

Impact of sustainable agricultural cultivation system policy on food security and welfare of rice farmers in south Sumatra province, Indonesia

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Abstract

Ensuring food security has become an issue for a critical country at various levels of economic development, but the agricultural sector plays a strategic role in improving food availability. Sustainable food production and environmental protection should be government policy. This research aimed to analyze the impact of the sustainable agricultural cultivation system (SACS) policy on food security and the welfare of rice farmers. The area of the research, Tanjung Lago District, of South Sumatra province, were selected purposively. The research method used was the survey method, and the sample withdrawal method was a sample random method with 30 farmers in 2021. The results showed that with the implementation of SACS, land productivity increased to 6.5 tons/ha, previously 4.5 tons/ha. Therefore, the farmers' income also increased, amounting to Rp1,647,464.00/ha. Food availability increased the impact of production, and the rice stock was steadier than before. Better food affordability due to distribution, stabilization of supply and price, stock management, and access to markets and information are raising the usability of food, including improving consumption patterns and food safety and quality. The welfare of farmers is feeling prosperous because of the SACS. So, SACS could improve food security and farmers' welfare.

Keywords: agriculture, food security, sustainable, welfare

1. Introduction

El Niño and La Nina as implications of climate change can have a negative impact on agriculture production (Li *et al.*, 2020). These two extreme climatic conditions have at least caused a drastic decline in rice productivity in Indonesia by -0.50% and -0.65% respectively for 40 years from 1970 to 2010 (Khairullah *et al.*, 2021). In addition to quantity, changes in the price and quality of agricultural commodities are indicators that show that climate change significantly impacts agricultural production (Anderson *et al.*, 2020; FAO, 2015; Tang, 2019). Extreme climate change also causes the emergence

of pests and diseases that attack crops and have an impact on decreasing agricultural production (Castex *et al.*, 2018; Gomez-Zavaglia and Mejuto, 2020; Hatfield *et al.*, 2020; Tjaden *et al.*, 2018). Climate change is becoming an unavoidable natural phenomenon. If allowed to continue, it will indirectly become a threat to food security and farmers' welfare (Lenderking L. *et al.*, 2021).

Nevertheless, food security has a strong relationship to the economic growth of a region. At least 76.92% of 26 empirical studies conducted between 2004-2021 show that food security and economic growth have a positive relationship (Fernandes and Samprutra, 2022). This opinion is also reinforced by research results from (Ceessay and Ndiaye, 2022) which state that food security is correlated with economic growth. Adequate food security is a basic human need, being a source of human nutrition and energy to carry out daily activities (Fanzo *et al.*, 2018). Meeting sufficient food needs can participate in encouraging one's behavior in carrying out economic activities. Moreover, the background of Indonesian people who are mostly farmers, there needs to be a special policy made by the government and oriented towards food security and farmers' welfare.

In several Southeast Asian countries such as Malaysia, the establishment and implementation of specific policies in the agricultural sector is carried out as a form of climate change mitigation and adaptation (Tang, 2019). Other studies show that sustainable agricultural policies that focus on increasing agricultural production and technology are positively able to increase agricultural productivity and farmer welfare (Shikur, 2020). Other sustainable agricultural policies at the local/regional level that focus on improving infrastructure and providing clean water have proven to be able to contribute to food security and economic growth (Chemin *et al.*, 2019). On the other hand, the state also has an obligation to ensure food availability and achieve food welfare for the community (Mukadar *et al.*, 2019).

In Indonesia itself, the sustainable agriculture cultivation system (SACS) policy is present as an effort to realize food sovereignty and security. Tanjung Lago is one of the regions in South Sumatra that has implemented this policy since 2015. Tanjung Lago is one of the regions in South Sumatra which has an area of tidal rice fields reaching 15.59 hectares. Tidal land can be used as an effort to support the success of SACS through various technological innovations. The forms of realization of the sustainable agriculture cultivation policy that have been carried out include the following: 1) Improvement of irrigation techniques; 2) assistance with driving equipment in the form of a water pump machine; 3) seed feeding and fertilizers; 4) The placement of extension workers who are ready to assist farmers in overcoming various problems faced. According to the problem description above, thus this paper presents a comprehensive review of how sustainable agriculture cultivation systems can fill the

gap between the threat of climate change to food security and the welfare of farmers which is one of the pillars of regional economic development.

2. Materials and methods

2.1 Research study and site sampling location

The study was conducted in Tanjung Lago District, South Sumatra Province, which is located between latitude 2°39'6.17"S and longitude 104°42'9.79"E was deliberately chosen as the research location because it has a large tidal rice field area and is one of the food granary locations in South Sumatra. For more details, the research location and site study can be seen in Figure 1 as follows:

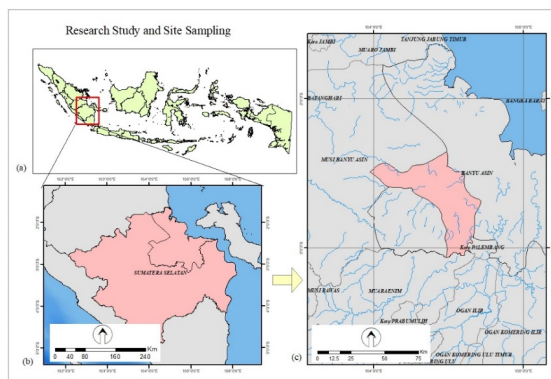


Figure 1. Study Area: a) Indonesia Map, b) South Sumatra Map, c) Tanjung Lago District

2.2 Research method

The research was conducted directly through an interview method of 30 farmers who were randomly selected simply and using the *Slovin* formula with 15% error from a total of 105 farmers who had implemented sustainable agricultural cultivation policies. The data collection method used in this study is the survey method, in order to obtain opinions or opinions from farmers through direct interaction with the observed objects. All variables in the questionnaire are valid and reliable. The data processing method is carried out using descriptive statistical analysis and multiple linear regression formulated with the following model:

$$LS_i = (\alpha_1 \text{Hea}_i) + (\alpha_2 \text{Eco}_i) + (\alpha_3 \text{Job}_i) + (\alpha_4 \text{Fam}_i) + (\alpha_5 \text{Fri}_i) + (\alpha_6 \text{Per}_i) + \mu_i$$

Descriptions

Where *LS*: A person's life satisfaction i , on a scale of 5 to 100, *Hea*: A person's health satisfaction i , on a scale of 5 to 100, *Eco*: A person's economic satisfaction i , on a scale of 5 to 100, *Job*: a person's job satisfaction i , on a scale of 5 to 100, *Fam*: Relationship satisfaction with one's family i , on a scale of 5 to 100, *Fri*: Relationship satisfaction of one's friendship i , on a scale of 5 to 100, *Per*: Personal Satisfaction of a person i , on a scale of 5 to 100, μ : Error Rate i , α , σ : Parameters to be estimated σ and i : Research Location

3. Results and discussion

3.1 Socio-demographic profile of rice farmers

Rice farmers' socio-economic factors are known to affect the impact of sustainable agricultural cultivation system policy on food security and welfare, namely gender, age, farming experience, education, farm size and household size. In accordance with previous research (Chiputwa and Qaim, 2016; Rachmah *et al.*, 2020; Satama *et al.*, 2022) Several variables above can explain the socio-demographics of farmers. Table 1. Shows that based on the gender category, all respondents are men who have a dominant role in running the sustainable agriculture cultivation system policy. In contrast, research conducted by (Satama *et al.*, 2022) shows that women have a more dominant role, especially in decision-making, knowledge and adoption of sustainable measures. Based on the age category, farmers can be classified into productive age categories (Issahaku *et al.*, 2020) and have had long independent farming experience, which is an average of 22 years. Age maturity and experience of farming independently will influence the attitude of individuals towards agriculture and the environment (Euriga, 2008). The more mature the age and the longer the experience of farming, the more concerned a person will be about agricultural activities and the environment (Mulyaningsih *et al.*, n.d., 2018). Based on the education categories, most farmers get access to education until junior high school. (Van Thanh and Yapwattanaphun, 2015) their research mentioned that the higher a person's level of education, the more they understand that the natural environment will affect human survival. Based on the category of land area, most farmers can be classified as large farmers (Assan, 2019) because they have an average land area of more than 1 hectare. Finally, based on age categories, most farmers have a fairly large number of family members, which is an average of 4 people. One of the advantages of having large family members is that farmers can involve family members in farming activities carried out (Oyewole *et al.*, 2022). Table 1 tabulates the data for the socio-demographic profile of the farmers.

Table 1. Socio-demographic farmers' profile

Characteristic	Categories	Percentage (%)	Average ± Std. Deviation
Gender	Male	100	-
	Female	0	
Age (Year)	26 – 35 (Early Adult)	26.67	41 ± 7.73
	36 – 45 (Late Adult)	46.67	
	46 – 45 (Early Elderly)	20.00	
	56 – 65 (Late Elderly)	6.67	
Farming Experience (Years)	1 – 9	16.67	22 ± 11.81
	10 – 19	16.67	
	20 – 29	30.00	
	30 – 39	26.67	
	>40	10.00	
Education (Years)	No Formal Education (0)	3.33	7.2 ± 2.25
	Elementary Level (6 Years)	46.67	
	Primary School (9 Years)	46.67	
	Secondary School (12 Years)	3.33	
Farm Size (Hectare)	1 – 2	86.67	2 ± 0.90
	3 – 4	13.33	
Household (Person)	Size 1 – 3	26.67	4 ± 0.85
	4 – 6	73.33	

Commented [VNI]: Why are the numbers in bold?

3.2 The impact of sustainable agricultural cultivation system policy on food security

The sustainable agricultural cultivation system (SACS) policy studied in this study focuses on increasing the crop index and productivity of smallholder rice farmers through several policy realizations, along with the threat of climate change to the tidal land such as 1) improved irrigation techniques; 2) assistance with driving equipment in the form of a water pump machine; 3) seed feeding and fertilizers; and 4) the assistance of extension workers. The impact of the sustainable agriculture program policy on food security in Tanjung Lago District is analyzed by comparing the values of food security indicators. Several indicators of the food security index will be analyzed including food

availability, food accessibility, and food utilization and stability. These indicators are measured by comparing the conditions before and after the sustainable agricultural cultivation system policy is implemented (Table 2).

Table 2. Brief Description About the Impact of Sustainable Agriculture Cultivation System Policy on Food Security

Indicators	Pillars of Food Security	The Implementation of the Sustainable Agriculture Cultivation System (SACS) Policy	
		Before the Implementation	After the Implementation
Availability (FAO, 2008)	Food Production	<ul style="list-style-type: none"> Food production of rice plants will produce 5-6 tons/hectare and the average production reaches 9,566.67 tons. 	<ul style="list-style-type: none"> Food production of rice crops will produce 6-7 tons/hectare and the average production reaches 10,000 tons.
	Food Stock	<ul style="list-style-type: none"> Generally, farmers will set aside as much as 500 kg of the harvest for family food reserves. 	
Accessibility (FAO, 2008)	Distribution	<ul style="list-style-type: none"> Farmers → Middleman → Factory (PT. Buyung) → End Consumers 	<ul style="list-style-type: none"> Farmers → Middleman → Factory (PT. Buyung) → End Consumers
	Supply and Price Stabilization	<ul style="list-style-type: none"> Unstable supplier and price. 	<ul style="list-style-type: none"> Unstable supplier and price.
	Stock Management	<ul style="list-style-type: none"> Stock management is quite good. 	<ul style="list-style-type: none"> Stock management is quite good.
	Access to the Market and Information	<ul style="list-style-type: none"> Access to markets is within easy reach; Access to information is sufficient. 	<ul style="list-style-type: none"> People's purchasing power is fixed; Access to markets is within easy reach; Access to information is sufficient.
Utilization and Stability (FAO, 2008)	Consumption Patterns Improvement	<ul style="list-style-type: none"> Fixed Consumption 	<ul style="list-style-type: none"> Fixed Consumption
	Food Safety and Quality	<ul style="list-style-type: none"> Food needs in quality and quantity have been fulfilled. 	<ul style="list-style-type: none"> Food needs in quality and quantity have been fulfilled.

Based on the availability indicators, Table 2. shows that the implementation of sustainable agricultural cultivation policies can increase rice production by 20% and total production increase by 4.5%. It has happened because the implementation of sustainable agricultural cultivation policies

focuses on improving agricultural production facilities, such as seed assistance, fertilizers and improving irrigation systems for rice fields. Thus, with the improvement of irrigation, farmers are able to carry out farming activities twice a year. This is also in line with the results of the research by (Materu *et al.*, 2018) which states that one of the realization of sustainable agricultural policies in the form of the application of irrigation techniques in rice farming can increase production by 1.5 tons /hectare/year while saving water by 33%. Nevertheless, it does not show a significant change in the amount of food stock by farmers. An increase in rice production will indirectly increase farmers' income. Generally, economic theory states that the higher the family income, the higher the quantity of food. This study is different from the research conducted by (Kansiime *et al.*, 2021) which shows that income affects the quality of household food consumption, such as during the Covid-19 pandemic which caused a shock in household income and had an impact on increasing the proportion of food insecurity by 38% and 44% in Kenya and Uganda.

Based on the accessibility indicators, the implementation of sustainable agriculture policies has no influence on the marketing channels. Both before and after the implementation of the policy will go through three levels of marketing channels until it reaches the end consumer. This is not in line with the results of research conducted by (Saleh and Endang S., 2023) which states that sustainable agriculture policies allow farmers to be able to produce superior commodities. While the superior commodities should have a bargaining position to be able to directly distribute agricultural products efficiently to consumers. A sufficient distribution and good marketing infrastructure is considered a dissemination of agricultural change in sustainable agriculture (Adenle *et al.*, 2019). However, in general, it can be concluded that sustainable agriculture policies can produce products that are commercial and their sales can be accessed by the wider community. Furthermore, from the price and supply stabilization point of view, farmers can get the benefit from inventory management, access and information access. This is in line with research conducted by (Khodijah *et al.*, 2022) which states that the sustainable agriculture cultivation system policy allows farmers to be able to access the market information from extension workers.

Based on the utilization and stability indicator, Table 2 shows that there is no change in the consumption pattern of farming families and farmers' food adequacy. However, in terms of quantity, farmers' food sufficiency increased in line with the increase in rice production which originally could only be harvested once a year into twice a year. It shows that sustainable agricultural cultivation system (SACS) policies as an effort to mitigate food insecurity have been successfully implemented.

3.3 The impact of the sustainable agricultural cultivation system policy on rice farmers welfare

Subjective well-being is used as a farmers' welfare indicator to see various factors that are affected, including satisfaction in life, health, economics, work, family and friendship. Figure 2. shows that more than 50% of farmers respond positively to all indicators of farmers' welfare. It means that sustainable agricultural cultivation (SACS) policies generally can provide welfare to the farmers. Personal and friendship are the two variables that most impact the existence of sustainable agricultural cultivation policies. This policy allows farmers to continue to carry out rice farming activities by maintaining the local wisdom of the Indonesian people such as mutual cooperation (*gotong royong*) in planting and harvesting season activities (Abidin *et al.*, 2019). *Gotong royong* indirectly created an interaction between farmers both personally and in groups. More detail of the data can be seen in Figure 2 as follows:

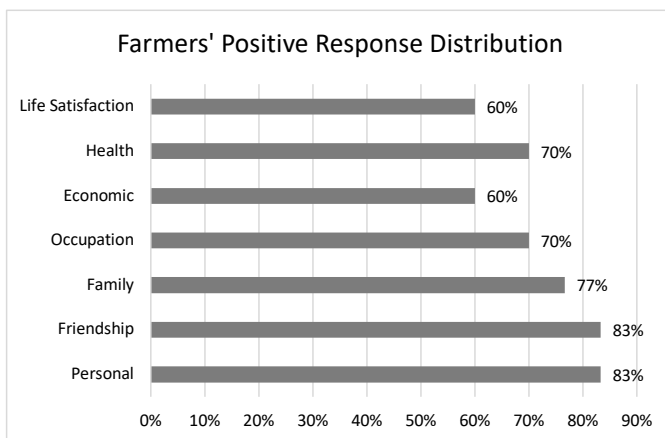


Figure 2. Farmers' Welfare Positive Response Based on Subjective Well Being

Furthermore, the impact of sustainable agricultural cultivation policies on farmers' welfare, seen through factors that affect life satisfaction, was analyzed through multiple regression models through the SPSS 24.0 program. Table 3 shows that the variables of health, work, family and friendship partially have a significant effect on the welfare of farmers with the SACS policy. The SACS policy facilitates farmers with assistance such as 1) Improvement of irrigation techniques; 2) assisted propulsion in the form of a water pump; 3) provision of seed feed as well as urea and fertilizer assistance; and 4) extension

assistance. The existence of technical assistance, one of which is by providing agricultural equipment such as machines, can help reduce the level of work farmers where usually work on traditionally and require lighter and more efficient effort (Khodijah et al., 2022). This indirectly makes farmers feel prosperous in terms of health, family and work. This is also in line with the research conducted which in research states that the purpose of implementing this SACS policy is to improve the standard of living and health of farmers (Guth et al., 2022; Laia et al., n.d.; Musilah et al., 2021). It is also stated that the technical efficiency through time, effort and costs emerged as a positive impact from the existence of the SACS policy. Furthermore, this SACS policy does not only provide technical assistance to farmers but also non-technical assistance such as extension efforts. Extension activities are usually carried out massively to members of farmer groups. In extension activities, social capital acts as a tool that is able to create harmonious interactions both between extension agents and farmers and among the farmers themselves (Moghfeli et al., 2023; Prayitno et al., 2022). The interactions among clusters shaped feedback and networks. This is the reason why with the SACS policy, friendship relations will also increase. For more details, the results of this study can be seen in Table 3. as follows:

Table 3. Regression Results Analysis of Factors Affecting Welfare of Rice Farmers in Tanjung Lago District

Variables	B	Std.Error	t-count	Sig.
Costant	4.681	8.274	0.566	0.577
Health	0.388	0.128	3.034	0.006
Economic	0.096	0.098	0.983	0.336
Job	0.256	0.134	1.912	0.068
Family	0.536	0.120	4.481	0.000
Friendship	-0.411	0.173	2.381	0.026
Personal	0.060	0.135	0.440	0.664
Adjusted R ²	0.76			
F _{count}	16.80			
Alpha	30%			
Significantly				

4. Conclusion

Food security and farmers' welfare are important issues that need attention because they are related to the economic development of a country. The existence of a sustainable agriculture cultivation system (SACS) policy comes as a mitigation effort to achieve food security and farmer welfare needs. The results of the study of the three food security indicators, namely availability, accessibility utilization and stability, prove that the SACS policy in Tanjung Lago District is able to meet the family food needs. Especially, in the availability of food productivity which has increased dramatically due to the assistance of various kinds of technical and non-technical assistance received by farmers. In line with this, another finding of this study shows that the implementation of the SACS policy can create farmers' welfare which is generally indicator measured by economic satisfaction variables, but there are other variables such as health satisfaction, job satisfaction, family satisfaction and friendships satisfactions which are other welfare indicator findings. Overall, the implementation of the SACS policy in Tanjung Lago District has succeeded fill the enhancement of food security and farmers' welfare needs.

Conflict of interest

The authors declare no conflict of interest.

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