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## The characteristic and problems of beef cattle – palm oil integration in Indonesia

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**Abstract.** Since 2003, the Indonesian government through the Ministry of Agriculture has been promoting the program of integration of beef cattle- palm oil. After fifteen years the program is completed, it is needed a study to find out the progress of integration implementation. The objective of this study is to identify the main characteristics and problems of implementing integration that have been carried out on a small and large scale from palm oil plantations in several provinces in Indonesia. The study has been conducted in several locations of integration in Indonesia. The conclusion of this research is the integration in Indonesia is carried out with intensive, semi-intensive, and extensive integration patterns. Bali Cattle is the most commonly used. There is no standard processing of cattle feed made from biomass of palm oil plantation industry. The issues encountered in the implementation integration by small-scale farmers are the difficulty of obtaining palm kernel cake, unfavourable feed processing technology, and the issue cattle destroying palm oil plantations. And large-scale are the issue cattle destroying palm oil plantations, marketing problem, and understanding of the principle of implementation integration. Business diversification carried out on integration activities is manufacture of solid organic fertilizer, liquid organic fertilizer, and the manufacture of biogas from cattle dung and urine.

### 1. Introduction

In 2017 to 2021, it is estimated that the average consumption of Indonesian beef per capita will grow 6.30% per year. In 2017 it is estimated that Indonesian beef consumption is 2.40 kg capita/year which continues to increase up to 2021 by 3.02 kg/capita/year [1]. It is projected that up to 2020 to meet the beef needs of the Indonesian, it still has to go through imports. Various programs have been carried out by the government to address the problem of the need for beef, one of which is implementing integration of beef cattle – palm oil.

The integration is very potential, because the area of Indonesian palm oil plantations is very wide. It is predicted that in 2016, the area of palm oil plantations in Indonesia will reach 11,672 million hectares [2]. The area of palm oil plantations in Sumatra and Kalimantan can be used for breeding but as many as around 9 million heads [3]. Based on the results of various studies it was reported that the development of cattle breeding through the beef cattle – palm oil integration system can breed well by utilizing biomass derived from oil palm plantation activities. The product and by product from the palm oil industry are valuable resources with potential to be utilised raw material of animal feed [4]. The beef cattle – palm oil integrated production systems are considered as one of successful and sustainable integrated agricultural production systems in Malaysia. [5]. Farmers in Rokan Hulu



Regency of Riau Province, have increased their income level by implementing **2** integration of beef cattle – palm oil [6]. The increasing **2** production of beef cattle towards meat self-sufficiency can be achieved through the development of integration of beef cattle – palm oil [7].

Since 20**2** The Indonesian government through the Ministry of Agriculture has been promoting program of integration of beef cattle – palm oil to secure the availability of beef needs. Several government agencies, both at the central and regional levels, have participated in encouraging the development of integration **2** Since 2003 the Agricultural Research and Development Agency, has studied the development of integration of beef cattle – palm oil, the results of studies has implemented to the farmers [8]. The Directorate General of Animal Husbandry and Health from 2012 to 2016 has provided cattle, cages, equipment for made feed from biomass of the palm oil industry, and fertilizer-making equipment to farmer groups in Indonesia to support the implementation of integration [9]. The Ministry of State **2** owned Enterprises has also encouraged the State Oil Palm Plantation Company to participate in the integration of beef cattle – palm oil [10]. The Company of Perkebunan Nusantara III has implemented the integration strategy of beef cattle - palm oil since 2012 [11]. The government encourages all levels of society, farmers, state companies, private companies, and research bodies to implement integration. Integration activities have been carried out by various companies and people in the form of small scale and large scale.

After fifteen years the program of integration of beef cattle – palm oil has been promoting, it is needed a study to find out the progress. The progress can be observed from characteristic and problems in the implementation of integration. The information generated from this study is very useful for **12** m evaluation and as materials for preparation of further development strategies.

The objective of this study is to identify the main characteristics and problems of implementation of integration was conducted on a small and large scale of palm oil plantations in several provinces in Indonesia.

## **1** **2. Materials and Methods**

The research was conducted in areas of palm oil plantations and in areas where the integration of cattle-oil has been successful. The locations of the research are Langkat regency, and Batu Bara regency in North Sumatra Province, Pelalawan regency and Siak regency in Riau Province, Tanjung Jabung Barat regency in Jambi Province, and Kotawaringin Barat regency in Central Kalimantan. This location was selected by the office that handled the integration of cattle –palm oil in each province and the Ministry of Agriculture of Indonesia. Interviews have been conducted to the parties that have implemented cattle - palm oil integration. The names of institutions interviewed for each location and business scale are presented in Table 1.

Respondents consist of small farmer groups and large scale companies. Small farmer groups are a group of farmers who own palm oil plantations or not, which seeks business integration of beef cattle - palm oil. Large Scale is a palm oil plantation company that operates a large scale cattle - palm oil integration and has a large area of land. Respondents who were interviewed were responsible for activities, namely: chairman or farmer group management for respondents from farmer groups and managers and personnel in charge of large scale companies. Each respondent has been interviewed directly with a structured questionnaire. The number of respondents in this study were two respondents from large scale and ten respondents from small scale.

The data collected are patterns of integration implementation, feed used, type of cattle used, and problems of implementing integration. Data evaluation is done by categorizing data to provide an overview of the application and problems of integration in several provinces in Indonesia.

**Table 1.** Research Location, Institution, and Business Scale

No.	Research Location	Institution	Cattle Heads	Business Scale
1.	Langkat Regency in North Sumatera Province	Palm Oil Research Center	160	Small
2.	Batubara Regency in North Sumatera Province	Group Farmer of Sentosa	25	Small
3.	Pelalawan Regency in Riau Province	Group Farmer of Karya Lestari	148	Small
4.	Siak Regency in Riau Province	Group Farmer of MajuMakmur	77	Small
		Group Farmer of SumberRejeki	71	Small
		Group Farmer of KaryaBersama	52	Small
5.	Tanjung Jabung Barat Regency in Jambi Province	Group Farmer of Bumi Aji	75	Small
		Group Farmer of Sidomakmur	28	Small
		Group Farmer of Teladan	67	Small
6.	Kota Waringin Barat Regency in Central Kalimantan Province	PT. Agro Lestari	>5.000	Large
		PT. Sulung Ranch	>5.000	Large
		Group Farmer of SuburMakmur	130	Small

### 3. Results and Discussions

#### 3.1 Pattern of Cattle - Palm oil Integration Adopted

Table 2 shows the pattern integration adopted by the community consists of three patterns that is intensive integration, semi-intensive integration, and extensive integration. There are four that conducted intensive integration, four of semi-intensive integration, and four of extensive integration. There are twelve institutions surveyed that consist of two large-scale institutions and both conducted extensive integration, while ten small-scale conducted intensive, semi-intensive, and extensive integration. This suggests that a large-scale tendency of choosing extensive integration. This condition is done to reduce the cost for the manufacture of cages and feed. In livestock breeding cost of feed is the biggest production cost that is sixty until eighty percent [12]. While small-scale does not tend to be one pattern of integration model, it may be based on various factors that is the ability to prepare feed, the availability of raw materials, the availability of palm oil plantation, the ability of human resources, and profit considerations. Farmers who conducted intensive integration due to consideration of not owning plantation, plantation companies do not allow their land to be used as grazing sites, and develop organic fertilizer businesses. Farmers who conducted semi-intensive integration because of the existence of oil palm plantations that can be used as grazing and security for cattle. And farmers who conducted extensive integration due to the availability of land for grazing and reducing the cost of making cage. Optimizing the utilization of palm oil by products through technological approaches, integration of beef cattle - palm oil can be implemented by semi-intensive patterns as well as intensive patterns [13].

#### 3.2 Type of Feed Used

Table 2 shows that feed used generally in the intensive integration is biomass of the palm oil plantation industry that is leaves: midrib, palm kernel cake, and solid. At the palm oil research center, biomass derived from palm oil is 88.6 percent, farmer group of Karya Bersama is 90 percent, farmer group of Bumi Aji is 75 percent, and farmer group of Subur Makmur is 98 percent. At the palm oil research center, the biomass used consists of leaves and midrib from harvesting, and palm kernel cake. Leaves and midrib chopped using a chopper machine that capable destroy leaves and midrib in fine size. The farmer group of Karya Bersama, and Bumi Aji use leaves and midrib only, while the palm kernel cake and solids are not used because it is difficult to get. Farmer group of Subur Makmur using



leaves and midrib chopped, palm kernel cake, and solid. This suggests that the integration can rely on feed from biomass derived palm oil industry. The potential of biomass derived palm oil industry that can be used as cattle feed is midrib, leaves, palm kernel cake, and solid [3]. Complete feed based palm oil biomass can be used for cattle fattening [14]. The use of midrib and leaves palm oil up to 60 percent can increase the weight of beef cattle compared to feeding forage only and more efficient in the use of feed [15]. Table 2 shows that there is a difference in the composition of the feed used, indicating that the preparation of cattle feed from palm oil biomass still has no standard. The study of cattle – palm oil integration still requires feed enrichment innovation that is cheaper and easier in the utilization of biomass for cattle feed by mechanical, chemical and biological means in a fermentation [16]. Addition of urea and EM-4 through the ammoniation-fermentation process shows the results relatively equal control over the consumption of feed, digestibility, and body weight gain of pampangan buffalo [17].

In the semi-intensive integration, the feed given mainly is the grass growing on the palm oil plantation. Types of grass that is consumed, consist of leguminous, ferns, bushes, and reeds. These grasses can be eaten by cattle. In addition to eating grass on the palm land, in the morning and afternoon cattle are also given grass taken from around the location of farms and grasses exclusively planted specifically. Unlike the others, group farmer of Karya Lestari provide concentrate on cattle in the morning. The raw material of concentrate is 90 percent biomass of palm oil that consist of solid, palm kernel cake, and midrib chopped and processed by fermentation. Meanwhile, when cattle graze to palm oil plantations only for additional and enrich the type of intake and in the afternoon no longer given food.

**Table 2.** Institution, Cattle Heads, Integration Pattern, Cattle type Used, and Feed Used

No.	Institution	Integration Pattern	Cattle type Used	Feed used
1	Palm Oil Research Center	Intensif	Bali Cattle, Ongole Crossbreed, and Simmental	Concentrate (Leaves and Midrib Chopped of Palm Oil, and Palm Kernel Cake: 88.6%)
2	Group Farmer of Sentosa	Semi Intensif	Bali Cattle	Leaves and Midrib Chopped of Palm Oil: 90%
3	Group Farmer of Karya Lestari	Semi Intensif	Bali Cattle	Leaves and Midrib Chopped of Palm Oil: 75%
4	Group Farmer of MajuMakmur	Semi Intensif	Bali Cattle dan Ongole Crossbreed	Concentrate (Palm Kernel Cake, Solid, dan Midrib Chopped: 98%)
5	Group Farmer of SumberRejeki	Ekstensif	Ongole Crossbreed	Grass under Palm oil, and Grass cultivated
6	Group Farmer of KaryaBersama	Intensif	Bali Cattle	Grass under Palm oil, and Concentrat (Solid Palm Kernel Cake, and leaves and Midrib chopped of palm oil: 90%)
7	Group Farmer of Bumi Aji	Intensif	Bali Cattle	Grass under Palm oil, and Grass taken from the surrounding land
8	Group Farmer of Sidomakmur	Semi Intensif	Bali Cattle	Grass under Palm oil, and Grass taken from the surrounding land
9	Group Farmer of Teladan	Ekstensif	Bali Cattle	Grass under Palm oil
10	PT. Agro Lestari	Ekstensif	Bali Cattle	Grass under Palm oil
11	PT. Sulung Ranch	Ekstensif	Peranakan Ongole	Grass under Palm oil, and Concentrate (Palm Kernel Cake, and Solid: 69%)
12	Group Farmer of SuburMakmur	Intensif	Ongole Crossbreed and Bali Cattle	Grass under Palm oil, and Concentrate (Palm Kernel Cake, and Solid: 69%)

In Extensive integration, there are two institutions (Farmer Group of SumberRezeki, and Farmer Group of Teladan) release cattle to graze on palm oil plantation and do not give any additional feed. Cattle grazing on palm oil sites owned by plantation companies in the surrounding area. There is an agreement that cattle are only grazed on palm oil above 10 years old. Plantation still holds that cattle are pests and can disrupt the growth of palm oil. Meanwhile, two other institutions (PT Agro Lestari and PT Sulung Ranch) release cattle for grazing on palm oil sites, but provide additional feed in the form of concentrate 69 percent composition of palm oil byproduct in the morning and afternoon. The given dose is 3 kg/day. According to the manager this is done to meet the nutritional needs of cattle. Shepherding is done in their palm oil plantations that are over 10 years old. According to the manager, grasses that grow less nutritious and the amount that can be consumed a little. The increasing age of palm oil, the growing variety and vegetation and the decreasing number of natural vegetation [13].

### 3.3 Cattle type used

Table 2 shows the types of cattle that are cultivated in integration activities, namely Bali, Simmental, and Ongole crossbreed. Bali type is the most cultivated. Bali can be bred on intensive, semi-intensive, and extensive integration patterns. The development of Bali cattle in the integration of cattle-palm oil in an intensive, semi-intensive, and extensive pattern can improve the productivity and population of Bali cattle [18]. According to the statement of the respondents there are several advantages of using the type of Bali cattle, which is easy to adapt to feeds derived from palm oil biomass, easy to get livestock seeds, not easily attacked by disease, preferably the community, and easier in marketing. While Simmental and Ongole crossbreed have some disadvantages that is the body is too large to be difficult to market, susceptible to disease, and difficult to adapt to the feed derived from palm oil. Bali cattle have proven to be adaptive and productive, and very suitable for development in palm oil plantation [19]. Bali cattle are preferred because the feed is easy and can develop well [20]. Bali cattle have a high fertility rate, and are able to adapt well in the palm oil plantation, which is indicated by good production performance and reproductive power and productive age of more than 10 years old [18]. Bali cattle are also smaller in size, making it easy to graze on extensive palm plantations.

### 3.4 Integration Implementation Issues

Table 3 shows, that problems faced by small-scale institutions are the difficulty to obtain solid and palm kernel cake, have not mastered the feed processing technology made from palm oil industry biomass, and issues about the problems caused by cattle that can damage the palm oil. Palm kernel cake has high nutritional value and has been widely used as a mixture of feed making. Palm kernel cake produced by palm oil mills have generally been contracted by large-scale feeding companies and exported. This condition makes the palm kernel cake has been controlled large-scale feeding companies and should not be sold to other parties. The needs of small-scale institutions are not able to make contracts with the palm oil mills, so it is not possible to obtain palm kernel cake. The palm midrib and leaves are the raw material feed source of crude fiber, each containing 50.9 percent and 21.5 percent so it can be used as a substitute for grass [21]. However, the level of lignin on the skin of palm midrib and leaves is quite high, so to be consumed by cattle and increased its palatability needs to be reduced in size. Appliances and chopper machines owned by small farmers have not been able to produce a delicate product, so it can interfere with the digestion of the cattle. Stick contained in the leaves, and midrib can not be chopped smoothly. Except at the palm oil research center, already has a chopping machine capable of chopping leaves and midrib until the existing stick can be consumed by the cattle.

Crude fiber, making palm kernel cake in its use as livestock feed is limited, to improve its utilization required fermentation process with *Aspergillus niger* mold. Similarly, the solid easily

becomes rancid and overgrown with mold if left in the open air. Increasing solid protein content can be done through fermentation process with *Aspegillusniger* [22]. Farmers have not mastered the feed processing technology of biomass of palm oil industry. Based on the results of field visits, farmer have never received training on cattle feed processing made from biomass of palm oil industry. And farmer do not know for sure the nutritional content of cattle feed that they make.

Cattle grazing in palm oil plantations by some parties is believed to cause damage to the growth and production of palm oil. Small farmers usually utilize existing palm oil areas as well as other community lands. These activities often get obstacles from the owners of oil palm plantations, they consider that the cattle can have a negative impact on palm oil. The cattle may consume the leaves on immature crops that damage the leaves, the cattle can be a carrier for the spread of ganoderma and caterpillar disease (metisa plana). In the rainy seasons, cattle may also damage the path for harvesting in the palm oil plantations. The damage caused by cattle in the palm oil plantation is the damage of leaves on immature crops, eating the falling palm oil fruit, to be a carrier of ganoderma boninense disease and caterpillar, and soil degradation in the form of soil compaction [23]. The conflict between farmer and owners of palm oil is common. Farmer need palm oil land as a grazing area, while palm oil plantation owners refuse because can damage their palm oil plantations. This condition leads to social problems in the community that is the conflict between farmers and owners of palm oil plantations.

In the palm oil plantation companies are implementing integration cattle – palm oil that is the belief that cattle grazing in palm oil plantations can have negative impacts for palm oil. The policy of the company that is still in doubt and considers that the entry of cattle into oil palm plantations is a pest and hamper the increase of palm productivity. Concerns about the destruction of palm oil are a major problem factor in the implementation of cattle – palm oil integration [24]. The number of cattle grazed in large quantities, often considered to be able to solidify the soil on palm oil area and damage to the harvest road especially in the rainy season. Harvest workers feel disturbed because the harvest road is damaged and difficult to transport the harvest. So there is a conflict of interest between the manager of the palm oil plantation and the livestock manager.

The problem that may also arise in the implementation of integration for large-scale institutions is the problem of marketing. That cattle breeding integration systems will continue if marketing can be adequate [24]. The remote location of the farm is a problem in the marketing. The transport from location to consumer will increase the cost and increase the selling price, so it will be difficult to compete with the cattle fattened close to the consumer. The location of large palm oil plantations and providing abundant feed for cattle is on the islands of Sumatra and Kalimantan. In addition, the location of palm oil plantations are far from the city that can be tens to hundreds of kilometers from downtown. While the island of Java is where the largest consumer of beef, so it takes more transportation to send it to the island of Java.

Another problem with integration is that there is no complete understanding of the principles of integration. There is still a conflict of interest between livestock manager and palm oil manager. That some principles in the implementation of cattle – palm oil integration are the palm oil industry is the main business that needs to be addressed in order to develop sustainably; and the presence of livestock in the integration should be able to improve competitiveness, preserve the environment, add value, and improve the welfare of farmers [16]. Concerns also arise from the negative impacts caused by the introduction of cattle livestock activities into palm oil plantations, may be an obstacle to the achievement of sustainable palm oil plantations. At the point of principle and criteria of sustainable palm oil Indonesia, it explain that is the plantation company must be able to carry out the maintenance of plants in support of crop productivity, and able to implement the control of plant pest organisms with the application of integrated pest control [25].



**Table 3.** Integration Implementation Issues

No.	Institution	Integration Pattern	Integration Implementation Issues	Diversification Activities
1	Palm Oil Research Center	Intensif	Cattle issues damaging palm oil plantation	Solid organik fertilizer, Liquid organik fertilizer, and Biogas
2	Group Farmer of Sentosa	<sup>19</sup> Semi Intensif	Difficulty obtaining palm kernel cake, feed processing technology that has not been optimal, and cattle issues damaging palm oil plantation	Solid organik fertilizer, Liquid organik fertilizer
3	Group Farmer of Karya Lestari	Semi Intensif	Difficulty obtaining palm kernel cake, feed processing technology that has not been optimal, and cattle issues damaging palm oil plantation	Solid organik fertilizer
4	Group Farmer of MajuMakmur	Semi Intensif	Difficulty obtaining palm kernel cake, feed processing technology that has not been optimal, and cattle issues damaging palm oil plantation	Solid organik fertilizer
5	Group Farmer of SumberRejeki	Ekstensif	Difficulty obtaining palm kernel cake, feed processing technology that has not been optimal, and cattle issues damaging palm oil plantation	-
6	Group Farmer of KaryaBersama	Intensif	Difficulty obtaining palm kernel cake, feed processing technology that has not been optimal, and cattle issues damaging palm oil plantation	Solid organik fertilizer, Liquid organik fertilizer, and Biogas
7	Group Farmer of Bumi Aji	Intensif	Difficulty obtaining palm kernel cake, feed processing technology that has not been optimal, and cattle issues damaging palm oil plantation	Solid organik fertilizer, Liquid organik fertilizer, and Biogas
8	Group Farmer of Sidomakmur	Semi Intensif	Difficulty obtaining palm kernel cake, feed processing technology that has not been optimal, and cattle issues damaging palm oil plantation	Solid organik fertilizer
9	Group Farmer of Teladan	Ekstensif	Difficulty obtaining palm kernel cake, feed processing technology that has not been optimal, and cattle issues damaging palm oil plantation	-
10	PT. Agro Lestari	Ekstensif	Cattle issues damaging oil palm plantations, marketing problem, and understanding of the principle of implementation of cattle – palm oil integration	-
11	PT. Sulung Ranch	Ekstensif	Cattle issues damaging oil palm plantations, marketing problem, and understanding of the principle of implementation of cattle – palm oil integration	-
12	Group Farmer of SuburMakmur	Intensif	Difficulty obtaining palm kernel cake, feed processing technology that has not	-

been optimal, and cattle issues  
 damaging palm oil plantation

### 3.5 Diversification Activities

Table 3 shows the institutions that carry out intensive cattle-palm oil integration pattern, all of which undertake business diversification activities that is the making of manure, liquid fertilizer, and biogas. The integration of beef cattle – palm oil has the potential for the development of bio-industry of solid organic fertilizer from cattle dung and liquid organic fertilizer from cattle urine[3]. The purpose of this additional activity is to increase income and utilize livestock waste to support palm oil plantation. The solid organic fertilizer and liquid organic fertilizer are sold to the group members and also to the farmers around. The results of this activity was able to cover the operational costs of integration activities that is labor costs. The resulting biogas is used for energy needs of cooking activities. In accordance with [12] reported, the cattle fattening business based on the waste of palm oil industry in Siak Regency can be feasible because of diversification from the processing of cattle dung and urine.

In the semi-intensive integration there are three institutions that carry out the utilization of solid and liquid waste. Two institutions do business of making solid organic fertilizer, liquid organic fertilizer, and utilization of biogas, while one institution only processed solid organic fertilizer. This activity can be done by using cattle dung and urine that existed when the cattle was held from the afternoon until morning. According to the manager, cattle generally throw a lot of dung in the morning. At the time cattle are grazed, the cattle dung that is wasted on the land is believed to be fertilized for palm oil.

In the extensive integration there is no diversification of business in the utilization of cattle dung. The cattle grazed throughout the day on oil palm plantations dump dung in any place on palm oil area, making it difficult to collect and process further. In PT Agro Lestari and PT. Sulung Ranch, cattle grazed on land bounded by an electric wire with an average area of 30 hectares and filled as many as 300 head of cattle. Every day cattle are moved to another location. According to the manager there are several advantages of extensive integration that is weed control costs are reduced and soil fertility is better. In line with [26] reports that livestock can be integrated with plantation because saving weeding costs. And another advantage cattle can produce feces and become organic fertilizer. According to [27] that goat manure can enrich the soil with valuable nutrients for plant growth, inhibit the growth and development of pathogenic fungi planted by *S. Rolfsii* soil and simultaneously reduce incidence disease.

### 21 Conclusions

The integration of beef cattle - palm oil in Indonesia is carried out with intensive, semi-intensive, and extensive integration patterns. Type of Bali is the most commonly used. There is no standard processing of cattle feed made from biomass of palm oil plantation industry. The issues encountered in the implementation of cattle-palm oil integration by small-scale farmers are the difficulty of obtaining palm kernel cake, unfavorable feed processing technology, and the issue cattle destroying palm oil plantations. And large-scale are the issue cattle destroying palm oil plantations, marketing problem, and understanding of the principle of implementation of cattle - palm oil integration. Business diversification carried out on integration activities is manufacture of solid organic fertilizer, liquid organic fertilizer, and the manufacture of biogas from cattle dung and urine.

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