Circular Economy on Cattle-Oil Palm Integration System to Realize Sustainable Agriculture (Case Study: District Penawar Aji Tulang Bawang)

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Abstract: - The Cattle - Oil Palm Integration System (SISK) has provided a synergistic advantage, namely a multiplied benefit, obtained from plants and livestock and the result of the interaction between the two. Oil palm plants get manure from cow manure. On the other hand, cattle obtain feed from palm oil waste, thus creating a *zero waste - zero cost condition,* which is in line with the Circular Economy model, which has the concept of reusing, reducing, and improving materials in the production process. The purpose of this study was to examine the economic impact (Circular Economy) on the Cattle - Oil Palm Integration System (SISK) to support the realization of sustainable agriculture. The method used in this study is qualitative, namely a survey of literature on circular economy and case studies of the implementation of Circular Economy on SISK in Karya Makmur Village, Penawar Aji District, Tulang Bawang Regency and its influence in realizing sustainable agriculture. The research was carried out from September to October 2021. The results of the literature study state that the circular economy is an economic model built through the management of waste into new products or as raw materials for other products so that economic efficiency is achieved and resources can be maintained continuously in a sustainable manner. The results of the case study of the implementation of the Circular Economy on the SISK show that the application of the SISK can save the cost of purchasing fertilizer by 64% and the cost of buying animal feed by 50% and can increase oil palm production and farmers' income by about 25% so that it is economically profitable. The application of SISK, apart from being able to improve/improve the physical and chemical quality of the soil, is also financially beneficial (production efficiency) to realize a sustainable agricultural system.

Key-words: - Circular Economy, System Integration, Production Efficiency, Sustainable Development
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1 Introduction

The environment is a part that needs to be taken seriously in sustainable development. The need for increased food production has triggered intensive agricultural practices. Intensive farming practices on oil palm plantations through continuous application of inorganic fertilizers can decrease the physical and chemical quality of the soil if it is not balanced with proper soil management. The sustainability of agricultural land productivity will be disrupted. Therefore, efforts are needed to improve soil quality to realize a sustainable agricultural system in the long term.

The Sustainable Agriculture System is an integrated agricultural management system that can gradually increase productivity per unit of land, maintain the integrity and diversity of ecology and biological natural resources

over the long term, provide economic benefits to the community, contribute to the quality of life and strengthen the country's economic development.

A Circular Economy is one of the economic models that need to be implemented to support sustainable agriculture. In this model, goods that have been consumed can be reprocessed. [1] states that the Circular Economy Concept can be said to be the antithesis of a production economy that puts forward linear calculations. So there are elements that are depressed due to continuous production.

The main characteristic of the Circular Economy is the utilization of the use of production goods to balance economic growth with the development of the environment and natural resources. In addition, the Circular Economy system is characterized by the end of the product life cycle with the central concept of reducing, reusing and improving materials in the production/distribution and consumption processes.

Circular Economy has not been widely implemented in the community, so it becomes a challenge for us to study and provide education in implementing agricultural activities that apply Circular Economy.

The reality on the ground shows that many farmers still depend on chemical fertilizers in their agricultural production processes. Excessive use of chemical fertilizers without the addition of organic fertilizers and the application of conservation will result in the soil becoming unproductive, resulting in a decrease in land productivity. This is by the statement of Uphoff (2006) and the results of research [2]–[4] that the continuous use of inorganic fertilizers will result in a decrease in soil quality.

The decrease in soil fertility due to the limited organic matter content of the soil and the development of a cattle farming business that produces manure can be overcome simultaneously by applying a pattern of integration of plants and livestock through the approach *Low External Input Sustainable Agriculture (LEISA) [5]*. [6] states that the Livestock-Plant Integration System can result in a "*zero waste-zero cost*" condition, making it efficient for farmers and environmentally friendly. Therefore, the livestock business is good to be integrated with the oil palm plantation business.

The Ministry of Agriculture [7] states that the Cattle-Oil Palm Integration System is expected to provide synergistic benefits obtained from plants and livestock and the results of their interactions. Oil palm plants get manure from cow manure, and on the other hand, cattle get feed from oil palm plant waste.

The Cattle-Oil Palm Integration System (SISK) is more profitable than the intensive (conventional) farming system because it can reduce input costs by purchasing fertilizer and animal feed, making it more economically efficient. [8] states that 1 (one) tonne of compost derived from cow dung is equivalent to 19.2 kg of Urea, 10.86 kg of TSP and 92.52 KCl and can substitute inorganic fertilizers for 5 (five) oil palm trees so as to reduce the cost of purchasing fertilizers. The results of [9] have shown that the integrated rice farming system with beef cattle has saved fertilizer costs by around 18.14-19.48%. This is in accordance with the concept of a Circular Economy.

SISK has not been widely applied by farmers/breeders in Tulang Bawang Regency. Based on data from observations in the field, out of 518 farmers/breeders in Penawar Aji District, Tulang Bawang Regency, only ± 65 farmers/breeders have performed SISK some farmers/breeders in Tunas Karya Village and Karya Makmur Village, Penawar Aji District. [10]. The implementation of cattle-palm integration is more focused on providing animal feed, not paying attention to its effect on the quality of agricultural land and production costs, because most people do not fully believe in the

positive impact of using livestock manure on improving the quality of farm land and efficiency in production costs [11].

In connection with these problems, this research was conducted to examine the economic impact (Circular Economy) on the Cattle - Oil Palm Integration System (SISK) to support the realization of sustainable agriculture, so that it is expected to provide education to farmers/breeders around the location or even the agricultural community in a holistic manner. To contribute to the realization of sustainable agriculture.

2 Research Methods

The research/writing method is a scientific way to obtain data to describe, prove, develop and discover knowledge, theories to understand, solve, and anticipate problems in human life [12]. According to Creswell in [12], Research Location (Kec. Penawar Aji) qualitative research methods are divided into five types, namely *phenomenological research, grounded theory, ethnography, case study case* and *narrative analysis, studies,* is qualitative research in which researchers conduct in-depth exploration of programs, events, processes, activity, against one or more people. A case is bound by time and action, and the researcher collects detailed data using various data collection procedures and in a continuous time.

This research uses qualitative methods through literature studies and case studies, namely literature studies on circular economy and case studies on the implementation of circular Economy in SISK in Karya Makmur Village, Penawar Aji District, Tulang Bawang Regency and its influence in realizing sustainable agriculture. The research was conducted from September to October 2021.

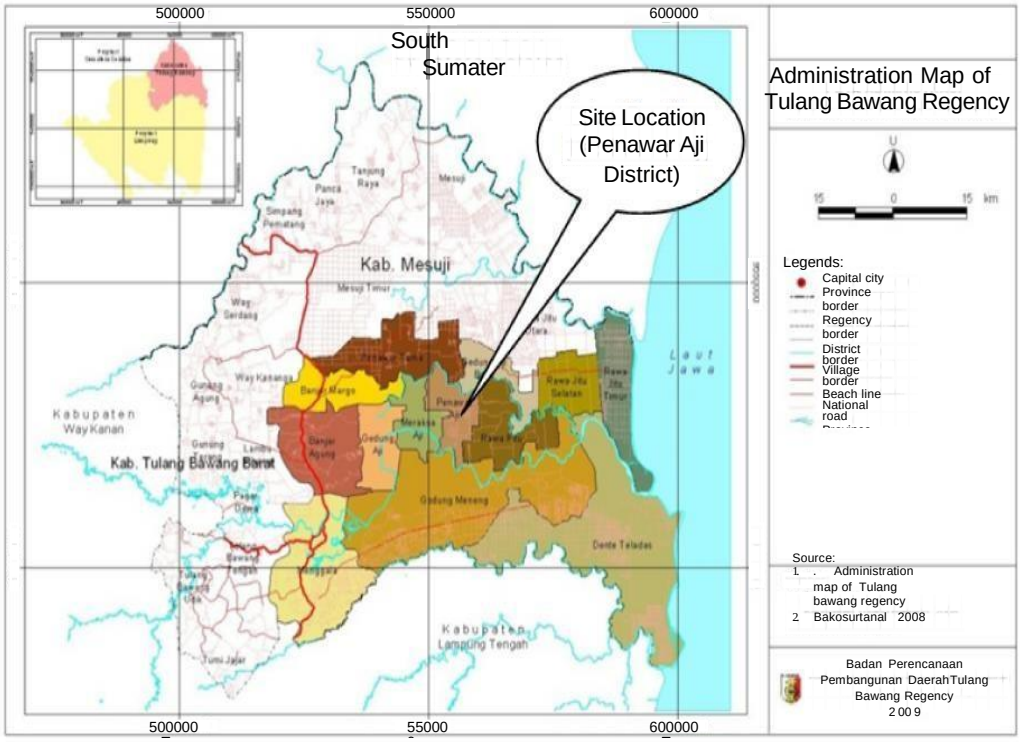

Figure 1. Map of Research Locations

3 Results and Discussion

3.1 Literature Study of CircularCircular

The economy became popular around the 1990s to answer economic development challenges and reduce excessive use of natural resources. The main point of a circular economy is the production of goods to balance economic growth with environmental and natural resource development. The Circular Economy concept is increasingly developing into research among academics and practitioners by suggesting different ideas, objectives and forms of implementation [13].

In his research, [14] states that the circular economy is an economic system with the main concept of reducing, reusing, and improving materials in the production/distribution and consumption processes. This activity can be carried out at the micro-country level with the aim of achieving a sustainable economy, creating good quality of the environment, economic prosperity and social justice. The Circular Economy can be made possible by creating new business models and responsible consumer behaviour.

Circular Economy has been implemented in various countries in the world. [13] stated that the Circular Economy has been implemented in several countries since 1990, as described in Table 1 below.

Table 1. Implementation of a Circular Economy in Several Countries in the World

Country of origin	Performance of a Circular Economy
Japan, Singapore and Korea	Implementation of a green city (eco-city), the application of the character of a responsible consumer.
Germany	An environmental policy with issues of sustainability of raw materials and natural resources.
China	In 1990 created an eco-industrial park, technology development, product development and production management.
UK, Denmark, Switzerland and Portugal	Waste management
North America and Europe	Collaborating on research and application of reducing, reuse, recycle principles in daily life

Winans *et al.* (2017)

Waste management is one form of implementing a circular economy. [15] the community that popularized the circular Economy explained that the core of the circular economy is: 1) to design waste, the products that are consumed can be recycled and used as a source of re-production; 2) segregation of long-term and short-term waste; and 3) the energy needed in this system is green, as well as to reduce the use of non-renewable energy sources.

Waste management is the preliminary design for the circular economy concept by examining product components and paying attention to the energy sources used to manage these products. The Ellen MacArthur Foundation [15] made a design for waste management, as shown in Figure 2. There are two types, namely manufacturing and food. Before being disposed of directly, as consumers, we can recycle the waste (waste) into various kinds of processed products.

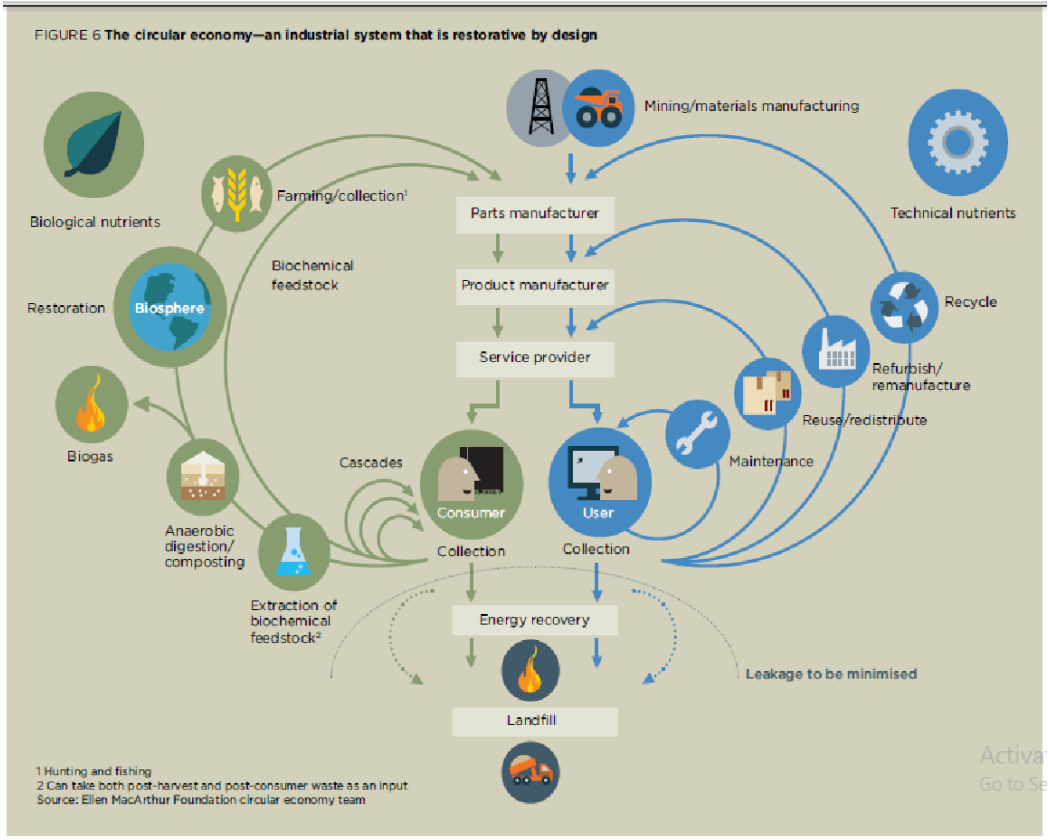

Figure 2. The Circular Economy (Ellen MacArthur Company, 2013)

[16] states that the circular economy in China is actively implemented at three levels, namely enterprises, eco-industrial parks, and some areas. The theoretical basis of ecological and economic consolidation has helped the circular economy determine its position as a new economic model to solve the problems of resources and the environment effectively.

The study results [17] showed that the implementation of a circular economy could be divided into 3 (three) clusters, namely one focused on design, one on retrieval management, and one on recycling. **Post** presented projects focus on additional adjustments to the existing process. Most companies are engaged in experimentation and learning about how CE (*Circular Economic*) can be integrated into their activities.

[18] state that new criteria for selecting a sustainable modern circular economy may include environmental certification, pollution control indicators, the extent to which waste items are replaced with raw materials, and environmentally friendly operations (quality checks, demolition, etc.).

3.2 Implementation of the Circular Economy in the SISK

Cattle - Oil Palm Integration System (SISK) is one of the implementations of the Circular Economy in agriculture with the main focus on the utilization of by-products. This is by Rossum's (2020) explanation that the Circular Economy in the Agricultural Sector is implemented by: a) Reducing inputs for the same level of production; b) Closing and recycling of nutrient cycles; c) Reduce and recycling waste; d) **Processing by-products, and** e) Reducing carbon emissions.

The Cattle-Oil Palm Integration System (SISK) is an integrated cultivation system (integrated) between cattle cultivation and oil palm cultivation. Each cultivation system utilizes production waste from other cultivation systems as raw material for its cultivation inputs. Cattle farming produces waste in the form of livestock manure which can be used as raw material for making organic fertilizer in the Organic Fertilizer Processing Unit (UPPO) and compost. Meanwhile, oil palm cultivation produces waste in the form of oil palm fronds, which can be used as animal feed for cattle. The Cattle–Oil Palm Integration System illustration is described in Figure 3 below.

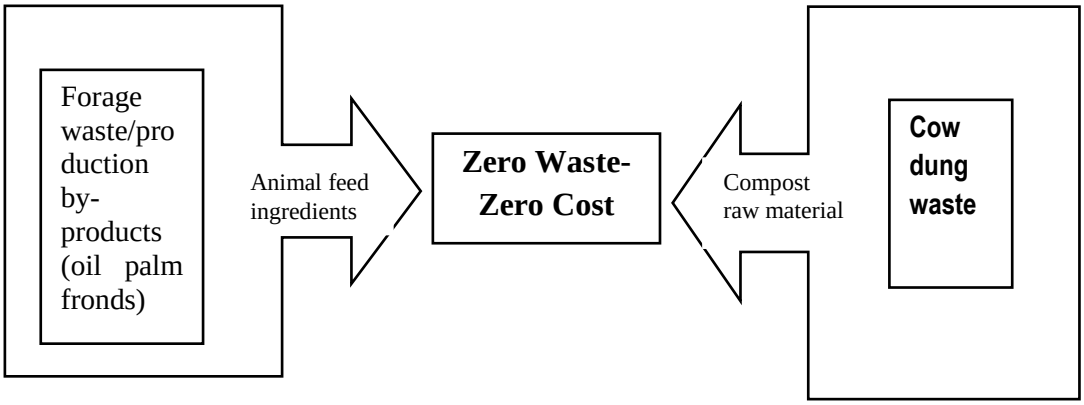

Figure 3. Illustration of the integration of the Cattle-Oil Palm Integration System The

Implementation of the Circular Economy often does not run smoothly, but several obstacles must be overcome. The results of Stumpf *et al.* [17] show that companies face various challenges when implementing circularity, namely lack of definitions and/or standards, lack of government enforcement and cooperation, and most importantly, technical barriers.

[11] stated that the Cattle-Oil Palm Oil Integration System (SISK) has been implemented by several farmers in Penawar Aji District, Tulang Bawang Regency. However, not all farmers/breeders implement SISK because they do not know the benefits of SISK. Meanwhile, [16] stated that China had initiated the process of regulatory legislation on the Circular Economy, which is one of several initiatives to develop core policies for a circular economy in China. Strict law enforcement of the current set of guidelines for energy saving and pollution reduction in China will create an enabling environment for the development of a circular economy. Therefore, in implementing a circular economy in the SISK in Tulang Bawang

Regency, it is necessary to make a series of policies and regulations. It is essential to enforce laws related to the implementation of these policies.

In the context of socializing the implementation of a circular economy at the SISK in Tulang Bawang Regency, it is necessary to cooperate between various parties, the government, the private sector and the community. The government as a program initiator and policymaker, oil palm plantation companies as partners and providers of animal feed raw materials can work together with cattle breeders to dispose of oil palm midrib waste and can establish partnerships with farmers to provide additional capital for the purchase of cattle, so that waste the livestock manure produced is increasing and can be used as organic fertilizer for oil palm plantations. This is in line with the opinion of Pasaribu [19] which states that factors related to institutions play a very important role in promoting the circular economy concept in rural areas and are a determinant of the success of the partnership program to a certain level. Through the partnership model cooperation as the embodiment of the circular economy concept, the three economic pillars, namely government institutions, the private sector, and the community must support each other and participate according to their respective capacities to contribute to regional economic development. The government as a facilitator and regulator, private companies as entrepreneurs, and the community as suppliers of raw materials or small business actors must interact, cooperate and participate in economic development programs.

In 2015, the village of Karya Makmur subdistrict Penawar Aji has a population of as many as 560 head of beef cattle and goats as many as 150 animals, so the manure produced every day pretty much, is estimated at 5,600 kg hr^{-1} derived from cow manure and 210 kg hr^{-1} comes from goat manure. This of course has a negative impact on the environment if it is not managed properly. In addition, Karya Makmur Village also has considerable potential in the plantation sector, especially oil palm plantations. BPS stated that the area of oil palm plantations in Penawar Aji District from 2013 to 2014 reached 900 ha. Of this area, ± 306 ha are located in Karya Makmur Village.

The implementation of the Circular Economy on the Cattle-Oil Palm Oil Integration System (SISK) has been carried out by farmers and ranchers in Karya Makmur Village, Penawar Aji District. In the cattle farming system, waste is produced in the form of livestock manure, which is a by-product of the cultivation system. Cow dung waste will be a problem for the environment if it is not treated. Meanwhile, oil palm farmers/planters produce waste in the form of oil palm fronds, which will cause problems for the environment, if allowed to continue to accumulate in oil palm plantation areas. To overcome these problems, each waste is reprocessed and used as input raw materials in other cultivation systems. Cow dung is processed into organic fertilizer by the local Organic Fertilizer Processing Unit (UPPO) and then the organic fertilizer produced is used as input in the oil palm cultivation system. Furthermore, oil palm fronds are processed to become *silage* (cow feed) which is an input to the cattle cultivation system.

Activities carried out continuously, thus forming Circular Economic cycles as described in Figure 4 below

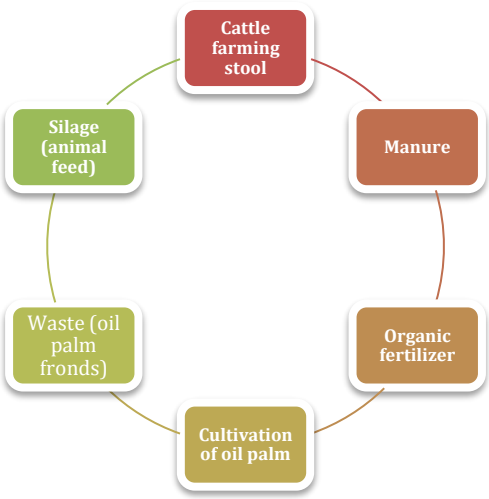

Figure 4. Circular Economic Integration System Cow-Palm Oil (Sisk)

Thus, through the implementation Sisk, the problem of garbage / waste from farming and palm oil plantations cattle farming can be solved. This is in accordance with [16] statement that the circular Economy is a new economic model, which effectively solves resource and environmental problems. [20] found that the strengths, weaknesses, opportunities and threats analysis (SWOT) the management of *bio-waste* (organic waste) is carried out by using economic criteria circular*(CircularEconomy*/ CE) to reduce consumption of raw materials and the formation of organic waste, and to extend the life benefits by completing the financial cycle and biological cycle of the resource.

3.3 Economic Impact on SISK

The Cattle - Oil Palm Integration System (SISK) has had a significant economic impact on farmers and ranchers. Romelah (2016) explained that the analysis of the economic impact on SISK was carried out through interviews with 60 respondents, namely 30 respondents (farmers/breeders who applied SISK) and 30 respondents (farmers/breeders who did not apply SISK) regarding the economic benefits of SISK, with the results as follows: listed in Table 2 below.

Table 2. Average Data Results of Interviews with Respondents on SISK and Non-SISK in Karya Makmur Village, Kec. Bidder Aji

Description	**LandSISK Non-SISK**	**Land**	**Efficiency**
Livestock dung produced (kg head^{-1}yr^{-1})	3,650	3,650	
Production of organic fertilizer/ UPPO yield (kg head^{-1}yr^{-1})	1,095	0	
Organic Fertilizer business yield per cow (Rp tail^{-1}yr-1)	930 750	0	
Costs for the purchase of chemical fertilizers (USD ha-1)	755,000	2.19 million	**1.435 million**
oil waste generated (kg ha^{-1}yr-1)	20,000	0	
Costs incurred to buy feed or additional feed (Rp^{-1}yr^{-1})	600,000	1,200,000	**600,000**
Palm production (t ha^{-1}yr^{-1})	18	14.4	
Income (Rp ha^{-1}yr^{-1})	21.600.000	17,280,000	**4,320. 000**

Source: Romelah (2016)

Based on the results of interviews (Table 2), it can be explained that the average cow cultivation produces animal manure as much as 10 kg head^{-1} day^{-1} or ± 3,650 kg head^{-1}year^{-1}. Meanwhile, oil palm cultivation produces waste in the form of ± 40 midribs^{-1}year^{-1} or 5,000 midrib ha^{-1} (oil palm population 125 trees ha^{-1}). If the weight of the frond is ± 4 kg frond^{-1}, then the waste generated is about 20,000 kg yr^{-1}.

The results of the study [11] show that farmers/breeders who apply SISK have processed livestock manure waste into organic fertilizer, through their Organic Fertilizer Processing Unit (UPPO), so that an animal can produce 1,095 kg of dry organic fertilizer^{-1} year^{-1}. If the average price of organic fertilizer is Rp. 850 kg^{-1}, the farmer will get an additional income of around Rp. 930,750 head^{-1} livestock per year. In addition, farmers/breeders on the SISK land have also utilized palm oil waste in the form of midribs to be used as *silage*. In an area of 1 ha, on average, fronds of 20,000 kg hawill be produced^{-1} yr^{-1}. This amount is sufficient to meet the need for forage for ± 4 (four) cattle. If the number of livestock owned by the farmer/breeder is less than 4 (four) heads, the excess *silage* palm frondis also an additional income for the farmer/breeder.

Meanwhile, for farmers/breeders who do not apply SISK, cow manure and palm fronds are left unattended, so they have no economic value in their farming business and even if left unchecked, it can cause environmental pollution.

The Palm Oil Cattle Integration System (SISK) can reduce cultivation inputs in the form of fertilizer purchases. [11] explained that in SISK, farmers/breeders use organic fertilizers from UPPO results, so that the dose of chemical fertilizers given is only in low amounts, namely Urea 100 kg ha^{-1}, TSP 50 kg ha^{-1}, KCl 50 kgha^{-1}, and dolomite 125 kg ha^{-1}, at a cost of around Rp. 755.000ha^{-1}. Meanwhile, non-SISK farmers/breeders do not use organic fertilizers, so that chemical fertilizers (inorganic) are needed higher. Based on the results of interviews, it shows that the average use of inorganic fertilizers on Non-SISK land consists of Urea 300 kg ha^{-1}, TSP 150 kg ha^{-1}, KCl 150 kgha^{-1} and Dolomite 126 kgha^{-1}, which are given 2 times a year, with a cost of around Rp. 2,190,000 ha^{-1}. Thus, the application of SISK can save the cost of purchasing fertilizer by Rp. 1.435.000 ha^{-1} or 66% of the total cost of purchasing fertilizer. This is in accordance with the results of Kariyasa's

research [9] that the use of manure in the rice farming system integrated with beef cattle has saved fertilizer costs of around 18.14-19.48% or about 8.8% of the total cost.

On the other hand, the implementation of SISK has provided benefits for farmers in the form of minimizing the cost of purchasing animal feed due to the use of oil palm fronds as raw material for *silage* to meet the needs of forage feed. This is in accordance with the statement of Elisabeth and Ginting [21] that palm fronds can be used as a substitute for grass for feed for ruminants. [11] explained that the purchase of feed at SISK is only used to provide concentrated feed, in the form of bran, cassava peel or cassava peel, with an average cost of ± Rp. 600,000 head^{-1} yr^{-1}. Meanwhile, for non-SISK breeders, the need for forage feed is obtained by utilizing the grass around them or by buying forage feed, so the cost required is also greater, ± Rp. 1.200.000 head^{-1} year^{-1}. There fore, SISK can minimize the cost of purchasing animal feed ± Rp. 600,000 head^{-1} cow or 50% of the total cost of purchasing cattle feed.

Apart from cost efficiency in purchasing fertilizers and purchasing animal feed, SISK can also increase oil palm production, thereby increasing the income of farmers/breeders. The results of the study [11] show that the production of oil palm on land that applies SISK is greater than on non-SISK land. The average production of oil palm plantations on SISK lands reaches 18,000 kg ha^{-1} yr^{-1} or 18 t ha^{-1} yr^{-1} while Non-SISK lands reach 14,400 kg ha^{-1} yr^{-1} or 14.4 t ha^{-1} yr^{-1}. Thus, the application of organic fertilizer to SISK land can increase oil palm production by ± 3.6 tons or 25%. If the price of palm oil iskg^{-1}Rp. 1,200, then the income of SISK farmers is ± Rp. 21,600,000 ha^{-1} yr^{-1} while Non-SISK farmers reach ± 17,280,000 ha^{-1} yr^{-1}. Thus, the SISK pattern can increase farmers' income by ± Rp. 4.320.000ha^{-1} yr^{-1} or 25% compared to Non-SISK. In this regard, [9] stated that rice farming in the Provinces of Central Java, Bali and NTB which was integrated with livestock or that used manure was able to produce about 6.9-8.8% higher than that of farming. partially managed without using manure. Basuni's research [22] showed that rice productivity in Cianjur Regency, West Java increased by about 10.29% compared to the farmer's habit pattern and decreased the use of inorganic fertilizers by 53.33%.

3.4 The Impact of SISK's Circular Economy on Sustainable

Agriculture*Sustainable agriculture*is agriculture in a broad sense, which includes physical, biological, socio-economic, environmental and human components that work ideally for now and in the future. [23] suggests that *sustainability* can be viewed as a stable increase in agricultural productivity over time, by enabling the development of agricultural technological innovations to maintain the productivity of the unit area of land.

According to Jaker PO (Organic Agriculture Work Network) and IFOAM (International Federation of Organic Agriculture Movement) [24], there are 4 (four) basic principles in building a sustainable agriculture movement, namely ecological principles, socio-economic principles, technical principles, and political principles. The nature of a sustainable agricultural system is to maintain ecological functions, be economically sustainable, humanely just, and flexible.

One of the characteristics of sustainable agriculture is an ecological perspective. This is in accordance with Ardiyanto's statement [24] that the characteristics of a sustainable agricultural system are: 1) It is economically profitable and can be accounted for (*Economy viable*); 2) Ecologically(*soundecologically sound*); 3) Social justice; 4) Humane and respect local culture; and 5) Able to adapt (*adaptable)*.

Integration of the use of organic waste in SISK can increase bioproducts (in the form of animal feed and organic fertilizers) in a sustainable manner. This is in line with the statement [18] that the integration of bio-waste (organic waste) into a cutting-edge circular economy has the potential to significantly increase the production of bioproducts and sustainable bioenergy. The potential and advanced innovation to convert complex and rich natural bio-waste into various bioproducts and bioenergy is carried out with an advanced circular economy.

The implementation of SISK supports the realization of sustainable agriculture. Through SISK, soil quality is maintained and can be enjoyed by future generations. The results of the study [11] showed that the quality of land that applied the Cattle–Oil Palm Oil Integration System (SISK) was better than that of land that did not apply SISK, as seen by the increase in soil chemical quality, namely K-dd, Ca-dd, Mg- dd, Na-dd, CEC and C-organic and the quality of soil physical properties (BD, Total Pore Space, texture, and moisture content) were better than non-SISK soils.

The implementation of the SISK circular economy results in capital efficiency for farmers and is environmentally friendly. Farmers do not need to spend capital for the purchase of inorganic fertilizers because the fertilizer needs have been fulfilled from the utilization of their livestock manure waste. At harvest time, farmers are not disturbed by the presence of by-products of production in the form of forage because it can be used as raw material for feed for their livestock. Circular Economy SISK creates a "*zero waste-zero cost*" condition, making it economically efficient and safe for the environment. This is in accordance with [6] statement that the Livestock-Plants Integration System can result in a "*zero waste-zero cost*" condition, making it efficient for farmers and environmentally friendly. Young [16] stated that Eco-efficiency, which is an integrated dimension of economic, resource and environmental efficiency is a good indicator to measure Circular Economy activity.

[11] stated that based on the results of interviews with farmers/breeders, on average stated that the Oil Palm-Cattle Integration System (SISK) has been economically profitable through cost efficiency of purchasing fertilizers and animal feed, so it is hoped that this system's farming pattern will ensure sustainability cattle-palm farming for the future.

Integration of Cattle with Oil Palm (SISK) is one solution to improve soil quality and crop production as well as economically efficient so that it benefits farmers and can support sustainable agriculture. This is by Rita [25] states that the characteristics of sustainable agriculture are helping farmers, producing sufficient quantities of food for the population, producing quality food ingredients according to the population's tastes, preserving the agricultural resource base, minimizing the use of non-renewable resources. And reduce their impact on the farm-wide environment. Furthermore, [17] stated that applying a circular economy is considered one of the possible ways for the transition to a sustainable economic system.

4 Conclusions and Suggestions

4.1 Conclusion

It can be concluded that the circular economy in the cattle–palm oil integration system (SISK) is carried out through the utilization of waste from the oil palm cultivation system and the cattle cultivation system as input raw materials for each of these cultivation systems. Then the implementation of SISK has not been carried out widely by the community, so it requires cooperation between various parties, both the government, the private sector and the community. SISK has provided an economic impact in the form of

production cost efficiency and increased income of farmers/breeders. The implementation of SISK can save the cost of purchasing fertilizer by 66%, the cost of buying animal feed by 50%, and can increase oil palm production and farmers' income by 25%, making it economically profitable so that the application of SISK can improve soil quality and be financially beneficial so that it will ensure the sustainability of the cattle-palm farming business for the future to realize sustainable farming.

4.2 Suggestion

From the conclusion, the researcher suggests that the Cattle-Oil Palm Integration System needs to be developed, especially in Tulang Bawang Regency, one of the centres for oil palm development and cattle development in Lampung Province, to realize sustainable agriculture. It is also necessary to have good cooperation from various parties, including the government, the private sector and the community, to optimize a circular economy in the Cattle–Oil Palm Oil Integration System (SISK).

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