are tapped around 25 years. Although both crops require a long-term perspective, farmers regard differences in production seasons as an important basis for crop selection. "Most people grow rubber here, but oil palm recovers faster. When people plant rubber, they often have to wait 7 or 10 years for the first results. But making money from palm oil can live much faster. Another person interviewed stated: My reason for going to oil palm is so I can harvest earlier.

Technical Aspect: Fertilizer Procurement

Based on research conducted by farmers, the use of fertilizers used is quite a lot, such as KCL, Dolomite, SP-36, Urea and subsidized fertilizer, namely Phonska. Non-subsidized fertilizers are quite easy to find, but subsidized fertilizers are quite difficult to find. In rubber and oil palm plantations both require the same fertilizer, only in rubber plantations do the farmers never fertilize, on the other hand, small oil palm farmers make fertilization costs up to IDR 2,300,000 per year per hectare. Farmers get fertilizer from fertilizer by selling kiosks in Parmaina village itself, or you could say buying fertilizer for farmers is quite easy.

The results Euler et al. (2016) show that it makes more economic sense to allocate more land to oil palm than to rubber, even though the average rural area is smaller. From a capital perspective, the results show greater flexibility in growing oil palm compared to rubber. In addition, in the second system, imitation model fertilization is important, while the dosage applied is less important in oil palm production. In Indonesia, there is no agricultural planting company that grows crops quickly. Several factors are discussed. First, land rent, which Thunen defines as the interests of landowners, is seen as an important factor. This form of land leasing claims that economic factors such as more roads and higher prices for agricultural products increase land yields and lead to the conversion of forests to agricultural land. Second, land tenure insecurity is another factor driving agricultural expansion. Local community land ownership becomes insecure in areas where migration, commercial pressure and/or plantation projects have been implemented. Third, population size, which has long been considered an important factor, is now being called into question. Recent studies have addressed its fundamental role in forest conversion, as population size itself is a variable influenced by other factors such as infrastructure, land and the availability of off-farm employment. Poverty and the development of agricultural technology are also considered factors. These and other factors have been proposed and discussed, but it is still uncertain which are the most important and the extent of their influence on agricultural expansion.

In areas with rapid land use change, such as the lowlands of Sumatra, where native lowland forest has been almost completely lost, it is important that at least some species of open forest survive in disturbed forest types. The potential importance of agricultural production systems in protecting biodiversity is underlined by conservation authorities and the international research community. Since the 1970s, most of the primeval and logged-over forests in lowland Sumatra have been converted to large-scale monoculture plantations (oil palm, rubber, industrial timber) and migrant destinations. The people's rubber plantation forest also called "rubber forest", is the main cultivation in the lowlands of Sumatra, which has existed since the early 20th century. Based on recent changes in land use, this is probably the most common forest-like vegetation type in the region.

Conclusion

A brief description of the area of rubber plantations maintained through transmission between generations, the area of rice fields and the number of men has significant implications. First, the area of rubber plantations conserved through intergenerational transmission decreased significantly in the year the fires in both fissures were extinguished. This suggests that households that received fewer rubber plantations sought forest earlier. This is because households with few rubber plantations must immediately clear the forest after marriage to have their own rubber plantation. In the study villages, rubber land was passed from one generation to the next in two ways: (1) Children receive rubber throws from their parents when they marry to earn a living. new households earn a living, and/or (2) rubber plantations after the death of one of the parents. Second, the low area of paddy fields reduces the incidence of deforestation and shortens the distance to the cleared forest. Households with fewer rice fields searched for forests earlier and more diligently. Third, an increase in the number of male family workers increases the distance to cleared forest areas. This is because logging is mostly done by men and farther from the village centre more men are needed for land clearing.

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