

An Analysis of Oil Palm Plantation Contribution Toward Jambi Province's Food Security

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Abstract. An increasing in population growth causes the need for a new strategy to meet sustainable food security. The key word for food security is to provide sufficient food, both quantity and quality, safety, equitable and affordable for all citizens in a sustainable manner. The ability to provide food is highly dependent on the level of community income. Sufficiency of community income to be able to access food is one of the dominant problems in determining the achievement of food security in an area. The purpose of this study was to analyze the contribution of oil palm plantations in achieving the household food security, as well as to analyze the dimensions of the sustainability of oil palm plantations related to the achievement of household food security in Jambi Province. The results showed that the income of smallholder from oil palm farming had a real contribution in meeting the expenditure needs for family food. The results also show that from the Ecological and Economic Dimensions, oil palm farming in Jambi Province cannot be said to be sustainable, while from the Social, Technological and Institutional Dimensions, oil palm farming can be said to be sustainable.

Keywords: Food security · Income · Oil palm plantations · SDGs · Sustainability

1 Introduction

1.1 Background

Community welfare is still an important issue in the development of almost all countries. The issue of fulfilling welfare which can be defined as the fulfillment of economic, social, and healthy environmental needs is found in almost all the goals to be achieved through the SDGs by every country in 2030 [1]. There are at least 10 (ten) goals among the 17 (seventeen) goals that must be met, fulfilled by every country in 2030 which is directly related to welfare aspects, two out of them are the elimination of poverty and hunger.

The population that continues to grow is a burden in realizing food security, namely the elimination of poverty and hunger. Statistical data shows that the population of Jambi Province is growing even though the growth pattern is decreasing. This implicitly indicates a growing need. On the other hand, the urgency of the scarcity of productive labor in rural areas and the increasingly intense supply of information have caused a number of farmers to choose to shift the function of their land resources to cultivate agricultural commodities that are more capital-intensive. The contribution of agriculture to regional income has proven to be maintained and even tends to increase.

The production value of agricultural commodities in Jambi Province tends to increase in an average of 12.06% per year during the period 2010 to 2021. The increase in the value of agricultural production has caused the contribution of the agricultural sector to grow quite significantly, from 26.07% in 2010 to 31.56% in 2020. The increase in the contribution of the agricultural sector with the leading commodity of oil palm is a separate opportunity that can be utilized by the community to achieve food security.

Since its introduction through the transmigration program in 1982, the oil palm plantation business has experienced consistent growth in Jambi Province. The area of oil palm plantations in Jambi Province has consistently increased from 532,293 Ha in 2011 to 1,033,354 Ha in 2020 [2]. The development of the oil palm planting area can be an indicator that this farming can be relied on as a source of income by the community to meet food needs and realize food security at the household level. This study was conducted to analyze: The contribution of oil palm plantations to the achievement of household food security and to examine the dimensions of the sustainability of oil palm plantations related to the achievement of household food security in Jambi Province.

1.2 Oil Palm

Oil palm (*Elaeis guineensis Jacq.*) is one of the imported plants that thrives in Indonesia and has even become one of the leading commodity-producing plants for the national economy. Some literatures refer that the oil palm plant originated from Nigeria–West Africa. However, a number of other authors stated that this plant actually came from Brazil, one of the countries in South America. Oil palm plants can thrive outside their native areas, such as in Malaysia, Indonesia, Thailand, and Papua New Guinea. Today, even oil palm plants have an important meaning and become a mainstay in the development of the national economy.

One of the important roles of oil palm plantations is to provide employment not only to farmers who own the plantations but also to a number of communities around the plantations, namely as laborers or freelancers on large plantations and non-governmental organizations. In addition to being able to act as a provider of employment, oil palm plants also contributes to creating foreign exchange for the country [3].

Oil palm plants are plants that can be found growing in various areas from 0 to 1000 m above sea level [4]. Oil palm plants can also thrive in topography with a slope of $0^{\circ}-12^{\circ}$. High adaptation at various altitudes causes oil palm plants to be found in various areas.

1.3 Sustainable Development Goals (SDG's)

Community welfare is the main goal of nation building which can be realized through economic development. On the other hand, a prosperous society is one of the factors in realizing sustainable economic development (SDGs). Sustainable economic development is an economic development aimed at improving the quality of life of the community, both in present and future generations. The realization of intergenerational community welfare has been agreed at the Rio de Jeneiro conference in 2012, namely through sustainable development called the Sustainable Development Goals (SDGs). It has been agreed to make the SDGs a framework for social, economic and political development of each country. The SDGs development framework is primarily aimed at improving people's welfare through eradicating poverty and hunger, reducing inequality both within and between countries. The eradication of poverty globally is carried out by protecting the earth through wise use of inputs, improving water and energy management, and taking strategic steps to address climate change. Two of the 17 goals in the SDGs are to free citizens from poverty in all its forms (Poverty), and to end hunger, achieve food security, improve community nutritional status, and promote sustainable agricultural practices.

1.4 Food Security

Food security can be defined as a condition in which the household needs of the people of an area can be met, which is reflected in the availability of sufficient food, both in terms of quantity and quality, safe, equitable and affordable by the community. This understanding is in accordance with the Law on Food No. 18 Year 2012, as well as the Declaration of Rome in 1996 and the Constitution of Indonesia Year 1945. In simple terms it can be understood that food is a basic need of every human being. The fulfillment of basic needs is a basic right of every citizen whose fulfillment is the responsibility of the government.

Food problems can technically be separated into three components, namely: availability, distribution and consumption. From the aspect of availability, it can be explained that food security cannot be separated from the seasonal nature of food commodity production. From the aspect of food distribution, the problem begins with food which is generally produced in rural areas separated from the location of consumers. No small effort is needed to distribute food from rural areas to urban areas where consumers are located. The third component in the realization of food security is the consumption aspect. In accordance with Law No. 18 of 2012, it is stated that food-resistant consumption is indicated by the availability of food ingredients in sufficient quantity and quality that are safe, equitable and affordable. The aspect of community income also determines the fulfillment of the food consumption criteria. The adequacy of community income to be able to access food is one of the dominant problems in determining the achievement of food security in a region. The development of oil palm agribusiness can contribute to realizing food security from the aspect of increasing people's income.

2 Research Method

2.1 Research Scope

This research was conducted to examine the role of oil palm plantation development in achieving food security in the Jambi Province. The role of oil palm plantation development in achieving food security is described by descriptive and econometric analysis approaches. This research was conducted by utilizing primary data that describes the condition of food security of oil palm farmers in Jambi Province. Data were obtained from 180 respondents representing the population of oil palm farmers in Jambi Province. The selection of sample farmers was carried out by stratified cluster random sampling, namely by selecting two main production districts, namely Tanjung Jabung Barat Regency and Muaro Jambi Regency. Each district is represented by two sub-districts which have the largest oil palm plantations. Tanjung Jabung Barat District is represented by Merlung and Tungkal Ulu Districts, while Muaro Jambi District is represented by Sekernan and Sungai Bahar Districts. In order to anticipate the normality of the respondent distributions, a total of 45 sample farmers per sub-district were grouped based on the area of oil palm plantation ownership into three strata, namely the broad strata with oil palm plantation ownership above 5 Ha, the medium strata with the plantation area of 3–5 Ha, and narrow ownership with smallholder's plantations under 3 ha. By grouping respondents based on the strata of ownership area, it is hoped that the respondents will be normally distributed and the opportunities for farmers from various income and food security conditions can be evenly distributed.

2.2 Data Analysis

To analyze the contribution of oil palm plantations to the achievement of household food security in Jambi Province was carried out descriptively. The analysis was carried out by presenting the distribution of respondents based on a number of variables that are theoretically related to efforts of household in fulfilling their food security. The second objective of this study is analyzed by using the Rapfish application developed by the Fisheries Center of the University of British Columbia. Rapfish uses MDS (Multidimentional scaling) statistical techniques to quickly assess the existence or sustainability status of a system. Rapfish was then modified in such a way as to be able to explain the sustainability aspects of food security at the research site.

The distance determination technique in MDS is based on Euclidean Distance with the Pythagorean formula as follows [5].

$$d = \sqrt{(|x_1 - x_2|^2 + |y_1 - y_2|^2)}$$
(1)

Furthermore, the ordination technique in MDS based on Euclidean distance in dimensional space (n) can be written as follows:

$$d = \sqrt{\left(\left|x^{1} - x^{2}\right|^{2} + \left|y^{1} - y^{2}\right|^{2} + \left|z^{1} - z^{2}\right|^{2} + \dots\right)}$$
(2)

The configuration or ordination of an object or point in the MDS is approximated by regressing the Euclidean distance (d_{ij}) from point i to point j with the origin (δ_{ij}) as follows:

$$d_{ij} = \alpha + \beta \delta_{ij} + \epsilon \tag{3}$$

Furthermore, the equation is regressed using the ALSCAL algorithm method. The ALSCAL method optimizes the squared distance (d_{ijk}) to the square (origin point = (ijk), in three dimensions (i, j, k) written with the S-Stress formula [6] as following:

$$S = \sqrt{\frac{1}{m}} \sum_{k=1}^{m} \left[\frac{\sum_{i} \sum_{j} (d_{ijk}^{2} - 0_{ijk}^{2})^{2}}{\sum_{i} \sum_{j} 0_{ijk}^{4}} \right]$$
(4)

where the squared distance is the Euclidean distance weighted by the following equation:

$$d_{ijk}^{2} = \sum_{\alpha=1}^{\prime} W_{k\alpha} (x_{i\alpha} - x_{j\alpha})^{2}$$
(5)

Measurement of goodness of fit is a measurement of how accurately the point configuration can reflect the original data in the MDS as reflected in the magnitude of the S-Stress value calculated based on the S value above. A low S-Stress value indicates good of fit, while a high value indicates the opposite [7].

Sustainability indicators for each dimension are modified from previous research conducted by [8], consisting of five dimensions, namely: Ecological Dimensions, Economic Dimensions, Social Dimensions, Technological Dimensions, and Institutional Dimensions. Each dimension is measured by a number of attributes or indicators according to the availability of data in the field. Attributes/indicators that have been identified are then given a score range between 0–3 according to the existing criteria. The lowest/worst score range is 0 and the most suitable/good is 3. To determine the score, the Rapfish technique can be referred to [6]. The score value can be different for each indicator according to the need for the total score. In this study the data used is ordinal data with a scale of 1 to 10 or it can also be made according to needs. Next, a food security sustainability index scale is scored which has an interval of 0% to 100%. In this study there are four categories of sustainability status used. The sustainability status categories are presented in Table 1.

Through the MDS method, the position of the sustainability point can be visualized through the horizontal and vertical axes. With the rotation process, the position of the point can be visualized on the horizontal axis with a continuous index given a score of 0% (bad) and 100% (good). If the system under study has a sustainable index value greater than or equal to 50% (>= 50%), then the system is said to be sustainable and unsustainable if the index value is less than 50% (<50%). Comparative analysis of sustainability between dimensions is visualized in the form of a kite as shown in Fig. 1.

3 Findings and Discussion

The public's image of the ability of oil palm agribusiness as an alternative to change the economy has been very widespread. The public's interest in oil palm farming is getting higher day by day. Apart from reducing poverty and ensuring that rural communities

D. M. Napitupulu et al.

Index	Sustainability Category
01–25	Unsustainable
26–50	Less Sustainable
51–75	Sufficiently Sustainable
76–100	Sustainable

Table 1. Status of Food Security Sustainability in Jambi Province.

Source: Susilo, 2003, Nurmalia, 2008, Wibowo et al., 2014



Fig. 1. Kite diagram of comparison among dimensions

have the income to provide more nutritious food, oil palm itself is an important source of food. Palm oil plantations that are managed sustainably are one of the answers in strengthening the economy and social welfare, as well as building food and energy security.

All respondents in this study have their main source of livelihood from oil palm farming. Although a number of farming households as described previously have income from non-oil palm and non-agricultural farming as well as outside the agricultural sector, the majority of farmers rely on oil palm as a source of income to meet their family's food needs. A total of 78.33% of respondents stated that oil palm agribusiness really supports the living costs of people in rural areas. Farmers stated that oil palm farming could provide a reliable income to meet the family's food needs. Although farmers do not produce the food they need themselves, they can use the proceeds from the sale of oil palm Fresh Fruit Bunches to buy various family food needs. One thing that farmers complain about is the lack of access to markets. There are a number of food stalls in the location of oil palm farmers' settlements, but access to food needs cannot be done easily. Limited access to food needs can occur due to limitations in the amount and type of food available at the research location.

An area is said to be successful in developing food security if there is an increase in food production, smooth food distribution and consumption of safe and adequate nutrition for the entire community. The realization of food security in the research location can thus be done by increasing farmers' access to the market for providing the food needed by farmers.

The proportion (share) of household expenditure on food needs in the study area is much higher than household expenditure on non-food needs. A total of 131 (72.78%) households spend 51–75% of household income on food needs. This means that more than half of household income is used to meet household food needs consisting of rice, side dishes, vegetables and other foodstuffs, while the remaining 47.76% of total expenditure is used for non-food expenditures such as clothing, housing, health, education, transportation, donations, buying animal feed and others.

The proportion of food expenditure which is higher than the proportion of non-food expenditure indicates that the respondent farmer households in the study area are still not prosperous. The welfare of the population greatly influences household economic access to food so that it also affects the quantity and quality of food consumed [9].

3.1 Oil Palm Sustainability in Jambi Province

3.1.1 Ecological Aspects

The ecological dimension is very basic in utilizing natural resources, a good environment has an impact on good natural products to be used by humans to prosper. One of the requirements in sustainable natural resource processing is to maintain the previous natural resource function, besides that it must also have Eco-Efficiency criteria which means Efficient both economically and ecologically [10]. The results showed that the land suitability indicator for oil palm was very suitable. However, another indicator, namely the procurement of protective plants is still very lacking. This happens because it is rare to procure protective plants in oil palm plantations in the research area. Another important ecological indicator that needs to be considered is the level of pests and diseases included in the heavy category. This is due to the unavailability of Integrated Pest Management (IPM/IPM) Technical Instructions in the research area. The same thing is shown by the indicators of maintenance of oil palm plantations which are still very lacking. The results of data analysis also show that there is no use of palm oil waste for either household or farming purposes. The value of the Ecological aspect is between 26-50 based on the sustainability scale. This means that this value indicates that the palm oil done by farmers from the ecological dimension is less sustainable.

3.1.2 Economic Aspect

The research data shows that there is an opportunity to increase welfare for farmers and the surrounding community. The productivity level of oil palm farming in the research location is already high, although the level of farmers' income is still low. This is due to the low price of palm oil while the production costs are quite high. The results also show that the market carrying capacity is still very low. Another economic indicator that needs to be considered is the low carrying capacity of economic institutions such as BUMDES whose role in supporting the development of oil palm agribusiness cannot be felt. Oil palm is a plantation commodity that has long been cultivated by farmers, especially in Indonesia. The increasing standard of living of farmers has an impact on improving the quality of life and thus has an impact on increasing Regional Original Income (PAD). Judging from the economic aspect, oil palm plantations in the research location basically have the potential to support the regional economy. This is also in accordance with the findings of [11] which says that domestic industries based on palm oil-based products should be able to grow well, in addition to the establishment of many economic centers in new areas will support regional economic development. This value is between 26–50 on a sustainable scale, which means this value indicates that oil palm farming carried out by farmers from the economic dimension is not sustainable.

3.1.3 Social Aspect

A number of indicators of the Social Aspects of oil palm plantations in the research location indicate opportunities for the sustainability of oil palm agribusiness. However, a number of variables need to be considered. The growth of economic centers as a result of the development of oil palm plantations is expected to absorb large numbers of workers and reduce the income gap between farmers and plantation entrepreneurs. The opening of employment opportunities cannot be supported by the availability of local workers. The indicator of the number of household members is considered less supportive. This is due to the attractiveness of urbanization which causes the second generation of oil palm farmers to prefer to continue their education and settle in urban areas. The strategy of opening job opportunities through the growth of higher impact industries needs to be carried out in oil palm plantation areas. The threat to the sustainability of oil palm agribusiness also comes from the age of farmers, who are already mostly unproductive. The results of this research show that the age of farmers and majority family members is below 20 years and above 65 years, which means that they are classified as unproductive and no longer productive. This value is between 51-74 on the sustainable scale, which means this value indicates that oil palm farming carried out by farmers from the social dimension is considered quite sustainable.

3.1.4 Technological Aspect

A number of indicators in the Technology Aspect show good opportunities for the development of oil palm agribusiness at the research site. The use of seeds, fertilization, harvesting and the carrying capacity of public infrastructure have been assessed as very supportive. A number of important indicators that need to be improved are HPT control and canopy pruning measures. This value is between 51–74 on the sustainable scale, which means this value indicates that the oil palm farming carried out by farmers from the technological dimension is considered quite sustainable.

3.1.5 Institutional Aspect

In general, the encouragement of institutional aspects in the development of oil palm agribusiness at the research sites has been quite supportive. However, a number of aspects still need to be improved, namely the quality of the system and the pattern of core

247

partnerships with plasma that need to prioritize the development and empowerment of communities around plantations. This is in accordance with the opinion of [11] which says that partnerships should be able to build dynamic and productive farmer institutions (farmer groups and cooperatives), so that the relationship between the community and plantation companies can understand each other and be mutually beneficial. The results showed that farmers have not been able to feel the benefits of a number of economic institutions that already exist around them, especially in terms of supporting the marketing system of Fresh Fruit Bunches produced. This value is between 51–74 on the sustainable scale, which means this value indicates that the oil palm farming carried out by farmers from the institutional dimension is quite sustainable.

3.1.6 Multidimensional Analysis

Assessment of the sustainability status of oil palm farming using the Multidimensional scaling (MDS) method with the Rapfis program. Based on the results of multidimensional data analysis consisting of ecological dimensions, economic dimensions, social dimensions, technological dimensions, and institutional dimensions, the status value is 58.89. This value is in the range of 51 - 74 on a sustainable scale with moderately sustainable status. This value indicates that the management of oil palm farming in Jambi Province is considered quite sustainable.

4 Conclusion and Recommendation

4.1 Conclusion

- 1. Oil palm farming can be relied on as a source of household income for farmers to meet the food needs of families in the research location
- 2. Oil palm farming income can contribute to the realization of food security at the research site
- 3. From the Ecological and Economic Dimensions, oil palm farming cannot be said to be sustainable, while from the Social, Technological and Institutional Dimensions, oil palm farming in the research location has been classified as sustainable.
- 4. Multi-dimensionally, oil palm farming in the research location is classified as sustainable

4.2 Recommendation

- 1. In parallel with the efforts to develop a competitive Indonesian palm oil industry, the development of oil palm from the Ecological and Economic Dimensions must be increased
- 2. It is necessary to improve the quality of a number of attributes so that the sustainability of oil palm agribusiness in an effort to increase its contribution to the realization of food security can be obtained.

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Authors' Contributions. All three researchers, members together with the main researcher worked together in conducting this research, starting from the preparation of research proposal, data collection, to reports and articles preparation.

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