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Feasibility of Integration of Cattle with Oil Palm Crops at Industry and Farmer Level

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Abstract: This study analyzes the feasibility of the market, technical and technological, financial and social integration of the system at the industrial and farmer levels. The market aspect can be seen in the market potential in absorbing integrated products, technical and technological aspects refer to the Regulation of the Minister of Agriculture of the Republic of Indonesia No. 46/Permentan/PK.210/8/2015, and financial feasibility using investment criteria analysis and social feasibility including the response of the surrounding community. The driving factor for implementing the integration system for cattle and oil palm plantations at the industrial level is the benefits of integration, while the inhibiting factor is that the company still finds doubts about the negative impact of organic fertilizer on oil palm plantations. At the farmer level, the driving factor is the profit gained from integration, while the inhibiting factor is the limited market for selling organic fertilizer. Market and marketing, technical and technological, financial and social feasibility at the industrial level is feasible and not sensitive to changes in input-output, while at the farm level is feasible except for market aspects and sensitive to changes in prices and output volumes (compost). The novelty of this research is the driving and inhibiting factors for the implementation of the integration of cattle with oil palm plantations at the industrial and farmer level, and the comparison of aspects of the feasibility of integrating cattle with oil palm plantations between industrial and farmer.

Keywords: cattle integration system, oil palm plantation, farmers.

牛与油棕作物在工业和农民层面整合的可行性

摘要：本研究分析了该系统在工业和农民层面的市场、技术和技术、金融和社会一体化的可行性。市场方面可以从吸收集成产品的市场潜力中看出,技术和工艺方面参考印度尼西亚共和国农业部长第46号常温PK.210/8/2015条例,以及使用投资标准的财务可行性分析和社会可行性,包括周围社区的反应。在产业层面实施牛油棕一体化体系的驱动因素是一体化带来的好处,而抑制因素是公司仍然对有机肥对油棕种植园的负面影响存有疑虑。在农户层面,驱动因素是整合带来的利润,而抑制因素则是有机肥销售市场有限。工业层面的市场和营销、技术和工艺、财务和社会可行性是可行的,对投入产出的变化不敏感,而在农场层面是可行的,除了市场方面,对价格和产量的变化敏感(堆肥)。本研究的新颖之处在于工业和农民层面实施牛与油棕种植园整合的驱动和抑制因素,以及在工业和农民之间比较牛与油棕种植园的可行性方面.

关键词：养牛系统、油棕种植园、农民.

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Introduction

The integrated farming system provides sustainable livelihoods for cattle farming families and reduces the amount of waste by recycling organic waste from livestock and crops [1]. The sustainable development of cattle in Jambi Province by using local resources more effectively and efficiently is implemented with its integration with oil palm plantations based on the principle of mutual support and benefit, which is pursued through an integrated system development pattern through a "zero waste management" (ZWM) approach. ZWM is a holistic waste management concept [2] with ethical, economical, efficient and visionary goals in designing and managing waste systematically to conserve and recover all resources [3]. Bioeconomic strategies based on agricultural waste management can prevent the suboptimal use of livestock manure and crop residues to produce value-added products, farmers' livelihoods, and sustainable employment opportunities [4, 5].

The pattern of integration of cattle with oil palm plants uses the LEISA (Low External Input System Agriculture) concept approach, namely the dependence between cattle and oil palm plants that can provide benefits to both at the industrial or company level and the farmer level. The integration of livestock and oil palm plantations is an innovative method for controlling understorey vegetation in oil palm plantations, while reducing the need for chemical herbicides and habitat heterogeneity [6].

The integration of oil palm crops and livestock at various scales to support landless smallholders is a strategy to mitigate the indirect land use change impacts of the expansion of the oil palm industry [7]. The strategy to increase national beef self-sufficiency and environmental sustainability of the oil palm plantation sector is to integrate cattle with oil palm plantations, where cattle graze in the bushes of oil palm plantations [6–8]. Oil palm stakeholders must reform existing plantation policies by implementing a crop/livestock integration strategy. A number of potential benefits from grazing cattle in oil palm plantations, both on a macro and corporate scale. On a macroscale, using already productive oil palm plantations for cattle production will reduce the need to convert existing agricultural land into grazing land [7]. To encourage the integration of cattle-oil palm in producing countries, special policies are needed to strengthen financial and technical support, so that farmers can successfully integrate cattle. Then it is necessary to determine the appropriate cattle densities for oil palm plantations under different oil palm management systems (ie large-scale or small-scale plantations) [6]. For this reason, information on the feasibility of an integrated system between cattle and oil palm plantations at the industrial and farmer levels is very necessary. At the industrial level, namely the integration of cattle and oil palm plantations in oil palm plantation companies, while at the farmer level, namely, the integration of cattle and smallholder oil palm plantations in the Farmers Group.

1. Materials and Methods

This research was conducted at the farmer level, namely the Farmers Group in Dataran Kempas Village and Purwodadi Village in Tebing Tinggi District, Tanjung Jabung Barat Regency, Jambi Province, Indonesia and at the industrial level in private oil palm plantation companies, Musi Banyuasin Regency, South Sumatra Province, Indonesia. The research method used is a survey method, which is a study by taking samples from a population with the aim of obtaining generalizations as far as the population from which the sample is taken. In accordance with the research objectives to be achieved, this research was carried out at an inferential level (inferential research). This study uses a Participatory Rural Appraisal approach, which is a data collection process that involves active collaboration between data collectors and respondents.

The research preparation consisted of preparing a questionnaire, compiling an interview guide, and determining the surveyor team, as well as couching surveyors. We trial research questionnaires on several samples to be able to test the validity and reliability of the research instruments. Primary data collection techniques include filling out a list of questions (questionnaires) with related parties. Beginning with conducting a field survey and reviewing secondary data, the aim is to obtain a general description of the condition of the location and object to be studied, and to obtain more concrete information about the condition of the location and object of research. The sampling technique used in this study is Stratified Random Sampling, which consists of 2 (two) Strata, namely, Strata I is a farmer group in a farmer group that integrates cattle with smallholder oil palm plantations and Strata II is a private oil palm plantation company that integrates cattle with oil palm plantations. From each stratum/strata, a sampling unit was selected using a simple technique random sampling. If in the first and second iterations, the sample size obtained is the same as the unit number, then the iteration is stopped. The value of n is the sample size that must be taken for research. By taking α = 5% and β = 5% as well as the smallest estimated correlation of ρ = 0.10. The sample size in this research was determined using the iterative method, namely as many as 128 respondents from farmer farmers who integrated cattle with oil palm plantations. To find a comprehensive measure of whether the integration of cattle with oil palm plantations use various indices called Investment Criteria. Each index uses a discounted present value of benefit and cost flows, namely, net present value (NPV), internal rate of return

(IRR), Net Benefit-Cost Ratio (Net B/C). To avoid inaccuracies in calculations and anticipate changes in the variables of acceptance and input costs, it is necessary to perform a sensitivity analysis.

2. Results and Discussion

2.1. Potential for Integration of Oil Palm Plantations with Cattle

An overview of the potential integration of oil palm plantations with cattle in Indonesia can be seen from the expansion of the area of oil palm plantations. Oil palm plantations in Indonesia consist of plantations by private companies, state-owned companies and smallholders [9]. Small farmers in Indonesia follow several paths, namely, making their own gardens called independent smallholders, while others following government programs are called plasma farmers [9]. Most smallholders involved in oil palm production in Indonesia have a plantation area of ≤ 2 ha, and about 70% of their household income comes from oil palm production [10]. The area of oil palm plantations in Indonesia over the last two decades (2000–2020) has continued to increase significantly with an average increase of 6.62% per year, from 4.18 million ha in 2000 to 14.86 million ha. in 2020 (Fig. 1). This fact is an illustration of the government's success in the plantation sector in accelerating the development of oil palm plantations in Indonesia.

The increase in the area of oil palm plantations in Indonesia is caused by both companies and individual growers. The area of the company's oil palm plantations was dominant, reaching an average of 60.80%, while the smallholders' oil palm plantations only average 39.20%. However, the dominance of the company's oil palm plantation area in the last 20 years has continued to decline, from 71.54% in 2000 to 59.58% in 2020, although the plantation area has increased from 2.99 million ha in 2000 and in 2000. 2020 to 8.85 million ha. Meanwhile, community oil palm plantations, both in area and share, continued to increase, from 1.19 million ha (28.46%) in 2000 to 6.00 million ha (40.42%) in 2020. The expansion of smallholder oil palm plantations in Indonesia, especially in Jambi Province, is mostly driven by independent smallholders. Independent smallholders do not receive direct support from the government and often have low yields. Independent smallholders often lack agronomic knowledge, such as adequate fertilizer doses and harvest cycles, as well as financial resources and access to good quality seeds [11]. The basic problems faced by independent smallholders are related to the legality of the land and its limited ability to manage good agricultural practices, access to funds and information on current prices, and the use of quality agricultural production facilities. Oil palm independent smallholders are one of the key actors in maintaining the continuity of the production cycle in the supply chain of the palm oil agro-industry in Indonesia [12].

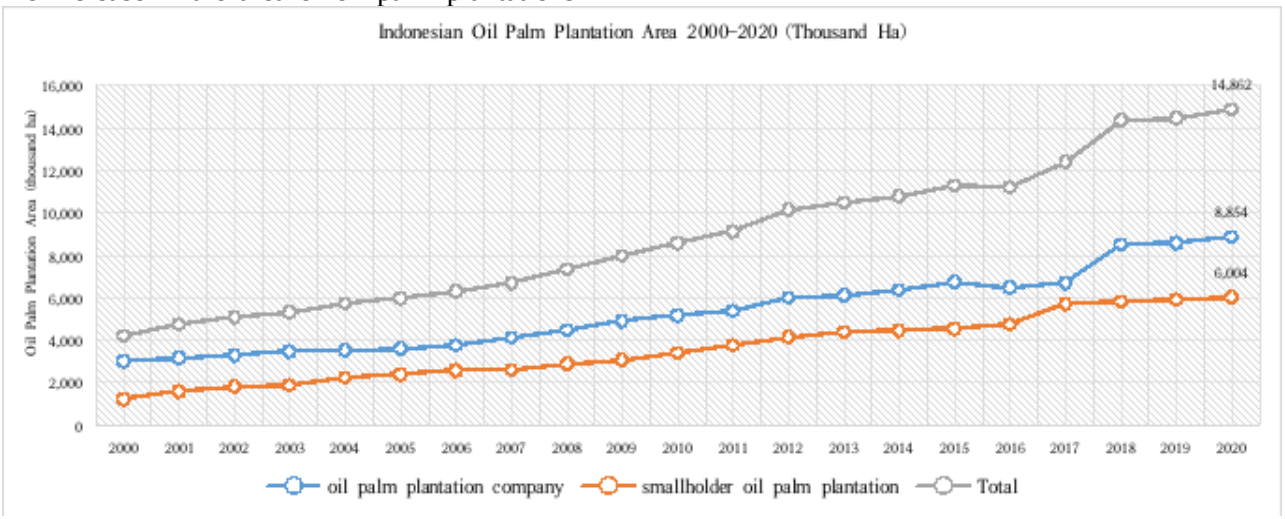

Fig. 1 Indonesian oil palm plantation area 2000–2020 (thousand ha)

The consequence of increasing the area of oil palm plantations in Indonesia is a significant increase in palm oil production. During 2000–2020, Indonesia's palm oil production continued to increase significantly, starting from 7.07 million tons in 2000 to 48.29 million tons in 2020 or average growth of 10.23% per year, but actually plantation productivity of palm oil in Indonesia is still low. The yield of oil palm plantations in Indonesia has reached 3.8 tons of CPO per hectare, which is still significantly lower than that obtained in Malaysia, which reports an average of 4.5 tons per ha [13]. The production of Indonesian palm oil during 2000–2020 was always dominated by plantation companies, which reached an average of 65.63%, while the production of smallholder oil palm plantations averaged 34.37%. In fact, the dominance of the company's palm oil production continues to decline, from 72.04% in 2000 to 66.23% in 2020, although its palm oil production increased from 5.09 million tons in 2000 to increase in 2020 to 31.99 million tons. Meanwhile, people's palm oil production continued to increase from 1.98 million tons (27.76%) in 2000 to

16.31 million tons (33.77%) in 2020.

Currently, Indonesia is the largest CPO exporter in the world, sharing global market dominance with Malaysia. To meet the growing global demand for palm oil, Indonesia will need an additional 6 million hectares of oil palm plantations by 2025 [13]. Thus, sustainable palm oil production is an urgent policy need for Indonesia and the world [14]. Meanwhile, the Indonesian domestic market absorbs 30% of CPO production in three main use categories: food, biodiesel production and other industrial non-food uses. Palm oil is the most important vegetable oil used for food in Indonesia; used twice as much as soybean and 4 times as much as peanut oil [13].

During 2000–2020, the number of oil palm plantation companies in Indonesia continued to increase significantly, from 693 companies in 2000 to 2,335 companies in 2020 or an average increase of 6.65% per year. The European Commission is very critical of palm oil production because it carries a high risk of indirect land use change from the expansion of the palm oil industry, which pressures landless/evicted smallholders to clear tropical forests [7]. The oil palm plantation companies are spread mainly on the island of Sumatra (including Jambi Province) as much as 55% and the island of Kalimantan as much as 40% and the rest (5%) are on other islands. Oil palm plantation companies in Indonesia are dominated by private oil palm plantation companies which account for 90.95% and the rest are state oil palm plantation companies as much as 9.05%. Unfortunately, according to the Commission for Supervision of Business Competition of the Republic of Indonesia, 26.90% of national private plantation control is concentrated in only five private business actors.

The success of accelerating the development of oil palm plantations in Indonesia conforms to the development of cattle farming development. The cattle population in Indonesia for 2 decades (2000–2020) grew a little slowly as reflected in the average growth of only 2.59% per year. The cattle population in 2000 was 11.01 million head, increasing to 17.47 million in 2020 (Fig. 2). The government issued the program "Buffalo Mainstay of the Country," in 2020 which is an effort to increase the population and production of cattle and buffalo in Indonesia.

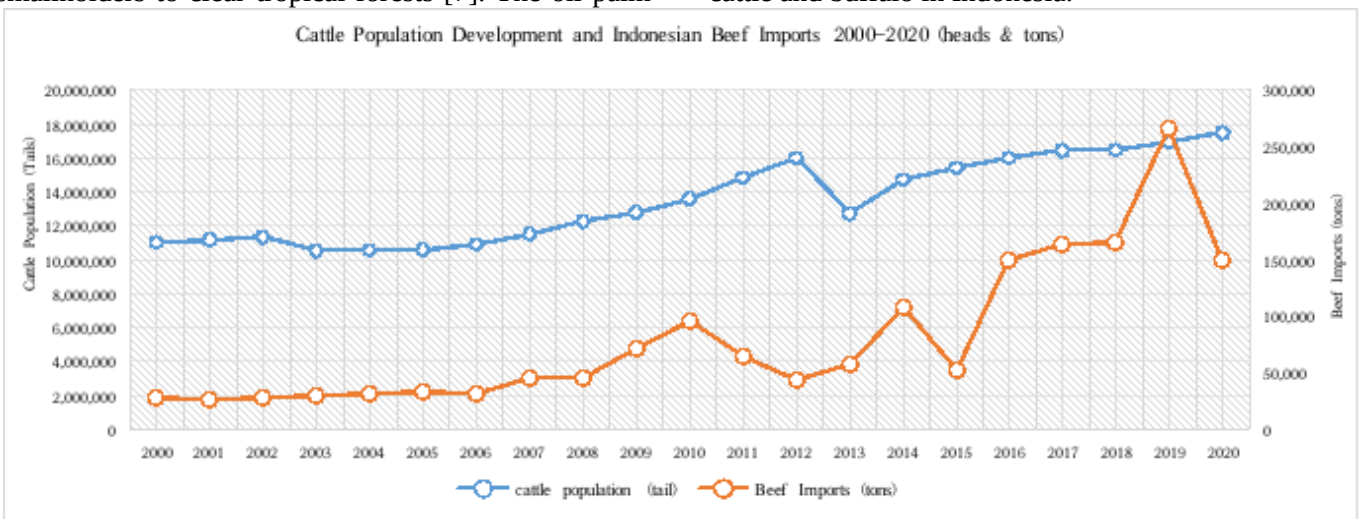

Fig. 2 Development of Indonesia's cattle livestock population and beef imports year 2000–2020 (tails and tons)

In Indonesian society, there is a perception that beef is considered a luxury food that must be present on religious holidays. Additionally, the *supply* of beef at that time is limited, it will increase the fluctuation of beef prices. To overcome this condition, the government was forced to increase *supply* by importing beef, especially from producing countries, namely, Australia. The government's policy is also to help local farmers to increase production so that they are not depleted due to high demand. The volume of beef imports in Indonesia for the period 2000–2020 fluctuated with increasing trend. In 2000, beef imports reached 26,962 tons, increasing to 266,459 tons in 2019 (2020 data only until October) or an average growth of 21.06% per year. Beef self-sufficiency was not achieved and imports continued. A cause of continued imports is the absence of accurate data on the national cattle stock so that the government always feels that it is short of stock and imports [15].

On the demand side, Indonesia's per capita beef consumption continues to increase every year. The Livestock and Animal Health Statistics Report for 2021 states that over the last 2 decades (2002–2020) beef consumption per capita in Indonesia has continued to increase, from 1.61 kg/cap in 2000 to 2.31 kg/cap in 2020, with an average increase of 2.12% per year. Despite the low increase in beef consumption, beef prices in Indonesia have continued to rise sharply over the last 2 decades. Livestock and Animal Health Statistics in 2021 reports that beef prices in Indonesia during 2000–2020 continue to soar. In 2000, the price of beef in Indonesia was IDR24,989,- per kg, increasing to IDR120,201,- per kg in 2020 or an average increase of 8.32% per year. The demand for beef in Indonesia continues to increase in line with economic growth. Additionally, because most of the

Indonesian population is Muslim, the demand for meat (especially beef) increases sharply during the Eid al-Adha vacation around September-October. The same condition also occurs during the fasting month and Eid al-Fitr around July-August [16].

The increase in beef prices occurred because of the imbalance between production quotas and the high public demand for beef. Additionally, there are numerous barriers to the distribution/transportation of cattle from cattle production centers to consumers, both related to inter-island ship transportation and land transportation, which have contributed to the increase in beef prices. Consequently, Indonesia must import beef. Initially, beef imports only catered to certain market segments, but have now entered the supermarket and traditional market segments.

2.2. Feasibility of Integration of Livestock with Oil Palm Crops at Industrial and Farmer Level

2.2.1. Industry-Level Push and Barrier Factors

Based on the results of a field survey at the industrial or oil palm plantation company level in Musi Banyuasin Regency, South Sumatra Province, Indonesia, it was found that the driving factor for the implementation of the integration of cattle with oil palm and sweet potato crops is the benefits of the integration. The benefits of integration are obtaining organic fertilizer from cattle waste and palm oil processing waste as a supplement to inorganic fertilizers whose prices tend to always rise. The results of the observations found that the need for organic fertilizer for the company's sweet potato and oil palm plantations can be met by this integrated system. This study found that organic fertilizers (compost) did not reduce chemical fertilizers (because they were standard) but as supplements. Additionally, the implementation of the integration where during the day, cattle grazing in the company's own oil palm plantations, which is carried out regularly at different oil palm plantation locations, makes cleaning weeds in the company's oil palm plantations easier and faster.

The integration of oil palm cultivation with cattle can have a positive effect on biodiversity and reducing herbicide use [6, 17, 18]. Targeted cattle grazing will reduce herbicide use from 75 sprays in a typical plantation cycle to 15 sprays. To get the desired results from the integration of livestock in oil palm plantations, the integration of livestock grazing in oil palm plantations must be carried out systematically [18].

While the inhibiting factor for the implementation of the integration of cattle, oil palm and sweet potatoes in oil palm plantation companies in this study is that there are still doubts from the company about the negative impact of organic fertilizers on plants, especially oil palm plants, thus inhibiting the use of organic fertilizers directly to plants. Research on cattle grazing under oil palm is novel and lacks knowledge about the long-term profitability and sustainability of the system, a major barrier to the adoption of the oil palm-cattle farming system [19]. Targeted livestock grazing is not suitable for establishing immature oil palms less than 5 years old, as the livestock can damage crops [18]. The main results of the review are (i) although the use of understorey as animal feed is a major advantage of integrated cattle-oil palm farming systems, the decline in understorey productivity in aging plantations indicates the need for alternative solutions for sustainable cattle productivity throughout the plantation life cycle; (ii) oil palm yields are reported to increase under livestock integration but the evidence is weak, both oil palm yields and the pathways by which oil palm yields are affected by livestock grazing should be explored further; (iii) economic analysis shows cattle grazing under oil palm plantations is profitable for large-scale oil palm producers due to the sale of livestock, and returns are further enhanced by reduced weeding and fertilizer costs [19].

2.2.2. Driving and Inhibiting Factors at the Farmer Level

The results of the survey at the farmer level, namely the Farmers' Group in Dataran Kempas Village and Purwodadi Village in Tebing Tinggi District, Tanjung Jabung Barat Regency, Jambi Province, showed that the driving factor for the implementation of the integration of cattle with oil palm plantations was the benefits obtained from integration. The profit is in the form of income from the sale of organic fertilizers to companies managing industrial forest plantations. Our findings suggest that cattle grazing can be a sustainable agricultural practice, used to promote scrub and suppress unwanted vertical growth of weeds. Additionally, the integration of livestock farming with oil palm cultivation has benefits in terms of environmental protection by reducing the use of chemical herbicides, as well as increasing food security, by optimizing agricultural land for beef and vegetable oil production. Cattle-oil palm integration is likely to result in lower production costs and increased profits [6].

Sustainable grazing of cattle is difficult in smallholder oil palm plantations due to limited land and current free grazing practices, options for increasing grazing sustainability and profitability in this system should be explored [19]. However, this study found an inhibiting factor in implementing the integration of cattle and oil palm plantations at the farmer level, namely the limited market for selling organic fertilizer, which is only to companies managing industrial forest plantations, which can be said the market for organic fertilizer for farmers is monopsony. A monopsony market is a form of market in which there is only one customer and a corporation will act as

the only buyer and controls the market content. For this reason, it is necessary to provide guidance or assistance to the Farmer Group to find new market alternatives for organic fertilizers. The new market for organic fertilizers is the oil palm plantation companies. Furthermore, it is necessary to make a new organic fertilizer composition containing substances needed by oil palm plants, so that they can be marketed to oil palm plantation companies. High-quality organic fertilizers can close the nutrient loop by returning it to agricultural soils while maintaining soil fertility and food security [20]. Organic fertilizers can increase soil fertility, quality and productivity of agricultural products, but will increase planting costs for farmers and transaction prices for retailers and market demand. Farmers' decisions about organic fertilizer substitution affect various agricultural product decision-making processes, namely, planting, transactions and consumption. In planting, the use of organic fertilizers affects the yield, quality, cost of agricultural products and the acquisition of farmer subsidies. Economic benefits will motivate farmers to adjust their planting decisions [21].

2.3. Market Aspect

Analysis of market aspects and product marketing integration of cattle, oil palm and food crops at the industrial and farmer levels play an essential role where market and marketing are two sides that cannot be separated from each other. The market aspect can be seen in the market potential in absorbing the integrated products of cattle and oil palm crops at the industrial and farmer levels. The potential market prospects for integrating cattle products with oil palm plantations at the industrial and farmer levels in the form of cattle are superb. The need for livestock and beef in Indonesia, including the provinces of Jambi and South Sumatra, for consumption is still very high and the price of beef continues to rise. The market for integrating cattle products with oil palm plantations at the industrial level in the form of organic fertilizers is the need for inorganic fertilizer supplements for the company's own sweet potato and oil palm plantations. Meanwhile, the market for integrated cattle and oil palm products for farmers is in a weak position only as price takers. Farmer groups must accept the price of organic fertilizers prevailing in the market, do not have a market share for organic fertilizers to influence the market price itself. It is estimated that in 2035 the actual demand for compost in Indonesia is 57,112,000 tons per year, of which 4,749,000 tons per year will be used by plantation crops, and food crops as much as 27,878 tons per year, and the remaining 24,485,000 tons per year for horticultural crops [22].

2.4. Technical and Technological Aspects

The technical and technological aspects in the feasibility of integrating cattle and oil palm plantations at the industrial and farmer levels refer to the Regulation of the Minister of Agriculture of the Republic of Indonesia Number 46/Permentan/PK.210/8/2015 [23] concerning the Guidelines for Good Beef Cattle Cultivation. The results of the survey found that on average, 9.52 heads of self-help cattle were raised per farmer with an area of 1.34 ha of oil palm plantations per farmer, while those who raised assistance cattle had an average of 2.11 heads per farmer with an oil palm plantation area of 2.14 ha. At the industrial level, the number of cattle is 204 cows consisting of 4 Brahman cattle and 36 Balinese cattle and there are 125 local cattle.

At the industrial level, cattle during the day is released or grazed in the company's own oil palm plantations. Every day cattle grazing at own oil palm plantations is carried out regularly at different oil palm plantation locations to regulate grass growth under oil palm plantations. The livestock and oil palm integration system relies heavily on the natural understorey available in oil palm plantations as a source of feed for livestock. Cattle grazing on oil palm plantations is very much in line with the principles and criteria of sustainable palm oil certification (eg the Roundtable on Sustainable Palm Oil) as it is a non-chemical strategy for controlling weeds. Further research should be conducted to determine suitable cattle densities for oil palm plantations under different oil palm management systems (i.e. large-scale or smallholder plantations) [6].

At night, the cattle are in the stable and given forage in the form of elephant grass, which is taken from the company's grass garden with an area of about 12 ha and added with legumes in the form of indegofera. 12 ha of forage land are available with superior grass plants, the condition of elephant grass is moderate to good (rainy season), information on 1 ha production of 20 tons/2 months, the need for cattle is 2.5 tons per day, there are already superior Indegofera plants. Both the quantity and quality of feed available in oil palm plantations are inconsistent in supply.

Facilities for integration of cattle, oil palm and food crops at the industrial level for good cattle cultivation include female and male cattle, feed, livestock tools and machinery and animal health, veterinary medicine, and cages. According to the Ministry of Agriculture No. 46 of 2015, for cattle farming business consists of male cages, parent cages, calving cages, rearing cages, calf cages, fattening cages, isolation cages, clip cages, paddock for grazing; and a cattle yard for handling cattle. At the industrial level, it has 4 massive cages with a size of about 12.5 m X 44 m, and 2 cages 10.5 m X 50 m, and a size of 15 m X 25 m. There are feedlot pens and cattle yards for handling cattle.

At the farmer level in farmer groups, cattle are released during the day or grazed in oil palm plantations belonging to the surrounding community freely until a certain time (afternoon). At night, the

cattle are in the stable and are given natural grass and an additional concentrate in the form of bran. At night, the cattle are in the stable and are given natural grass and an additional concentrate in the form of bran. Most smallholders practice the concept of free grazing, which requires minimal input. Cattle are allowed to move freely from one area to another in the community's oil palm plantations in search of feed.

In the integration system of cattle and oil palm plantations at the industrial and farmer levels, they have processed cattle solid waste such as feces into compost. Compost at the industrial level has a composition consisting of 60% cow dung and 40% palm fruit cobs, plus ash, brown sugar, urea, dolomite fertilizer and E4, while the liquid waste of cattle has not been processed. Compost fertilizer is used for the company's sweet potato and oil palm plantations. The use of manure as a fertilizer can contribute to reducing the use of synthetic fertilizers on agricultural land, thereby reducing environmental and human health threats. It is estimated that nitrogen fertilizer use could be reduced by 3%-32%, by increasing manure recycling from 30% in 2015 to 34%–70% in 2050, depending on fertilization measures and cropping systems [24].

At the farmer level, processing cattle solid waste such as feces into compost (organic fertilizer) with a composition of 30% cow dung, 30% black ash and 40% dry waste consisting of palm fruit fibers, sawdust and palm fronds. The liquid waste of cattle has not been processed into liquid organic fertilizer with the composition of cow urine, goat manure, fermented household waste and added E4. The biourin processing installation is located not far from the pen, which is connected through a sewer, so that urine from cattle in the pen can be accommodated properly. At the end of the canal there is a urine reservoir. Biourin installations can be made with an aeration system that is raised by a water pump machine. Replacing synthetic fertilizers with manure has agronomic and environmental benefits, especially for countries with increasing livestock populations and high-fertilizer use. However, there are various socioeconomic and technical barriers to replacing manure with manure, which are not well understood [25].

2.5. Financial Aspect

Cost flow or outflow the integration of cattle and oil palm plantations at the industrial and smallholder levels consists of investment and operational costs. The investment costs consist of building stables, production facilities, forage gardens for fodder, vehicles and machinery, equipment. Meanwhile, operational costs are the overall costs associated with the operational activities of the integrated system of cattle and oil palm plantations at the industrial and smallholder levels, which are divided into variable costs and fixed costs. The flow of revenue or inflow is the income obtained from the integration of cattle and oil palm plantations at the industrial and farmer levels are different. The industry level of the revenue stream is assessed because it uses its own needs, both compost and cattle. Meanwhile, the revenue stream for farmer groups consists of revenues obtained from the sale of compost, rejected cows, seed cattle, and feeder cattle. The results of the investment criteria analysis can be explained by the fact that the net present value (NPV) < 0 value of Net B/C < 1 then the integration system of cattle and oil palm plantations at the industrial and farmer levels is feasible. Then a sensitivity analysis (switching value) was carried out, that the integration of cattle and oil palm plantations at the industrial level was not sensitive to changes in input-output. Meanwhile, the integration of cattle and oil palm plantations is sensitive to changes in prices and output volumes.

2.6. Social Aspect

The social feasibility of the integrated system of cattle and oil palm plantations at the industrial and farmer levels includes the response of the surrounding community. The response of the surrounding community to the integrated system of cattle and oil palm plantations at the industrial and farmer levels is different. At the industrial level, the integration system for cattle and oil palm plantations is carried out by the company's own area or plantation so that it does not impact the surrounding community. When grazing, livestock are also exposed to the risk of chemical poisoning from the application of herbicides, pesticides and fertilizers in oil palm plantations. This is different from the integration of cattle and oil palm plantations at the farmer level, which is carried out partly in the plantations of surrounding communities and oil palm plantation companies. The field survey of the community around the location yielded information that the entire community around the location supported the integration of cattle and oil palm plantations.

3. Conclusion

The driving factor for the implementation of the integration system for cattle and oil palm plantations at the industrial level is the benefit of the integration, namely, obtaining organic fertilizer from cattle waste and palm oil processing waste as a supplement to inorganic fertilizers and easier and faster cleaning of weeds in the company's oil palm plantations. Meanwhile, the inhibiting factor is that the company still finds doubts about the negative impact of organic fertilizer on oil palm plants, thus preventing the use of compost directly to oil palm plants. At the farmer level, the driving factor is the profit derived from the integration in the form of income from the sale of organic fertilizers to companies managing industrial forest plantations. The inhibiting factor for the implementation of the integrated system is the limited

market for selling organic fertilizer, which is only available to companies managing industrial forest plantations, which means that the market for organic fertilizer for farmers is monopsony. The market and marketing, technical and technological, financial and social feasibility of the cattle and oil palm plantation integration system at the industrial level is feasible and not sensitive to changes in input-output, while at the farmer level it is feasible except for the market aspect.

The novelty of this research is the identification of the driving factors for the implementation of integration of cattle with oil palm plantations at the industrial level in the form of benefits from the integration, namely, obtaining compost from cattle waste and palm oil processing waste as a supplement to inorganic fertilizers whose prices tend to always rise. While the inhibiting factor is that there are still doubts from the industry about the negative impact of compost on oil palm plants, thus inhibiting the use of compost directly to oil palm plants. For this reason, further research is needed on the impact of organic fertilizer application on oil palm plantations.

The driving factor for the implementation of the integration of cattle with oil palm plantations at the farmer level is the profit obtained from the integration, namely income from the sale of compost. Meanwhile, the inhibiting factor is the limited market for selling compost, which is only available to companies managing Industrial Plantation Forests as a monopsony market. For this reason, it is necessary to provide guidance or assistance to the Farmers Group in finding new market alternatives for compost. New markets for compost include oil palm plantation companies around the research area and other districts and provinces that have oil palm plantation companies. Furthermore, it is necessary to make a new composition of compost containing substances needed by oil palm plants, so that they can be marketed to oil palm plantation companies.

The limitation of this research is that it does not examine the impact of organic fertilizer application on oil palm plantations in the oil palm industry. At the farmer level, the limitation of this study is that the composition of organic fertilizer (compost) is only for Industrial Plantation Forests, not for oil palm plantations, making it difficult to market it to the oil palm plantation industry.

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