The role and impact of oil palm plantations in landscape management in South Tapanuli District, North Sumatra, Indonesia

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Abstract. This study was conducted in South Tapanuli District, which is one of the two oil palm centres implementing the landscape management project. Data collected from Regional Plan documents and 169 smallholder samples and analysed with Cross Tabulation and Compare Means Test. The results show that landscape management has been implemented through Regional Planning and various regulations. However, many institutions are authorized to manage landscape, which occasionally result in confusing and contradictory decisions. Through regulations, the Government has limited the expansion of oil palm plantations by specifying Forest and Food Regions. Intensification and diversification approaches are also considered as alternatives for balancing land allocations among sectors and commodities. Intensification is taught through the Sustainable Oil Palm Field School Program, which can improve smallholder knowledge and implementation of landscape management. However, smallholders with larger plantation areas are less interested in participating in the program. Diversifications were indicated through the smallholder cropping system, which is focused on potential commodities such as rubber, coffee or cacao. Smallholders perceive other commodities as less profitable because most of their agribusiness systems are less developed than the palm oil agribusiness system. Therefore, improvement in every potential agribusiness system is recommended to optimize landscape management in South Tapanuli.

1. Introduction
Palm oil is one of the most important commodities in Indonesia. The high global market demand leads to a significant increase in oil palm plantation areas. From 1990 to 2018, the total Indonesian oil palm plantation area has increased by 13 million ha [1]. Thousands of hectares of secondary forests and other agricultural crop areas have been converted into oil palm plantations [2]. There are two main concerns regarding palm oil, namely deforestation and biodiversity loss [3,4]. With the significant increase in oil palm plantation areas, the remaining available and suitable area for oil palm expansion has become increasingly limited. Taking into account the underutilization of protection areas, environment sustainability criterion and accessibility, the only sufficient suitable land size for oil palm expansion in Indonesia is located in Kalimantan [5,6]. In 2016-2017 the oil palm area growth in Sumatra has increased from 13.41% to 220.07% [7]. Secondary forests were still identified as a significant conversion source of the oil palm expansion [8,9]. This has raised concerns for sustainability in both oil palm and other agricultural commodities.
The global increase in oil palm production tend to decrease market prices and the expansion of oil palm production in less suitable land leads to the increase in production costs. Both decrease palm oil profitability. Smallholdings have reached 43% of the Indonesian oil palm plantation areas in 2018 [1]. Lack of technical, managerial and financial capabilities is the main factors for smallholding low productivity. In 2019, smallholding productivity averaged at 3151-ton CPO/ha/year, while major companies averaged at 3672-ton CPO/ha/year [1]. In the 1980s, when smallholdings started to grow, their average land area were approximately 2 ha/household which has increased to more than 5 ha/household in 2019 [1]. Therefore, landscape needs to be properly managed. A number of previous studies have attempted to build landscape models. However, most of the models tend to focus on physical aspects such as hydrological level [10] or carbon balance [11] while only a few have addressed the social economic aspects [12,13].

South Tapanuli is one of the districts in North Sumatra that has tried to utilize landscape management as an approach to improve sustainable palm oil plantations. The district is home to forests with high biodiversity and endemic animals such as Orangutan, Sumatra Tiger and Tapir. South Tapanuli is also recorded as one of the districts with an increasing oil palm plantation area. The local government has worked together with an international NGO to implement a good landscape management, with a focus on sustainable palm oil development. One of the programs is the Field School for oil palm smallholders, which was designed to increase productivity and not further expand their plantations to protected areas. The aim of this study is to analyse whether the jurisdictional approach sufficient to improve the landscape management.

2. Materials and methods
The study was conducted in South Tapanuli District, one of the 2 districts implementing the landscape management pilot projects in Sumatra. Primary data were collected in 2 stages. In the first stage, data were purposively collected from 134 smallholders, 4 NGO staff (the Landscape management project initiator) and 1 head of forestry office staff (Forest Management Unit) to address the four research questions through interviews. In the second stage, data were collected from 35 smallholders and 7 extension workers through interviews and focus group discussions. The purpose is to collect details of landscape management information related to the case of food area regulation. Secondary data were collected from various maps and documents namely Landscape Model for South Tapanuli District, Regional Planning KPH X Long Term Plan and Statistics of South Tapanuli District.

This study analyses the development of land usage/changes, programs and policies, the subsystems consist of input, production, processing, marketing and supporting subsystems. The conditions of each managerial component and subsystem were scored 0, 1 or 2, referring to not available, available but not well-functioning and available and well-functioning, respectively. The results were then compared with Cross Tabulation with Pearson Chi Square Test Values between landscape management knowledge and implementation of the Field School Participant and non-participant groups. Knowledge is measured by the understanding on forest benefit, regional division and land allotment, while implementation is measured by land usage and changes. In addition, the land size and level of education between the Field School participants and non-participants were tested with Compare Means.

3. Results and discussion
The development of oil palm plantations as part of the South Tapanuli landscape management has been addressed in at least 3 documents namely RTRW 2017-2037, Landscape model and Sustainable Palm Oil Action Plan 2019-2028. The RTRW has been legalized as local regulation South Tapanuli Number. 5/ 2017, covering 14 districts and 212 villages. Landscape management categorized the district areas into forest and non-forest areas, and subcategorized these areas into a number of functions. In South Tapanuli, forest areas are managed by 3 Forest Management Unit (FMU) written in Forestry Minister Decree No 102/Menhut-11/2010. Other complementary regulations include Presidential Decree No 10/2011 on Primary Forest and Peat and management, Ministry of
Environment and Forestry on Management in Forest usage, and P83/Minlhk/Setjen/Kum.1/6/2016 on Social Forestry. The Number of Rules in Forest types and allocations has been issued for a considerable while, from the national up to the district level. Units in charge related to the rules were also appointed. However, the unclear data and the weak and overlapped coordination between the national, province and district levels have led to a number of problems. This includes the establishment of a number of oil plantations in the forest areas.

Indonesia has also determined irrigated paddy field areas to support the food security program in the Decree of Ministry of Public Works and Housing No. 14/prt/m/2015. Indonesia has been giving high priority to the development and maintenance of paddy fields, especially in achieving the food security target. Unfortunately, being a staple food and having a strategic role does not equal to a high profitable commodity. The paddy selling price is relatively low yet requires a lot of effort to farm, leading some farmers to convert their irrigated paddy fields into oil palm plantations. Actuating and Controlling have proven to be challenging as the data are still not accurate. A number of programs have been designed and implemented by governments, companies and other stakeholders. However, the high variations in stakeholder characteristics and lack of accurate data have caused actuating and controlling to be a substantial challenge. Rules that focus on sustainable palm oil can be seen in the Presidential Decree No.8/2018 and No.6/2019, which list programs that will be conducted until 2024 in detail. These programs were used as the base of provincial and district programs under the North Sumatra Governance and South Tapanuli Regent Decrees, respectively.

According to [9] provided a good review of the possible role of spatial planning as a key instrument for sustainable landscape. The landscape management laws and policies in South Tapanuli are relatively complete and comprehensive [14-17]. However, involving a number of authorized institutions has often led to contradictory plans that can also be seen in the Regional Planning (RTRW). Table 2 shows that until 2037, the South Tapanuli Government plan to maintain their protected forest, sanctuary and production forest similar to the 2015 RTRW. The wetland agriculture area is only targeted to reach less than 18,000 ha, while in 2017 the total paddy field area has already reached more than 38,000 ha. In the RTRW, plantation areas for all plantation commodities totalled to merely 7.33%, while the forest and riverbank zones make up almost 70% of the total South Tapanuli land areas. Table 2 shows that the land allocation plan in Tapanuli Selatan prioritizes forest and agriculture areas. Dry land is almost doubled in the RTRW target compared to 2017. However, the estate area target, which only covers smallholdings is less than the 2027 condition. Furthermore, oil palm company plantations have reached more than 85,000 ha in 2017. The difference could not be covered using dryland, thus leaving forest conversion as the only possibility.

According to [15] identified influencing factors of landscape management in Sumatra, which include bureaucratic licensing, inaccurate maps, less transparent and incompatible policies. In fact, this could lead to uncertainties for oil palm smallholders in Muara Batang Toru requiring several years to process replanting funds as there is no clear information regarding their area status. Initially, their areas were established as the irrigated paddy field region. However, the designation has changed to plantation region yet the information has not been well socialized among extension workers and statistic staffs that directly interact with smallholders. Oil palm smallholdings are developed from various lands of origin. In Districts Muara Batang Toru, smallholdings were initially opened and designed as paddy field through the transmigration program in 1986. A few years later, several paddy fields have changed into dry land and cultivated with horticultural crops such as beans and lemonades. In 1995, irrigation was built, supporting the development of both paddy fields and horticultural farming. However, horticultural diseases increased and income from paddy production is not enough to support the household expenditures of farmers. Therefore, farmers started to plant oil palm which contracted less diseases, requires less intensive work and provides more financial support from the mills.

According to its overall impact, land conversion can be grouped into 6 levels from the least to most impactful namely palm oil (replanting), other perennial crops (mostly rubber), seasonal crops (mostly
vegetables and herbs), food crops (paddy and corn), peatland and forest (including secondary and primary forests).

Table 1. Land use plan in RTRW and existing condition (ha)

|                        | Target1 | Existing condition |
|------------------------|---------|--------------------|
|                        | 2037    | 20152 | 20173 | 20174 |
| Protection Forest      | 134,176 | 132,520 |
| Sanctuary              | 14,897  | 14,827 |
| Production Forest      | 45,226  | 45,212 |
| Limited Production Forest | 83,626 | 83,925 |
| Wet-land Agriculture/ Irrigated paddy field | 17,791 | 38,495 |
| Dry-land Agriculture/ horticulture | 86,867 | 47,099 |
| Plantations smallholdings | 31,931 | 45,139 | 85,109 |
| companies (private and state) |         |        |        |

Source: 1 South Tapanuli Regional Planning (RTRW) 2017-2037; 2,3 Tapanuli Selatan Regency in Figures 2016 and 2018; 4 Directorate General of Estate Crop, 2018

The largest land of origin consists of perennial and food crops, each consisting of 39% of the 119 total observations (some samples did not answer). Most of the oil palm establishments were independent, without support from state or private companies. Farmers are not aware of the rules regarding land division. The majority of them uses illegitimate seeds and does not follow good agricultural practice. Many have low productivity, although some that are located in fertile lands still enjoy relatively high productivity.

Table 3 shows that a number of regulations from national, province and district levels have been issued to ensure the proportional land use between oil palm plantation and other sectors or commodities. Even so, oil palm areas are increasing at a much higher rate compared to other commodities as farmers perceive that maintaining other crop farms would not provide a better livelihood. For major companies, a larger area will decrease average costs and increase profits. The economies of scale cover all of the agribusiness subsystems of the palm oil agribusiness, which is also supported by a well-functioning input and output market and infrastructures.

Table 2. Conditions of subsystems of main agricultural commodities

| Subsystem | Paddy | Oil palm | Rubber | Coffee | Cacao |
|-----------|-------|----------|--------|--------|-------|
| Input     | 2     | 2        | 1      | 1      | 1     |
| Farming   | 1     | 1        | 1      | 1      | 1     |
| Processing| 1     | 2        | 2      | 2      | 1     |
| Marketing | 1     | 2        | 1      | 2      | 1     |
| Supporting| 2     | 2        | 1      | 1      | 1     |

0 = not available, 1 = available, 2 = available in good condition

For smallholders, such a condition provides broader markets, incentivizing starting or increasing oil palm plantations. The survey shows that 56% of the smallholder samples presume that oil palm is more profitable, thus determined their decision to increase their oil palm land area. However, such a huge specialization could lead to trade-offs between economic gain and ecosystem functions. A large scale of specializations and monocultures could reduce biodiversity and significantly limit ecosystem functions [16]. As part of the specialization stems from the well-functioning of oil palm agribusiness subsystems, similar improvements in subsystems of other commodities are expected to provide incentives for growers to develop other potential commodities as well.
Supported by many parties, the organizing and implementation stages of the programs tend to focus more on oil palm crops. This means that the programs are attempting to further develop oil palm plantations without harming Forest Zone management. Forest Management Units could provide a multiuse landscape management framework in which degraded land suitable for oil palm development could be identified and possibly re-zoned for oil palm, while forests located within (and possible outside but adjacent to it) the zone would be sustainably managed as forests [17]. A similar concept has been designed in detail in a Landscape Model from an NGO that has worked together with the Tapanuli Selatan Government since 2014. Another outcome of the joint work between the NGO and the government is the Sustainable Palm Oil Action Plan 2019-2028. The idea is to increase oil palm smallholder productivity and to implement sustainability principles, thus supporting landscape management practices. One of the sustainable palm oil programs is the field school for smallholders, which is attended by both locals and immigrants. However, the compare mean test indicates that smallholders with a relatively large land size were less interested in participating, shown by the -3,441, -1,874 and -2,595 t values of oil palm, other crops and total land size of participants and non-participants, respectively. On average, the total participant and non-participant land sizes are 2,468 and 3,309 ha, respectively. Among the 91 participants, only 29 possess other types of crop lands, while among the 43 non participants, only 23 possess other types of crop lands. However, the level of education of Field School participants and non-participants are not significantly different. The average education of both groups is in the junior high school level.

The Cross-Tabulation Test results indicate that land size significantly correlate with the decision in land usage and diversification application, shown by the Chi-square values of 13,783 and 3,633, respectively. In addition, the test results also indicate that the level of education significantly relate to smallholder knowledge regarding regional division, land allotment, and land use with Chi square values of 14,451, 16,442, and 5,744, respectively. Most importantly, the results indicate that school field can improve both smallholder knowledge and landscape management implementation, with knowledge on forest benefit and land changes having Chi square values of 32,112 and 24,814, respectively.

4. Conclusions and recommendations
The landscape management in South Tapanuli District is planned by the District Government in the Spatial Planning Document (RTRW). The plan balances social, ecological and economic needs, but is not fully implemented. Therefore, to date oil palm plantations dominate and change the Tapanuli Selatan landscape. The development is voluntary, but is likely influenced by the strong support of policies, programs and facilities from both government and companies. Field School could improve the awareness of regional among smallholders, although most smallholders are not fully informed and understood on landscape management. Therefore, to maintain smallholding sustainability, more socialization and dissemination are needed. In addition, proportional support in policies, programs and facilities for other commodities to develop are also needed. In other words, the ideal landscape management in South Tapanuli District should cover both the implementation of sustainable palm oil as well as the utilization of the potency of other commodities.

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