



# Social Impact of Circular Economics Implementation on Pig Farming in Indonesia (Case Study on Pig Farming in Rural Areas of North Sulawesi)

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**Abstract.** This study was conducted to determine the social impact of implementing a circular economy on rural pig farming. This study used a survey method on 100 households living side by side with 80 pig farms spread across Sonder District, Minahasa Regency as a pig farming center, 25 households each in Kauneran Village, Kauneran Satu Village, Kolongan Atas, and Kolongan Atas Dua using purposive sampling. The data were analyzed using qualitative descriptive analysis, by explaining the social impacts including: social conditions, economic conditions and community culture. The results of the study showed that based on the results of a survey of households living side by side with pig pens, 80% of pig farms implemented restrictions on access in and out of the pens. This condition means that pig farmers have implemented a circular economy, especially biosecurity and waste collection. The impact on the social conditions of the community is the improvement of the health of the surrounding community due to reduced pollution, the formation of interaction patterns that impose restrictions on pig pens, and the formation of a pig farmer community. The impact on the economic conditions of the community is the ease of obtaining pork, the contribution of pig farmers to religious and community activities, the opportunity for cooperation with corn and rice farmers for animal feed needs. The impact on community culture is the sustainability of pig farming from generation to generation and the maintenance of the culture of pork consumption.

**Keywords:** Income, farmers' awareness, pig farming, social impact, waste management.

## 1 Introduction

Most rural areas of North Sulawesi run pig farming businesses that contribute to household income. These pig farming businesses are still classified as traditional based on pig maintenance models [1];[2];[3]. Until now, pig farmers who apply this model have experienced many problems with the surrounding environment. One effort to reduce the environmental impact is by applying the circular economy concept to pig farming [4];[5];[6]. The circular economy concept in pig farming is a sustaina-

ble economic model that seeks to minimize waste and utilize available resources [7]. Some pig farms in Minahasa Regency have begun to implement a circular economy, as shown by the attitude of farmers who process waste and biosecurity in pens. This attitude began to be applied when pig farmers experienced losses due to the impact of African Swine Fever (ASF), which attacked pigs to death. Pig farming interacts with the surrounding environment, namely household members and the surrounding community. The problem is how applying a circular economy in pig farming affects the environment around the pig farming.

The application of biosecurity in pig farming has an impact on improving livestock health. Furthermore, it also impacts the health of pig farmer households and the community around the pig farming location [8]. The application of pig waste processing through the use of a shelter (sekpitank) has an impact on improving health around the pen [9] and the conversion of waste into energy through biogas technology [10];[11]. Waste processing activities can also increase household income [12].

Several studies [4];[5];[6] have found that the implementation of a circular economy has an impact on farmers and their environment. The current study fills a gap that has not been touched by previous studies, namely the social dimension of the implementation of a circular economy in pig farming at the local community level. In addition, this study is based on the Indonesian cultural context, especially in rural North Sulawesi, which has a strong socio-religious character, different from previous study areas. Thus, this study not only broadens the perspective of the circular economy to the social aspect, but also proves the relevance of the circular economy in improving social welfare and the quality of community relations around traditional pig farms in Indonesia.

## **2 Materials and Methods**

### **2.1 The Site, Sample, and Data Collecting Technique**

This research was conducted in Minahasa Regency, precisely Sonder District which was determined by purposive sampling method [13] with the consideration that Sonder District, Minahasa Regency has the largest pig population in North Sulawesi Province. The villages used as samples were Kauneran Village, Kauneran Satu Village, Kolongan Atas Village, and Kolongan Atas Dua Village, with the consideration that these villages have the largest pig population with farmers who have implemented the circular economy concept including biosecurity and waste management. The respondent sample as the main source of data collection was determined as 25 respondents each as households living within a maximum distance of 200 meters around the pig pen in each village, so that the total sample was 100 households.

### **2.2 Data Analysis**

This study uses a qualitative descriptive method on the social impact of implementing a circular economy on pig farming. Primary data were obtained through in-depth in-

interviews with households with a maximum distance of 200 meters from the pig pen. The data was then analyzed using a qualitative descriptive method with a Likert scale calculation (1-5) [13] which aims to describe and explain in more detail the problems to be studied by studying as much as possible an individual or an event, about the social impact of implementing a circular economy on pig farming. Social impacts include: social conditions, economic conditions and culture of the community living around the pig pen.

### **3 Results and Discussion**

#### **3.1 Application of Circular Economy in Pig Farming**

Pig farming in Sonder District, Minahasa Regency has implemented the concept of circular economy, especially biosecurity by limiting visitor access to pig pens and waste processing [14][15][16]. The concept of circular economy applied by pig farming is still very simple. However, farmers have tried to change farming patterns by adopting science and technology as a measure of sustainability of pig farming in the future [17].

The results of the study showed that the main reason for pig farmers to implement the circular economy concept was the presence of African Swine Fever (ASF) disease in pigs which causes sudden death of pigs [18][19]. In addition, farmers began to receive complaints from local residents about pig manure waste. There are still few pig farmers who have their own awareness to implement the circular economy concept. This is due to the lack of information received by pig farmers about the circular economy concept and efforts to sustain pig farming.

#### **3.2 Social Impact of Implementing the Circular Economy Concept in Pig Farming**

This study analyzes the social impact of the application of the circular economy concept to pig farming in Minahasa Regency. The social impact on the community living around the pig farming is explained based on the social conditions, economic conditions and cultural conditions of the community. The social conditions of the community are measured based on 3 indicators, namely improving the health of the surrounding community, the formation of interaction patterns that limit pig pens, and the formation of a pig farming community. The economic conditions of the community are measured based on 3 indicators, namely the ease of obtaining pork, the contribution of pig farmers to religious and community activities, and the opportunity for cooperation with corn and rice farmers for animal feed needs. The cultural conditions of the community are measured based on 3 indicators, namely the sustainability of pig farming, the culture of continuous pork consumption, and "mapalus culture" (mutual assistance) which continues, is explained in Table 3.

**Social conditions of society.** Three indicators are used to explain the social conditions of the community around the pig farming business, namely the health of the surrounding community, the formation of interaction patterns that impose restrictions on pig pens, and the formation of a pig farming community, which are further explained in Table 1. Based on Table 1, it is known that there are 84.8% of the community who agree with the improvement of public health around the pig pen, there are 88% of the community who state that there are restrictions on interaction with the pig pen, and there are 89.4% of the community who state that there is a pig farmer community. Based on the results of the analysis, it was found that the behavior of pig farmers who apply biosecurity to pig farming has a positive impact on the condition of the community around the pig farming. This certainly motivates pig farmers to apply other technologies.

**Table 1.** Social Conditions of Communities Around Pig Farming.

Indicator	Category	Frequency	Weight Value	Total	Percentage
The health of the surrounding community	Strongly Agree	44	5	220	44.0
	Agree	51	4	204	40.8
	Undecided	5	3	15	3.0
	Disagree	0	2	0	0.0
	Strongly Disagree	0	1	0	0.0
Interaction patterns that impose restrictions	Strongly Agree	47	5	235	47.0
	Agree	46	4	184	36.8
	Undecided	7	3	21	4.2
	Disagree	0	2	0	0.0
	Strongly Disagree	0	1	0	0.0
Formation of a pig farming community	Strongly Agree	52	5	260	52.0
	Agree	43	4	172	34.4
	Undecided	5	3	15	3.0
	Disagree	0	2	0	0.0
	Strongly Disagree	0	1	0	0.0

The social conditions of an area are influenced by something that happens. Before being hit by ASF, pig farmers were reluctant to pay attention to the health of the surrounding environment. The location of pig pens in Minahasa Regency is generally close together. In addition, residences and pig pens are generally close together. This causes people to consider the stench from waste to be commonplace and to consider it the smell of money. ASF disease has an impact on farmers' decisions to adopt science, namely biosecurity in pig farming [20]. Pig farmers began to think about and prioritize pig health maintenance activities as the most important thing rather than making a profit. By maintaining pig health, it indirectly affects the surrounding conditions or the environment around the pig pen, including the reduction in the stench of pig waste.

The restriction of access to the pig pens allows for low interaction between humans and pigs. Of course, pigs are healthier because they do not come into direct contact with the outside environment. Pig farmers are also healthier because they have to implement biosecurity standards in handling pigs. This behavior is certainly very beneficial for pigs, pig farmers and the community around the pig farming business. The formation of a pig farmer community, further strengthens the relationship and social interaction between fellow pig farmers. The exchange of information and experience between farmer and another, allows the creation of social conditions that have sensitivity and concern for the surrounding environment. Changes in behavior that pay attention to environmental health can have an impact on public health globally. This is because the livestock production process, especially pigs, has a greenhouse effect that causes global warming. By forming a pig farmer group, the transfer of knowledge will be maximized and have an impact on better social conditions in the region in the future.

**Economic conditions of society.** There are 3 indicators that explain the economic conditions of the community around pig farming in Minahasa Regency, namely the ease of obtaining pork, the contribution of pig farmers to religious and community activities, and the opportunity for cooperation with corn and rice farmers for animal feed needs, explained in Table 2.

Based on Table 2, it is known that 85.6% of the community agreed that it was easy to obtain pork, 83% of the community stated that there was a contribution from pig farmers to religious and community activities, and 86.8% of the community stated that there was an opportunity for cooperation with other farmers as suppliers of raw materials. The results of the analysis show that the behavior of pig farmers who apply biosecurity in livestock farming practices has a positive impact on the social conditions of the community around the farm location. The application of biosecurity not only plays a role in maintaining livestock health, but also increases community trust and acceptance of the existence of pig farms in their environment [20]. The existence of business units in an area, including pig farms in rural areas of Minahasa Regency, directly provides economic and social benefits to the surrounding community. The community has easier and faster access to quality pork, because they can see directly the process of raising and slaughtering livestock, which guarantees the quality and cleanliness of the product [21]. In addition, the price of pork at the local level be-

comes more affordable because the community does not need to bear additional distribution or transportation costs from outside the area. Furthermore, pig farming businesses play an active role in supporting various social and religious activities in the village. Pig farmers often become donors in traditional events, religious celebrations, and other social activities. This contribution is known as social costs\*, which is a sum of funds or donations given by farmers to the community as a form of social participation and environmental responsibility. The amount of this social cost varies, depending on the scale of the business and the number of pigs raised. Indirectly, this social cost is one of the strategies of farmers to maintain harmonious relations with the community and minimize the potential for complaints or social conflicts that may arise due to the environmental impact of livestock activities.

**Table 2.** Economic Conditions of Communities Around Pig Farming.

Indicator	Category	Frequency	Weight Value	Total	Percentage
The ease of obtaining pork	Strongly Agree	43	5	215	43.0
	Agree	42	4	168	33.6
	Undecided	15	3	45	9.0
	Disagree	0	2	0	0
	Strongly Disagree	0	1	0	0
The contribution of pig farmers to religious and community activities	Strongly Agree	38	5	190	38.0
	Agree	41	4	164	32.8
	Undecided	19	3	57	11.4
	Disagree	2	2	4	0.8
	Strongly Disagree	45	1	0	0
The opportunity for cooperation	Strongly Agree	44	5	225	45.0
	Agree	11	4	176	35.2
	Undecided	0	3	33	6.6
	Disagree	0	2	0	0
	Strongly Disagree	0	1	0	0

On the other hand, the existence of pig farms also opens up opportunities for cooperation between farmers and local farmers, especially in the provision of feed ingredients such as corn and bran. This cooperation pattern can support rural economic growth

through the formation of a business network based on local potential. However, until now, pig farmers in the area still face challenges in the form of limited local feed supplies, so they have to rely on purchases from outside the village. This is one of the obstacles that needs to be found a joint solution so that the sustainability of pig farming businesses in rural areas can be guaranteed, while providing more equitable economic benefits for the surrounding community.

**Cultural conditions of society.** There are 3 indicators to measure the cultural conditions of the community, namely the sustainability of pig farming, the culture of continuous pork consumption, and "mapalus culture"(mutual assistance) which continues, is explained in Table 3, explained in Table 3.

**Table 3.** Cultural Conditions of Communities Around Pig Farming

Indicator	Category	Frequency	Weight Value	Total	Percentage
The sustainability of pig farming	Strongly Agree	49	5	245	49.0
	Agree	43	4	172	34.0
	Undecided	8	3	24	4.8
	Disagree	0	2	0	0
	Strongly Disagree	0	1	0	0
The culture of continuous pork consumption	Strongly Agree	42	5	210	42.0
	Agree	43	4	172	34.4
	Undecided	15	3	45	9.0
	Disagree	0	2	0	0
	Strongly Disagree	0	1	0	0
"mapalus culture" (mutual assistance) which continues	Strongly Agree	44	5	220	44.0
	Agree	40	4	160	32.0
	Undecided	16	3	48	9.6
	Disagree	0	2	0	0
	Strongly Disagree	0	1	0	0

Based on Table 3, it is known that 88.2% of the community agreed to the sustainability of pig farming, 85.4% of the community stated that there was a culture of continuous consumption of pork, and 85.6% of the community stated that there was a culture

of mapalus (helping each other) that continued. The results of the analysis of the three indicators that explain the cultural conditions of the community, mean that pig farming that applies the concept of a circular economy has a positive impact on the culture of the surrounding community. It is hoped that pig farmers can adopt other knowledge related to the concept of a circular economy in pig farming, so that pig farming in Minahasa can become a culture that can improve the socio-economic conditions of the community sustainably [22].

## 4 Conclusion

The application of the circular economy concept in pig farming, in addition to providing a positive impact on environmental sustainability, can also contribute to the creation of social changes in society that support community welfare. These results can be the basis for determining policies for developing sustainable pig farming in rural areas that can have a global impact.

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