Research Article

Concept Analysis and Implementation of Sustainable Agriculture based on Farmer Group Development and Agribusiness Patterns

Amnilis¹, Jhon Rinaldo²
¹,²Universitas Ekasakti Padang, Indonesia
Email: amnilis4@gmail.com

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Abstract. This study aimed to analyze the concept and implementation of sustainable agriculture based on farmer group development and agribusiness patterns. This study uses a qualitative research type. The criteria that influence the success of sustainable agriculture include socio-cultural, economic, agricultural technology, institutions, and government policies. The resource persons in this study were farmers in the Nanggalo sub-district, amounting to 12 people. The types of data used in this study are primary data and secondary data collected through observation, literature study, and in-depth interviews. This study uses a decision-making method to determine the priority of various choices, namely the Analytical Hierarchy Process (AHP). The results of the research based on the combined opinion weighting factor matrix of all criteria indicate that the order of priority of the most important criteria according to respondents' assessment for sustainable agricultural planning in Nanggalo District, Padang city is Institutional criteria (25.05%), Social Culture (20.73%), Agricultural Technology (20.69%), Economics (18.21%), and Government Policy (15.31%).

Keywords: Concept, Implementation, Sustainable Agriculture, Farmer Group Development, Agribusiness Patterns.

A. INTRODUCTION

Agricultural development and development plays a major and strategic role in the national economy (Dima & Inze, 2021). This strategic role is shown in the formation of capital, providing food, industrial raw materials, bioenergy, employment, a source of foreign exchange, and a source of income for business people and farmers at large—environmentally friendly farming (Kurbatova & Aisner, 2020).

Based on the findings of research conducted by Reghvendra Pratap & Rahul Handa (2020), the development of the agricultural environment is directed towards sustainable agricultural development as part of the implementation of sustainable development. Sustainable agricultural development (including rural development) is an important strategic issue of concern and discussion in all countries today. Sustainable agricultural development has not only become a goal but has also become a paradigm of agricultural development patterns (Jia et al., 2020). Conceptually, sustainable development was formulated in the late 1980s as a response to previous development strategies that focused more on the main objective of economic growth. Over time, this has proven to lead to environmental quality degradation due to overexploitation of resources.

In the end, intensive farming practices, on the one hand, have resulted in reduced organic matter, hardened soil, lack of soil porosity, low soil ion exchange rate, low water holding capacity, low microbial population and activity, and overall low soil fertility (Marcu et al., 2020). This condition results in inhibiting the process of root uptake of water and
dissolved nutrients so that the presence of nutrients in low quantities cannot be taken up by the roots optimally. Thus, a higher dose of fertilizer is needed to allow the roots to absorb nutrients in sufficient quantities from the available nutrients in the soil (Shen et al., 2020).

Today, any development efforts, especially those involving the environment, will always touch on the concept of sustainability. Sustainable agriculture can be understood based on the 1945 Constitution, article 33. The national economy is organized based on economic democracy with the principles of togetherness, efficiency, justice, sustainability, environmental insight, independence, and maintaining a balance of progress and national economic unity. A sustainable agricultural system can also be understood as an integrated agricultural management system that gradually increases the income of each unit of land while maintaining the integrity and ecological and biological diversity of existing natural resources in the long term, providing economic benefits for everyone, contributing to quality improvement life, and strengthen the country’s economic development (Sentiteerakul et al., 2020).

Conventional agricultural approaches and practices implemented in most developed and developing countries, including Indonesia, are agricultural practices that do not follow the principles of sustainable development. Conventional agriculture is based on an industrial approach with the orientation of large-scale agribusiness agriculture, capital intensive, technological innovation-intensive, planting seeds/varieties of superior plants in a spatial and temporal uniform manner, and dependence on production inputs, including the use of various types of agrochemicals (fertilizers and pesticides), and agricultural machine tools (Smidt, 2021).

According to economic calculations, the application of conventional agriculture is considered an appropriate alternative technology to solve the problems of food and nutrition shortages and food security faced by the world's population. However, it has recently been realized that conventional agricultural practices have, in some areas, causing negative impacts on the environment, as reported by various research institutions and non-governmental organizations, as well as economic and environmental experts (Aznar et al. 2020). The exploitation of natural resources by plantation and mining development activities has exceeded the ecological carrying capacity, resulting in excessive exploitation of natural resources (Danbaki, 2020). Various ecological, economic, social, cultural, and public health impacts increasingly doubt the world community about the sustainability of agricultural ecosystems in supporting human life in the future.

The country's agriculture is said to be advanced, and it can be seen from the application of the latest technology, which has many advantages, especially environmentally friendly technology. In this regard, the development of the national economy is based on agricultural development. This means that the agricultural sector is the driving force for national development. The agricultural sector is a mainstay in national development because it is a mainstay contributor to the country's foreign exchange. The Data and Information Center of the Ministry of Agriculture (2020) states that the contribution of the agricultural sector (excluding fisheries and forestry) to Indonesia's Gross Domestic Product (GDP) reached 10.21% in 2019. This data proves the progress and success of the agricultural sector in providing food for the Indonesian people. One of the factors that determine the agricultural sector's success is the dissemination of agricultural technology innovations in agricultural development. Agricultural technology innovation aims to provide convenience in the agricultural process, but this cannot be separated from the ability of farmers to implement these agricultural innovations. Therefore, the important role of agricultural extension workers is to act as a bridge and, at the same time, a conductor of agricultural technology innovation.
One problem that hinders sustainable agricultural production is the low level of farmer adoption of sustainable agricultural technology innovations. The government has produced many innovations in sustainable agricultural technology that aim to increase agricultural yields to meet the needs of farmers in particular and the wider community in general (Honc & Merta, 2020). However, in reality, not all farmers adopt these sustainable agricultural technology innovations. It can be said that the level of farmer adoption of sustainable agricultural technology innovations is still low, so that agricultural productivity is not yet fully optimal. This is due to the diversity of farmers' perceptions of these sustainable agricultural technology innovations (Tygai, 2021).

Several internal and external factors influence farmers' perceptions of agricultural technology innovations, including 1) The level of farmers' income is relatively low; 2) The process of creating technological innovations that are less comprehensive; 3) The process of disseminating technological innovations is less effective, and 4) Farmers still face various problems, both internal and external. The external obstacle generally faced by farmers is the lack of availability of agricultural production facilities and infrastructure that supports the application of sustainable agricultural technology innovations (Mohapatra & Rath, 2021). The lack of availability of seeds, fertilizers, and environmentally friendly pest control hinders farmers who are already willing to apply innovations in sustainable agricultural technology.

Sustainable farming systems can be implemented with several models, including organic farming models, integrated farming, integrated pest control, and LEISA (Low External Input Sustainable Agriculture). An organic farming system is an agricultural production system that uses organic matter as the main factor in the farming production process. LEISA (low-external-input and sustainable agriculture) is agriculture that optimizes the use of local/local natural and human resources, is economically feasible, ecologically stable, culturally appropriate, socially equitable, and external inputs are only complementary. Integrated pest management is a pest control technology that aims to maximize the effectiveness of biological and cultural control. Chemical control is carried out by minimizing disturbance to the environment. In addition, the agroforestry system is made up of three main components: 1) forestry, 2) agriculture, and 3) livestock. The combination of these various components results in the form of a GRI silviculture (forestry + agriculture), silvopasture (forestry + livestock), and agrosilvopasture (forestry + agriculture + livestock). The conservation farming system is an integration of farming activities and conservation activities carried out on sloping land. Soil erosion control, water conservation, soil productivity improvement, and hillside stability are the principles of conservation farming. Therefore, planning in the concept stage and the implementation stage of sustainable agriculture is very important.

B. METHOD

This study uses a qualitative research type. The criteria that influence the success of sustainable agriculture include socio-cultural, economic, agricultural technology, institutions, and government policies. The resource persons in this study were farmers in the Nanggalo sub-district, amounting to 12 people. The results of the interviews were then recorded, summarized, and re-confirmed to the informants. The types of data used in this study are primary data and secondary data collected through observation, literature study, and in-depth interviews. Furthermore, the data is presented in a table with a brief description containing the conclusions/important points of the criteria and alternatives presented by the resource persons. This study uses a decision-making method to prioritize various choices, namely the Analytical Hierarchy Process (AHP) (Poompavai, 2021). The AHP method is based on the
assessment results of decision-makers based on the importance of criteria and alternatives to the objectives to be achieved.

C. RESULT AND DISCUSSION

1. Calculation Result of Criteria and Alternative Priority Vector

Based on the results of the formulation of criteria and alternatives for sustainable agricultural planning in Nanggalo District, a hierarchical framework for selecting criteria and alternatives for sustainable agricultural planning in Nanggalo District was compiled as follows:

Table 1. Criteria and Alternatives for Sustainable Agricultural Development Activities

| Criteria               | Alternative                                                                 | Explanation                                                                 |
|------------------------|-----------------------------------------------------------------------------|----------------------------------------------------------------------------|
| Socio-Cultural         | A1 (Improvement of Farmer HR)                                                | Increasing knowledge, attitudes, and behavior of farmers towards sustainable farming systems through field studies, training, and comparative studies |
|                        | A2 (Development of sustainable agriculture awareness groups)                 | Develop farmer group cadres who implement sustainable farming systems as role models for other farmers |
|                        | A3 (Developing local wisdom on nature conservation)                          | Growing socio-cultural potential in the form of community customs that support sustainable agricultural systems |
| Economy                | B1 (Changes in farming patterns to agribusiness)                             | Changing the pattern of farming orientation from subsistence to commercials, such as farmer cooperatives, and the development of organic farming |
|                        | B2 (Creating alternative economic sources other than on-farm agriculture)    | Creating alternative employment opportunities                                  |
|                        | B3 (Increase support for farming capital)                                    | Provide venture capital assistance and loans to support the program          |
| Agricultural Technology| C1 (Improved access to information and continuous technology transfer)        | Improved access to information and transfer of agricultural technology, such as facilities and media such as village internet wifi and provision of libraries to expand village literacy |
|                        | C2 (Increase in sustainable agricultural technology upgrade activities)       | Increase the practice of implementing sustainable agricultural technology, such as conservation and demonstration plots for biogas production. |
|                        | C3 (Development of the integration of annual crops and annual crops with high selling value) | Development of agroforestry systems to achieve sustainable agriculture for farmers in mountainous areas |
| Institutional | D1 (Institutional strengthening for farmer groups) | Institutional empowerment for farmer groups in realizing sustainable agriculture, increasing institutional capacity in collaboration with various parties |
| Institutional | D2 (Increasing the role of extension workers in the context of fostering farmer groups) | Increasing the role of extension workers organized by the government or community groups to increase the ability of farmer groups |
| Government Policy | E1 (Incentive for farmers who are interested in implementing sustainable farming systems) | Incentives are given to farmers interested in implementing a sustainable agricultural system, and these incentives can be in the form of subsidies for production inputs and livestock assistance. |
| Government Policy | E2 (Regulatory emphasis on land use) | Making regulations on land management and land conversion |
| Government Policy | E3 (Includes education on site-specific environmental conservation in formal schools) | Provide education about environmental conservation starting from elementary level education so that a sense of care for environmental preservation grows from an early age in students |
| Government Policy | E4 (Supervising sustainable agricultural activities) | The commitment of the government and the community in guarding and assisting sustainable agricultural activities that have been carried out by farmer groups and continue to develop them |

Source: Data Proceed

Farmers are food producers as well as managers in farming. The increasing demand for food, both in terms of quantity and quality (safety and health), requires the ability of reliable farmers to apply the principles of sustainable agriculture. Sustainable agriculture is an agricultural system that in the long term can maintain the environment to meet the needs of food and fiber for humans, can improve the quality of the environment in agricultural needs, use natural resources as efficiently as possible, and can improve the quality of life of farmers without destroying nature, and can use natural resources. Natural resources in a comprehensively integrated manner (Kurmanalina et al. 2020).

Farmer groups can be a place for learning, namely a means to work together in developing an agriculture-based economy. Farmer groups can play an important role in disseminating new information and technology to other farmers. The right way to disseminate this information is through group counseling. The group counseling method is more effective than the mass media. With this method, there will be feedback that can reduce misunderstandings between extension workers and farmers in delivering information. In this method, the interactions that arise between farmers and extension workers will be more intensive (Barrios et al. 2020). In addition, farmers are invited and guided in groups to carry out more productive activities based on cooperation.
The government, through the regulation of the Minister of Agriculture number 67/Permentan/SM.050/12/2016 concerning Farmer Institutional Development, there are three directions for the development of farmer groups, namely 1) Increasing the ability of farmer groups in carrying out their functions (as a learning platform for cooperation and unit development). production); 2) Increasing the ability of members in developing agribusiness, and 3) Strengthening farmer groups to become strong and independent farmer organizations.

This is a challenge for the development of farmer groups in Indonesia, and the Nanggalo sub-district has an area of 251 hectares of rice fields, 225 hectares of the yard, 193 hectares of gardens, and 83 hectares of fields. With a population of 61,110 (2017), this sub-district has a huge potential to be developed. Another challenge regarding agriculture faced by the Indonesian state, including the Nanggolo sub-district, is the increasingly limited agricultural land and the increase in population, climate change, and little water. Water limitations and increasingly narrow land make the application of the principles of sustainable agriculture important. Sustainable agriculture, according to the Minister of Agriculture in his remarks at the 11th Governing Council meeting CAPSA (The Center for the Alleviation of Poverty through Sustainable Agriculture).

As described above, the extension workers' ability to develop farmer groups can be adjusted to the direction of farmer group development, as stated in the Regulation of the Minister of Agriculture. Thus, it can be said that the level of development of farmer groups is very much influenced by how big the role of the extension agent is in carrying out the development of farmer groups. However, the number of agricultural extension workers in Indonesia is still not ideal and not following the mandate of Law Number 19 of 2013 concerning the Protection and Empowerment of Farmers. The Head of the Extension and Human Resources Development Agency stated that of the 72,000 villages that have potential in agriculture, only 44,000 agricultural extension workers are available.

Based on the results of the assessment of respondents consisting of 12 people, it shows that institutional criteria are the most important relative priority choices in sustainable agricultural planning in Nanggalo District with a weight of 25.04%; then socio-cultural 20.74% and almost the same as agricultural technology 20.68%; then the economy 18.22%; the last government policy 15.31%. The calculation table is as follows:

Table 2. The Results of the Calculation of the Priority Vector Criteria and Alternatives for Farmer Groups

| Criteria | SC   | EC   | AT   | IS   | GP   | VE   | VP   | CI   | CR   |
|----------|------|------|------|------|------|------|------|------|------|
| SC       | 1    | 1.18436 | .89707 | .82889 | 1.35883 | 1.608 | 21851 | .0035 | .00316 |
| EC       | .829 | 1    | .89643 | .84623 | 1.19832 | .83383 | .19317 |
| AT       | 1.0886 | 1.8568 | 1    | .84522 | 1.05797 | .20796 |
| IS       | 1.107885 | 1.35878 | 1.4829 | 1    | 1.27974 | .26056 |
| GP       | .7946 | .8518 | .672156 | .61914 | 1    | .88586 | .16415 |

Source: Data Proceed

Farmer institutions, such as farmer groups, are considered the most important in sustainable development planning in Nanggalo District. Farmer groups are a place for farmers to gather, share knowledge, transfer technology and information, change mindsets, work together to solve agricultural problems faced personally and collectively. In general, many agricultural activities are collective, require a lot of energy, and cannot be done alone. They start from land management, plant maintenance, harvest, and post-harvest. The application of sustainable agricultural models such as organic agriculture requires togetherness between farmers in an area. Activities to break the cycle of plant pests also require the cooperation of all farmers in an area (Abdullahi et al., 2021).
Socio-cultural criteria are important criteria after institutional with a priority weight of 20.74%. The social aspect relates to humans as the subject of development, including the agricultural sector. The research findings conducted by Marciniak-Wlodarczyk et al. (2020) state that socio-cultural aspects are important in development planning because planning is a moral activity.

Agricultural technology criteria with a priority weight of 20.69% related to introducing sustainable agricultural technology models. The more familiar with forms of sustainable agricultural technology, both from technical and financial aspects, the farmers' knowledge will increase. The opportunity to choose alternative sustainable agricultural technologies that suit the specific needs of the location they face is increasingly appropriate.

Economic criteria are related to the demands of human life. The more the population increases, the more the necessities of life increase. 69.3% of the people of Nanggalo Subdistrict work as farmers with land as their main asset, so the efforts made by farmers are to maximize land productivity to maximize income. This triggers the exploitation of land for agriculture. As the research findings conducted by Xing Yang et al. (2020), very sloping lands are processed intensively / super intensively, and some do not heed the rules of land conservation, which ultimately leads to land degradation in the form of erosion, landslides, low soil organic matter. How to harmonize economic interests with the interests of resource sustainability is an important thing to do.

The last criterion is government policy (15.31%) related to the authority and power needed to encourage the realization of sustainable agriculture, among others with financial assistance, regulations, and so on. Based on the priority order of these criteria, it can be seen that government policy should not be used as the main choice, only as a supporter of the existing planning process at the farmer level. These results strengthen the findings of previous research conducted by Matthew Ayamga et al. (2021), who found that assistance to farmer groups through policies could increase the independence of farmers. The independence of farmer groups must be prioritized so that they do not become dependent communities, which are only active when there is assistance from the government/sponsors. Furthermore, the results of the synthesis of the weighting of all alternatives, which show the priority order of farmers, are presented in the following table:

| Code | Score (%) | Information                                           |
|------|-----------|-------------------------------------------------------|
| D1   | 9.1%      | Institutional strengthening of farmer groups          |
| A2   | 8.8%      | Cadre and capacity development of farmers aware of sustainable agriculture |
| C2   | 8.8%      | Development of renewable agricultural technology demonstration activities |
| C1   | 8.2%      | Improved access to information and sustainable agricultural technology |
| B1   | 8.4%      | Changes in farming patterns to agribusiness patterns   |
| A1   | 7.9%      | Improving the quality of human resources for farmer group members |
| D2   | 6.6%      | Increasing the role of extension workers to foster farmer institutions |
| E1   | 6.5%      | Incentives for farmers who want to implement sustainable farming systems |
| B3   | 6.0%      | Developing farm capital support                       |
| C3   | 5.7%      | Development of seasonal crop integration              |
| A3   | 5.6%      | Development of local wisdom values on nature conservation |
| B2   | 5.3%      | Realizing alternative economic sources other than agriculture (on- |
Furthermore, based on the combined opinion of respondents on institutional criteria, it is known that alternative strengthening of farmer institutions is the most important priority in sustainable agricultural planning in Nanggalo District. Empowerment of farmer groups is the key to strengthening farmer institutions. Empowerment implies that farmer groups position themselves as subjects of agricultural development. Farmer groups can identify themselves, are aware of the problems they face, are willing to help themselves solve their problems, know what the group needs are, and finally increase the role of farmer groups independently. The tendency of some of the existing farmer groups is not optimal in their function and management.

This is because some farmer groups position themselves more as agricultural development activity programs, namely a forum for receiving assistance from the government and other funders. Institutional farmers are more likely to be dependent where the act or not the role and function of the institution depends on the presence or absence of assistance provided. Through the farmer institutional empowerment program, it is hoped that farmers will be able to take the initiative independently to solve the problems they face, especially those related to the implementation of sustainable agriculture. The assistance from various parties was felt as a group need and part of their planning to overcome their problems. This will ensure the continuity of the activity assistance provided because it is needed, and the farmers have a sense of ownership (Maryunani, 2020). In addition, farmer institutions are important to increase their role in establishing mutually beneficial cooperation with various parties to overcome the problems faced, for example, low prices when over-production occurs, overcome by a partnership system.

The next alternative priority is to develop a cadre of farmer groups aware of sustainable agriculture as role models. The program becomes important and strategic because farmers need figures, figures, examples, role models who have successfully implemented sustainable agricultural models. Through this process, farmers will see firsthand, learn, analyze, consider, and finally decide. The introduction of various forms of application of sustainable agriculture through real examples will be easier to accept than the theory in the room. Cadres of farmers/farmer groups need to be continuously initiated by various parties so that the actors of sustainable agriculture models can thrive so that other farmers have no trouble imitating, imitating. These various agricultural practices apply various sustainable agricultural principles around them.

The next alternative priority is to increase demonstration plots of sustainable agricultural technology. Demonstration plots are important to introduce existing sustainable agricultural technology, how it is operationalized, the benefits, then farmers become aware of, believe in, and believe in the introduced agricultural technology. The hope is that there will be a process of increasing farmers' knowledge, attitudes, and behavior in the application of sustainable agriculture. Thus, the sustainable development triangle framework in this study can be presented in the following figure:
In other words, the concept of sustainable agriculture is oriented towards three dimensions of sustainability, namely:

The economic dimension is related to maximizing the income stream that can be obtained by at least maintaining the productive assets that are the basis for obtaining the income. The main indicators of this economic dimension are efficiency and competitiveness, the amount and growth of added value, and economic stability. The economic dimension emphasizes the aspect of fulfilling human economic needs for both present and future generations.

The social dimension, popular orientation, is related to the need for social welfare, which is reflected by a harmonious social life (including preventing social conflict), reservation of cultural diversity, and socio-cultural capital. For this reason, poverty alleviation, equal distribution of business opportunities and income, socio-political participation, and socio-cultural stability are important indicators that need to be considered in the implementation of development.

The dimension of the natural environment emphasizes the need for the stability of natural ecosystems that include biological living systems and natural materials. This includes the maintenance of biological diversity and biological carrying capacity, soil, water, agro-climate resources, and environmental health and comfort. Emphasis is placed on preserving the flexibility and dynamics of ecosystems to adapt to change, not on the conservation of a static ideal that is impossible to achieve. These three dimensions influence each other, so they must be considered in a balanced way. A stable and healthy social system, natural resources, and environment are the basis for economic activities.

In contrast, economic prosperity is a prerequisite for maintaining socio-cultural stability and preserving natural resources and the environment. An unstable or sick social system will tend to cause actions that damage the sustainability of natural resources and damage environmental health. In contrast, threats to the sustainability of natural resources and the environment can encourage chaos and social disease.

D. CONCLUSION

The results of the research based on the combined opinion weighting factor matrix of all criteria indicate that the order of priority of the most important criteria according to respondents' assessment for sustainable agricultural planning in Nanggalo District, Padang city is institutional criteria (25.05%), Social Culture (20.73%), Agricultural Technology
(20.69%), Economics (18.21%), and Government Policy (15.31%). At the same time, the priority order of the most important alternatives includes strengthening farmer institutions, developing a cadre of farmers groups aware of sustainable agriculture, and increasing demonstration plots of sustainable agricultural technology.

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