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RESEARCH PAPER

Sustainability practices among Indonesian oil palm smallholders

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Abstract. Indonesia is the largest oil palm producing country in the world. The increases of plantation area and oil palm production in Indonesia are feared to have negative impacts on environment. As an effort to overcome it, Indonesian Government made a certification called Indonesian Sustainable Palm Oil (ISPO). This research was carried out in plasma plantations in Siak Regency, Riau, Indonesia. The purpose of this study is to determine characteristics of smallholders and application of sustainability aspects in facing ISPO standardization. Results showed that average sample of smallholders who was men, in their productive age, had received 9-year compulsory education program, and had more than 10-year farming experience. Application of economic aspect is in "Very Good" category with a score of 4.80. Application of economic aspect is in "Fairly Good" category with a score of 2.31. The application of environmental aspect is in "Fairly Good" category with a score of 2.77. The application of aspects is not maximal because there are several indicators of ISPO that have not been implemented by the smallholders.

Keywords: oil palm; ISPO; economic; social; environment

1. Introduction

Agricultural and plantation development is one of the factors that has an important role in increasing national economic growth and improving people's living standards. One of the agricultural commodities which is considered to improve the standard of living and in great demand by the Indonesian people is oil palm (*Elaeis guneensis jacq*.). Oil palm is one type of plantation with economic value that is of the highest size and a leading commodity for Indonesia (Fuadah & Ernah, 2018). This makes Indonesia as the largest oil palm producer in the world. Every year there is an increase in the plantation area and amount of oil palm production in Indonesia. From 2011 to 2015, the area increased by 20.13% and production increased by 25.66%. Increased area and production of oil palm in Indonesia can be seen in Table 1.

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Palm oil products consistently receive negative press and criticism, for causing deforestation, land use changes, peat land conversion, species loss, greenhouse gas emissions, biomass waste generation, violation of indigenous people's rights and limited local employment (Lim & Biswas, 2019). Non-Governmental Organizations (NGOs) have assessed that the increase of area and oil palm production can lead to various environmental problems and issues. Indonesian NGOs regard the expansion of oil palm plantations as the main cause of illegal land clearing, habitat destruction, dredging of national parks, and deforestation (Lestari et al., 2015). Indonesia's oil palm plantations are also considered to be the cause of deforestation and forest fires which trigger world gas emissions, losses of the world's lungs, and decreases of the number of protected flora and fauna (Sibarani et al., 2015).

Table 1. Plantation area and oil palm production in Indonesia

Year	Area (ha)	Production (ton)
2011	8,992,824	23,096,541
2012	9,572,715	26,015,518
2013	10,465,020	27,782,004
2014	10,754,801	29,278,189
2015	11,260,277	31,070,015

Source: Directorate General of Plantation, 2016

As an effort to overcome the challenges of developing oil palm plantations and the increasing competition of international trade, Indonesian Government has made a standard called Indonesian Sustainable Palm Oil (ISPO). Nowadays, standards play a central role in the governance of international business relations; oil palm is no exception (Kadarusman & Herabadi, 2018).

ISPO was made in 2011 which was later revised to Minister of Agriculture Regulation Number 11/Permentan/OT.140/3/2015. ISPO was made to improve the competitiveness of Indonesian oil palm in the world market and to help reduce greenhouse gases and give attention to environmental problems as well (ISPO, 2015). ISPO is a certificate that must be owned by all industries, plantation operators, oil palm producers and derivative products that are operated in Indonesia, for plasma plantations and independent plantation are still voluntary (Fadillah, 2018). ISPO consists of sustainability indicators, criteria, and principles. Sustainability indicators are increasingly seen as important tools in the implementation of sustainable development (Morse et al., 2001).

There are two stages in ISPO, standardization and certification. Before obtaining ISPO certificate, the plantation enterprise must fulfill all ISPO standards and indicators. After that, the plantation enterprise can register its enterprise for certification. If the plantation enterprise is declared feasible at the time of certification, then the plantation enterprise is entitled to an ISPO certificate (Kementerian Pertanian, 2015). ISPO standardization and certification is carried out to support sustainable oil palm agriculture. Oil palm sustainability can be achieved if there is integration between three main pillars of development, which are sustainability in economic, social, and environmental aspects (Agustina et al., 2014).

ISPO has seven principles, namely: plantation legality, plantation management, protection of the use of primary natural forests and peat lands, environmental management and monitoring, responsibility for workers, social responsibility and community economic

empowerment, and sustainable enterprise development. ISPO in Minister of Agriculture Regulation Number 11/Permentan/OT.140/3/2015 is divided into several appendices that are adjusted to the type of enterprise, namely:

(i) Appendix II for plantation companies conducting an enterprise in plantation cultivation integrated with processing and renewable energy

(ii) Appendix III for plantation companies conducting a business in plantation cultivation

(iii) Appendix IV for companies conducting a business in processing plantation products

(iv) Appendix V for plasma plantations

(v) Appendix VI for independent small-scale business enterprises

While the ISPO may appear good on paper, it is difficult to judge to what extent these practices are used by smallholders as oil palm producers, especially because the specification of ISPO principles and criteria are not always precise (Ernah et al., 2016). The non-mandatory implementation of ISPO for plasma plantation has made many plasma smallholders neither apply the ISPO standards nor obtain ISPO certificates. Plasma plantation is smallholders' plantation enterprise that has partnership with a company. At the end of 2018, only three plasma plantationa in Indonesia have received ISPO certificates (BPDP, 2018).

One of the plasma plantations that will face ISPO standardization is plasma plantation located in Siak Regency, Riau, Indonesia. This plasma plantation targeted the implementation of the ISPO standards in 2019 and obtained an ISPO certificate in 2020. This condition is interesting to study, to see the extent of ISPO principles and criteria in that plasma estate.

ISPO for plasma plantations consists of six principles, which are: legality of the plasma plantation, plasma plantation management, environmental management and monitoring, responsibility for occupational health and safety, social responsibility and community empowerment, sustainable enterprise improvement. Business legality is needed so that all activities in the plasma plantation business are legitimate in the eyes of the law, known by the state, and the location is in accordance with the designation. Plantation management is needed to maintain the quality and quantity of Fresh Fruit Bunches (FFB). Environmental management and monitoring is needed, to minimize the environment impact. Responsibility for occupational health and safety must be applied to ensure the safety, health and security of smallholders in carrying out farming activities. Social responsibility and community empowerment aims to help communities around the plantations. Sustainable enterprise improvement is needed as a form of improvement from the cultivation activity evaluation in plasma plantation.

Based on the description above, this study aims to find out and explain the implementation of social, economic, and environmental aspects based on the ISPO principles and criteria carried out by plasma smallholders in Riau, Indonesia.

2. Literature review

2.1. Sustainable development

In response to development with high economic growth without causing a decrease in production capacity or environmental quality, the concept of sustainable development was formulated. This concept was formulated in 1987 in the Bruntland Report as a result of the United Nations Congress on Environment and Development. In the Bruntland Report, sustainable development is a development that embodies the present needs without reducing the ability of future generations to realize their life needs. Sustainable development must be

socially just, not sacrifice the environment, and must think about the needs of the next generation. Serageldin (1996) explains that sustainable development is integrated into three aspects of life in a synergistic relationship. The three aspects of life and sustainable development goals are economic, social and environmental aspects and all three can be described as "a triangular framework".

Sustainable development is a development that supports social justice, supports economy, and preserves environment to realize the current needs of life without reducing the opportunity for future generations to enjoy and use the environment. Thus, sustainable agricultural development can be achieved if it meets three aspects, namely: social, economic and environmental aspects.

2.2. Social aspect

According to Hurlock (2003), social behavior is described as a person's behavior in society in response to what he feels. Such behavior is shown through feelings, actions, and attitudes to others. Social behavior is a person's physical and psychological activities towards other people and vice versa in order to meet self-needs in accordance with social demands. Ibrahim (2001) states that social behavior is an effort to guarantee human existence because there is an atmosphere of interdependence which is a necessity. This behavior becomes a proof that a human cannot live alone, but needs another person to help him. Every human being depends on each other. For this reason, people are required to be tolerant in living in a society and have mutual respect. Thus, social behavior is the activity of someone towards other people in society which is shown in different ways. This is done because humans have the nature of interdependence and can't live alone. Therefore, the community must be tolerant and respectful.

2.3. Economic aspect

According to Sukirno (2013), economics is a science that is very broad in scope, usually associated with the ability of production factors to produce goods and services, as well as the desire of people to obtain goods and services. Economics can also be interpreted as a study of individuals in society in making a decision to use limited resources to produce various goods and services, and distribute them to the public (Samuelson and William, 2003). In the economy, there are a number of objectives to achieve, namely: achieving rapid economic growth, creating price stability, overcoming the problem of unemployment, and realizing equitable income distribution (Sukirno, 2013). Hanafie (2010) states that agricultural economics studies human behavior and efforts, both directly and indirectly related to the production, distribution, and consumption of agricultural products. These efforts include organizing, capitalizing, managing labor to produce and market a variety of goods needed by humans. According to Mubyarto (1989), agricultural economics is general economics that studies phenomena and issues related to agriculture, both micro and macro. The agricultural economy is not only limited to the production, processing, distribution and consumption of agricultural products, but also about agricultural policies, agricultural laws, and land rights.

2.4. Environmental aspect

Environment is the sum of all inanimate and living things and all conditions that are in the room we occupy (Supardi, 2003). According to Rivai and Anugrah (2016), the dimensions of the natural environment emphasize the need for the stability of natural ecosystems which include biological living systems and natural materials, which include the maintenance of biodiversity

and biological carrying capacity, land, water and agro-climate resources, and environmental health and comfort. Soegianto (2010) describes the environment as all external factors that influence an organism; these factors can be in the form of living organisms (biotic factors) or non-living variables (abiotic factors), where there are two main components of the environment, namely: biotic (organism) and abiotic (energy, chemicals, etc.). So, the environment is a unit of inanimate and living things, including human behavior that can affect nature and the welfare of humans and other living things in it.

2.5. Oil palm

Oil palm (*Elaeis guineensis jacq.*) is one of the most important vegetable oil producing plants. Today, oil palm grows as a cultivation crop that is spread in various tropical countries and even approaches subtropics in Asia, South America and Africa. In Indonesia, the distribution is in Sumatra, Java and Kalimantan. Hakim (2013) distinguishes oil palm into four types (varieties) based on the thickness of shell and oil content in the fruit, namely: Dura, Pisifera, Tenera, and Marcocarya. Oil palm can grow well in the wet tropics around 12° North Latitude and 12° South Latitude at an altitude of 0-500 masl. If oil palm is planted at an altitude of 400-500 masl, it can inhibit production, because the air temperature becomes cool. The optimal rainfall for oil palm plants is around 2,000-2,500 mm per year with a sunshine duration of 5-7 hours per day. The optimum temperature of oil palm cultivation ranges from 24-39°C (Mawardati, 2010).

2.6. Plasma plantation

According to Sudrajat et al. (2007), plasma plantation businesses are smallholder plantations whose development is integrated into both Private Plantation (PBS) and State Plantation (PBN) because of inadequate farmer skills, while business funds are bailed out by the government through banking in the form of credit. This program has been implemented since 1977 with the issuance of the Nucleus Estate Plantation (PIR) program and in 1986, the program was integrated with the transmigration program. Mawardati (2010) states that plasma plantations are businesses managed by farmers with various limitations, such as low education and weak capital, so that plantation companies are present to foster and develop the smallholding business. It can be concluded that plasma plantation is community-owned plantation businesses whose land comes from the government or the people and is facilitated by plantation companies to develop plantations and foster farmers, due to limitations in education or capital.

3. Research methods

3.1. Research site

This research was carried out at plasma plantation located in Siak Regency, Riau, Indonesia. This location was chosen because this plasma plantation is facing ISPO standardization in 2019 and obtained an ISPO certificate in 2020.

Figure 1. Map of research location

3.2. Data collection

This study uses mixed-method design. Mixed method is a research design that combines quantitative and qualitative methods to use together so that it can be obtained more comprehensive, valid, reliable and objective data (Sugiyono, 2017). The research method used is descriptive survey. Descriptive survey method is employed to obtain data from a particular place, but the researcher treats data collection, for example, by distributing questionnaires, tests, and structured interviews (Sugiyono, 2017). Determination of the samples uses Arikunto sampling technique which is explained. If number of population in research site is less than 100, then all respondents are used as samples. If population is more than 100, sample can be taken between 10-15% or 20-25% or more (Arikunto, 2012). The population of plasma plantation is 215 households and 32 smallholders determined as samples.

3.3. Data analysis

Data were analyzed descriptively using Guttman Scale. This scale was employed to get evident answers to the stated problems. The highest score for each answer is 1 and lowest score is 0. Guttman scale can be made in the form of multiple choice or checklist (Sugiyono, 2017). To find out the application of economic and social aspects based on ISPO, the modified Guttman Scale was used. Through this scale, respondents who have implemented ISPO standards will get higher score, while those who have not implemented them will get lower score. The implementation of ISPO standards in plasma plantation is grouped into five interval scales, namely: very good, good, fairly good, deficiently good, and not good (Table 2). Calculation of the implementation of ISPO standards uses a modified formula (Sibarani et al., 2015):

- For each criteria implementation:

$$\text{Interval Scale} = (\text{highest score} - \text{lowest scale})/(\text{total groups}) - 0.01 \quad (1)$$

where the highest score is 5 and the lowest score is 0. Total group is 5.

Table 2. Category based on interval scale

Category	Interval Scale
Very good	4.00 – 5.00
Good	3.00 – 3.99
Fairly good	2.00 – 2.99
Deficiently good	1.00 – 1.99
Not good	0.00 – 0.99

The average score for each criteria is calculated by summing the scores of each sample for certain criteria, divided by the number of samples. The average score in each criteria is calculated by this formula:

$$\bar{x}_k = \frac{\sum_{s=1}^{n} x_{ks}}{n} \quad (2)$$

where $\bar{x}_k$ is the average score for all samples in each criterion (k), x_{ks} is the total of sample's score (s) in each criterion (k), and n is the total sample.

- For each aspect

$$\bar{x} = \sum_{k=1}^{n} \left[\frac{\sum_{s=1}^{n} x_{ks}}{n} \right] \quad (3)$$

where $\bar{x}$ is the average score for all samples of each criterion (k) in each aspect, $\bar{x}_k$ is average score for all samples in each criterion (k), and n is the total criteria.

4. Results and discussion

4.1. Plasma smallholder's characteristics

The majority of smallholders in plasma plantation in Riau Province are male (81.25%). This is because oil palm cultivation is a risky farming and requires large amounts of labor. Most smallholders (78.13%) are in the productive age and all smallholders (100%) have received the 9-year compulsory education program. Thus, smallholders can follow the development of Good Agriculture Practices (GAP). The majority of smallholders' experience of oil palm cultivation are over 10 years (65.63%), thus making them more experienced, able to increase their productivity, and respond quickly to solve cultivation problems.

4.2. ISPO implementation

Based on the observations, plasma plantation in Riau, Indonesia has tried to implement indicators of ISPO that are used in this research (Table 3). The implementation of ISPO indicators is presented in Table 4.

Table 3. ISPO Indicators

Principles	Criteria	Indicator
Plantation Legality	Plasma Plantation Legality	Smallholders have land certification
		Smallholders have Plantation Enterprise Registration Certificate (STB-D)
		Smallholders have signed document to join group
		Smallholders have conversion document from plantation companies to smallholders
		Smallholders have document of cooperation between plantation companies and group
	Plasma Plantation Location	Plasma plantation location is in accordance with its designation by referring to spatial planning or local regulations
		Land use permits are available by the company
		Farmers have Forest Zone Release Permits
		Access to plasma plantation locations supports transportation
		Smallholders have location maps
Plantation Management	Plantation Management	Smallholders are members of group
		Group has a group management structure
		The cooperative has a cooperative management structure
		Group and cooperative make a Plan Operational Activities for farmers
		Smallholder and group documentation
		Smallholders know cooperative's *Anggaran Dasar/Anggaran Rumah Tangga* (Articles of Association)
		Plantation is free from overlapping land
		Plantation is free from disputes
		Smallholders provide information about their plantations to stakeholders
		Smallholders provide information about their plantations to those in need
	Application of Cultivation Technical Guidelines and Oil palm Carriage	Smallholders have work instructions for clearing land
		Smallholders maintain springs found on plantation land
		Smallholders do not plant around water sources
		Smallholders use government recommended seeds
		Smallholders have planting planning
		Smallholders make arrangements for the number of plants and the distance of plants
		Smallholders plant land cover crops
		Smallholders make plantation water system
		Smallholders do inserts to maintain the number of plants
		Smallholders maintain the terracing
		Smallholders maintain the disk
		Smallholders maintain the land cover crops
		Smallholders do sanitation and weeding
		Smallholders fertilize according to the plantation needs
		Smallholders control the pest with integrated pest management
		Smallholders use pesticides that are recommended by government
		Smallholders handle plantation waste
		Smallholders prepare labor if they enter the harvest period
		Smallholders provide facilities and equipment for harvesting
		Smallholders determine the criteria for harvest according to the color of the fruit
		Smallholders determine harvest rotation
		Smallholders have transportation and supporting facilities for transporting fruit
		Smallholders transport FFB to the processing site less than 24 hours

Table 4. Cont'd

Principles	Criteria	Indicator
		Smallholders record prices and sales of FFB
		Smallholders record the amount of FFB that are appropriate and not
		Smallholders, groups or cooperatives monitor price information for FFB pricing
Sustainable Enterprise Improvement	Sustainable Enterprise Improvement	Smallholders make improvements from the results of internal evaluations and suggestions from plasma managers and other relevant agencies
Occupational Health and Safety	Occupational Health and Safety Implementation	Smallholders have occupational health and safety instruction
		Plasma managers carry out occupational health and safety training and campaigns
		Smallholders know the records of accidents and occupational health problems
		Plasma managers carry out regular health checks on smallholders
		Smallholder has equipment for safety occupational
Social Responsibility and Community Empowerment	Social Responsibility and Community Empowerment	Cooperatives provide assistance to the community
		Cooperatives provide assistance to the community in the form of facilities
		Cooperatives have held activities for the community
		Cooperatives make savings and loans
		Cooperatives provide equipment assistance for economic activities
Environmental Management and Monitoring	Obligations Related to Environmental Permits	Smallholders have environmental permit
		Smallholders implement environmental permit in plantation management
		Smallholders submit reports on the implementation of environmental permit to plasma manager
	Fire Prevention and Management	Smallholders have fire prevention and management instruction
		Smallholder conduct fire prevention training
		Smallholders have guidelines for land clearing with no burning
		Smallholders have facilities and infrastructure for fire control and prevention
		There is a fire prevention brigade or human resources that prevents fires
	Conservation of Biodiversity	Plasma managers/cooperatives/group leaders socialize to smallholders about biodiversity and conservation efforts
		Smallholders have a list of animals and plants in and around the plantation
		Smallholders know animals and plants that are in and around the plantation
		Smallholders make efforts to conserve animals and plants such as making buffer zones, posters, warning boards, etc.
		Smallholders report to Natural Resources Conservation Center (BKSDA) if there are rare animals/plants in their plantation area

Source: ISPO Standards based on Minister of Agriculture Regulation Number 11/Permentan/OT.140/3/2015

4.2.1. Economic aspect ISPO implementation

Criterion 1: Legality of plasma plantation (C1)

Legality of plasma plantation must fulfill several indicators that are based on ISPO principles (Table 3). The aim of these indicators is to make the plantation legally recognized in the eyes of law and state. Based on observations, all (100%) sample farmers have not fully fulfilled the Plantation Legality indicators contained in ISPO. The implementation of Plantation

Legality is measured by using Equation 1, where the average is $\bar{x}_k$= 128/32 = 4 (see Table 4). It implies that plantation legality is classified as "very good" (see Table 2) or a percentage 80.00% (maximum score is 5). However, there is still 1 out of 5 indicators that has not been fulfilled by all smallholders, which smallholders have conversion documents from companies to planters. This is because there was change in partner company tutorial in 2005, from Medan to Riau tutorial, and therefore the documents were still in Medan Head Office.

Criterion 2: Location of plasma plantation (C2)

The best location of oil palm plantations must fulfill several indicators that are based on ISPO principles (Table 3). The aim is to make sure that plasma plantation does not violate local regulations and is in line with its designation. Based on observations, all smallholders (100%) have fully fulfilled the indicators. By using Equation 1, where $\bar{x}_k$ = 160/32 = 5, the implementation of this criterion is classified as "very good" with a score of 5 or a percentage of 100.00% (maximum score is 5). All smallholders (100%) have fulfilled and implemented 5 of the 5 indicators in ISPO.

Criterion 3: Management of plasma plantation (C3)

Good management of smallholdings must fulfill several indicators pursuant to ISPO principles (Table 3). The purpose of these indicators is to make all smallholders involved and participate in plasma plantation organization. Based on observations, all smallholders (100%) have fully fulfilled the indicators. According to Equation 1, it is calculated that the average is $\bar{x}_k$= 160/32 = 5. This implies that the implementation of this criterion is classified as "very good" with a score of 5 or a percentage of 100.00% (maximum score is 5). All smallholders (100%) have fulfilled and implemented 10 out of 10 indicators.

Criterion 4: Application of cultivation technical guidelines and oil palm carriage (C4)

The application of cultivation technical guidelines and oil palm carriage must fulfill several indicators pursuant to ISPO principles (Table 3). The aim is to make smallholders maintain the quality and quantity of Fresh Fruit Bunches (FFB). Based on the results of observations, all sample farmers (100%) did not fulfill the indicators in this criterion. The application of this criterion is classified as "very good" with a score of 4.8 ($\bar{x}_k$= 153.6/32 = 4.8) or a percentage of 96.00% (maximum score is 5). All smallholders (100%) have only fulfilled 24 out of 25 indicators. The indicator that has not been fulfilled by all smallholders is handling waste. Waste is divided into three based on its forms, which are: solid, liquid, and gas (Abdurrahman, 2006). All smallholders stated that there was no liquid and gas waste in the plasma plantation. However, there was solid waste in the form of empty bunches, midribs, and loose fruit. All smallholders let the three wastes in the plantation, because they could be used as fertilizer for the plantation.

Criterion 5: Sustainable enterprise improvement (C5)

The implementation of Sustainable Enterprise Improvement must fulfill indicators pursuant to ISPO principles (Table 3). The aim is to make improvements to the evaluations and suggestions provided. Based on observations, all smallholders (100%) have fully fulfilled indicators of this criterion contained in ISPO. The implementation of this criterion is classified as "very good" with a score of 5 ($\bar{x}_k$= 160/32) or a percentage of 100.00% (maximum score is 5). All smallholders (100%) have fulfilled and implemented 1 of 1 indicator based on ISPO principles and criteria. Several suggestions followed up and implemented by smallholders are as follows: maintaining the quality of FFB, paying attention to harvest criteria, not harvesting raw fruits, carrying out plantation sanitation, preventing FFB harvesting with long stalks, and also

maintaining disk and terracing at least twice a year. The suggestions followed up were partly derived from Plasma Manager. Warning banners were also made in several plantation areas, to make all smallholders remember the suggestions and implement them while carrying out cultivation activities.

Based on these five criteria, the average of the economic aspect implementation in Riau plasma plantation is following Equation 2, where:

$$\bar{x} = \sum_{k=1}^{n} \left[\frac{\sum_{s=1}^{n} x_{ks}}{n} \right] = \frac{4 + 5 + 5 + 4.8 + 5}{5} = 4.8$$

This value means that in terms of economic aspect, plasma plantation is categorized as "very good". However, even though it is already in "very good" category, there are still 2 ISPO indicators that have not been implemented by smallholders, which are: the availability of conversion documents from companies to planters and waste management.

4.2.2. Social aspect ISPO implementation

Criterion 6: Responsibility for occupational health and safety (C6)

Responsibility for good occupational health and safety must fulfill 5 indicators pursuant to ISPO principles (Table 3). The aim is to minimize smallholders' work accidents. The average of this criterion application is $\bar{x}_k$= 31/32 = 0.97. This value falls in "not good" category or a percentage of 19.38% (maximum score is 5). The low score on this criterion is because all smallholders (100%) have not implemented 4 out of 5 indicators, which are: availability of occupational health and safety instructions, training and campaigning on occupational health and safety, availability of accidents and work disruptions records, and regular health checks for smallholders by Plasma Manager. Occupational health and safety instructions are only available at the nucleus, so there has been no training and campaign on occupational health and safety to smallholders. The low level of concern of smallholders in occupational health and safety instructions made farmers never record the accidents and work disruptions that had occurred during activities. Plasma Managers have never checked the health of smallholders regularly, because plasma plantation in Riau has just implemented replanting, so the new harvesting activities just began in early 2019.

Criterion 7: Social responsibility and community empowerment (C7)

Social responsibility and community empowerment must fulfill 5 indicators pursuant to ISPO principles (Table 3), so the community around plantation is prosperous. The application of this criterion is classified as "good" category with a score of 3.66 ($\bar{x}_k$= 117/32) or a percentage of 73.13% (maximum score is 5). There are 2 out of 5 indicators that have not been implemented, which are: cooperatives provide assistance to the community (facilities) and provide equipment assistance for economic activities. All smallholders (100%) stated that cooperatives had not provided assistance in facility, whether it was educational, religious, or health. This is because facilities in village are still adequate and can be easily reached by community. Meanwhile, equipment assistance for economic activities has not been evenly distributed. There are 10 smallholders (31.25%) who have never received equipment assistance, because smallholders have never asked the cooperatives.

Based on these two criteria, the social aspect implementation in Riau plasma plantation by using Equation 2 is:

$$\bar{x} = \sum_{k=1}^{n} \left[\frac{\sum_{s=1}^{n} x_{ks}}{n} \right] = \frac{0.97 + 3.66}{2} = 2.31$$

This value falls in "fairly good" category. This is because there are several indicators from ISPO principles that have not been implemented such as occupational health and safety instructions, training and campaigns on occupational health and safety, smallholders know accidents and occupational health problems records, periodic smallholders' health checks by Plasma Manager, smallholders have work safety facilities, cooperatives provide assistance in the form of facilities, and cooperatives provide equipment assistance for community economic activities.

4.2.3. Environmental aspect of ISPO implementation

Criterion 8: Obligations related to environmental permits (C8)

The implementation of this criterion must fulfill 3 indicators pursuant to ISPO principles (Table 3). Based on observations, all smallholders (100%) have not fully fulfilled indicators of this criterion contained in ISPO. The implementation of this criterion is classified as "good" with a score of 3.33 ($\bar{x}_k$= 105.6/32) or a percentage of 66.00% (maximum score is 5). All smallholders (100%) have fulfilled and implemented 2 out of 3 indicators based on ISPO principles and criteria. The indicator that has not been fulfilled and implemented by all smallholders is submission of reports on the application of environmental permits. The period for submitting the implementation report to the requirements and obligations in the Environmental Permit is once every 6 months. All smallholders (100%) have not submitted the reports to their manager once every 6 months.

Criterion 9: Fire Prevention and Management (C9)

The implementation of this criterion must fulfill 5 indicators pursuant to ISPO principles (Table 3). Based on observations, all smallholders (100%) have not fully fulfilled indicators of this criterion contained in ISPO. The application of this criterion is classified as "good" with a score of 3 ($\bar{x}_k$= 96/32) or a percentage of 60.00% (maximum score is 5). All smallholders (100%) have fulfilled and implemented 3 out of 5 indicators based on ISPO principles and criteria. The indicators that have not been fulfilled and implemented by all smallholders are: conduct fire prevention training and have facilities and infrastructure for fire control and prevention. Smallholders never conduct any training because they never experience land fire in their plantation. If smallholders need any kind of facilities and infrastructures for fire control, they need to call the District Government, and the government will send their team to the plantation.

Criterion 10: Conservation of biodiversity (C10)

The implementation of this criterion must fulfill 5 indicators pursuant to ISPO principles and criteria (Table 3). Based on observations, all smallholders (100%) have not fully fulfilled indicators of this criterion contained in ISPO. The implementation of this criterion is classified as "fairly good" with a score of 2 ($\bar{x}_k$= 64/32) or a percentage of 40.00% (maximum score is 5). All smallholders (100%) have fulfilled and implemented 2 out of 5 indicators based on ISPO principles and criteria. The indicators that have not been fulfilled and implemented by all smallholders are: have a list of animals and plants in and around the plantation, make efforts to conserve animals and plants such as making buffer zones, posters, warning boards, etc., and

report to BKSDA (Natural Resources Conservation Center) if there are rare animals/plants in their plantation area.

Based on these three criteria, the environmental aspect implementation in Riau plasma plantation is in "fairly good" category with a score of 2.77 (maximum score is 5). This is because there are several indicators from ISPO principles that have not been implemented, which are: submission of reports on the application of environmental permits, conduct fire prevention training, have facilities and infrastructure for fire control and prevention, have a list of animals and plants in and around the plantation, make efforts to conserve animals and plants such as making buffer zones, posters, warning boards, etc., and report to Natural Resources Conservation Center (BKSDA) if there are rare animals/plants in their plantation area.

Table 4. The measurement of ISPO indicators implementation of oil palm smallholders

	Principle	Criteria	Average (Equation 1)	Average (Equation 2)
Economic aspect	Plantation legality	Plasma plantation legality (C1)	4.00 (very good)	4.80 (very good)
		Plasma plantation location (C2)	5.00 (very good)	
		Plasma plantation management (C3)	5.00 (very good)	
		Application of cultivation technical guidelines and oil palm carriage (C4)	4.80 (very good)	
	Sustainable Enterprise Improvement	Sustainable enterprise improvement (C5)	5.00 (very good)	
Social aspect	Occupational Health and Safety	Occupational health and safety implementation (C6)	0.97 (not good)	2.31 (fairly good)
	Social responsibility and community empowerment	Social responsibility and community empowerment (C7)	3.66 (good)	
Environmental aspect	Environmental management and monitoring	Obligations related to environmental permits (C8)	3.33 (good)	2.77 (fairly good)
		Fire prevention and management (C9)	3.00 (good)	
		Conservation of biodiversity (C10)	2.00 (fairly good)	

4.3. Color mapping of sustainable aspects implementation

In order to make it easier for readers to see the results, a color mapping is applied to the ISPO implementation (see Table 5). Color mapping technique is part of one of the image segmentation techniques using the clustering method. Clustering method is used because color

is given to groups that have certain similarities so that the steps taken have similarities with the clustering method (Widodo et al., 2009). There are five categories in this study, which are: not good, deficiently good, fairly good, good, and very good. Each category is given different colors, which are: red for "not good" category, orange for "deficiently good" category, yellow for "fairly good" category, green for the category "good", and blue for the category "very good". Based on the color mapping, the implementation of the ISPO principles and criteria to smallholdings in Riau plasma plantation is mostly blue, which means that the average smallholders in the plasma plantation are in the "very good" category. However, there are still several criteria in another color, such as: green, orange, yellow, and even red.

Table 5. Color mapping

No. Sample	Economic Aspect					Social Aspect		Environmental Aspect		
	P1		P2		P6	P4	P5	P3		
	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10
1	4	5	5	4.8	5	1	3	3.3	3	2
2	4	5	5	4.8	5	1	3	3.3	3	2
3	4	5	5	4.8	5	1	3	3.3	3	2
4	4	5	5	4.8	5	1	4	3.3	3	2
5	4	5	5	4.8	5	1	3	3.3	3	2
6	4	5	5	4.8	5	1	4	3.3	3	2
7	4	5	5	4.8	5	1	3	3.3	3	2
8	4	5	5	4.8	5	1	4	3.3	3	2
9	4	5	5	4.8	5	1	4	3.3	3	2
10	4	5	5	4.8	5	1	4	3.3	3	2
11	4	5	5	4.8	5	1	3	3.3	3	2
12	4	5	5	4.8	5	1	4	3.3	3	2
13	4	5	5	4.8	5	1	3	3.3	3	2
14	4	5	5	4.8	5	1	4	3.3	3	2
15	4	5	5	4.8	5	1	4	3.3	3	2
16	4	5	5	4.8	5	1	4	3.3	3	2
17	4	5	5	4.8	5	1	4	3.3	3	2
18	4	5	5	4,8	5	1	4	3,3	3	2
19	4	5	5	4,8	5	1	4	3,3	3	2
20	4	5	5	4,8	5	1	3	3,3	3	2
21	4	5	5	4,8	5	1	4	3,3	3	2
22	4	5	5	4,8	5	1	4	3,3	3	2
23	4	5	5	4,8	5	1	4	3,3	3	2
24	4	5	5	4,8	5	1	4	3,3	3	2
25	4	5	5	4,8	5	0	3	3,3	3	2
26	4	5	5	4,8	5	1	4	3,3	3	2
27	4	5	5	4,8	5	1	4	3,3	3	2
28	4	5	5	4,8	5	1	4	3,3	3	2
29	4	5	5	4,8	5	1	3	3,3	3	2
30	4	5	5	4,8	5	1	3	3,3	3	2
31	4	5	5	4,8	5	1	4	3,3	3	2
32	4	5	5	4,8	5	1	4	3,3	3	2
Total Score	128	160	160	153,6	160	31	117	105,6	96	64
Average Criteria Score	4	5	5	4,8	5	0,97	3,66	3,3	3	2
Average Aspects Score	4,80					2,31		2,77		

5. Conclusion

The economic aspect implementation to plasma plantations is in "Very Good" category with a score of 4.80 (maximum score is 5). The social aspect implementation is in "Fairly Good" category with a score of 2.31 (maximum score is 5). The environmental aspect implementation is in "Fairly Good" category with a score of 2.77 (maximum score is 5). The score of sustainable aspect has not been maximized due to the several indicators on the ISPO Principles and Criteria that have not been fulfilled and applied by smallholders in Riau plasma plantation.

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