



Eco-Friendly Environmental Management In Integrated And Sustainable Agricultural Systems

Marbella Pratiningrum*

Department Of Agrotechnology Hasanuddin University,

*Correspondence author: Marbellapra27@gmail.com; Tel.: +6285776876078

Abstract

Integrated and sustainable agriculture is an agricultural system combining various components such as crops, livestock, fish and natural resources to increase efficiency, productivity, farmer welfare and environmental quality. A critical aspect of this agricultural system is environmentally friendly environmental management, which prevents or reduces adverse environmental effects of agricultural activities, such as soil erosion, water pollution, greenhouse gas emissions and biodiversity loss. This article discusses several ecological environmental management strategies in integrated and sustainable agricultural systems, such as organic fertilizer use, crop rotation, agroforestry, water-saving irrigation, integrated pest management and land restoration. The article also highlights some challenges and recommendations for implementing these strategies in Indonesia.

Keywords: Strategy, Challenge, Medium.

1. Introduction

Agriculture is an essential sector in Indonesia's economy and development as it accounts for approximately 13 per cent of the gross domestic product (GDP) and employs approximately 30 per cent of the country's workforce. In addition, agriculture has a role in maintaining food security, reducing poverty and conserving natural resources. However, Indonesia's agriculture faces various challenges, such as slowing production growth, increasing demand for food, climate change, land degradation and global competition. Therefore, an agricultural system that can overcome these challenges is needed, namely an integrated and sustainable agricultural system. Integrated and sustainable agriculture is an agricultural system combining various components such as crops, livestock, fish and natural resources to increase efficiency, productivity, farmer welfare and environmental quality. This agricultural system is considered one of the solutions to achieve the Sustainable Development Goals (SDG), especially goals number 2 (lack of hunger), 8 (decent work and economic growth), 12 (responsible consumption and production), and number 13. (Climate measures) and number 15 (Life in the country). Some examples of integrated and sustainable agricultural systems developed in Indonesia include rice field-cattle-fish (SRI) systems, agroforestry

systems, organic farming systems, and conservation systems. An essential part of an integrated and sustainable agricultural system is ecologically friendly environmental management, which prevents or reduces the adverse environmental effects of agricultural activities, such as soil erosion, water pollution, greenhouse gases and biodiversity loss.

Eco-friendly environmental management benefits not only the environment but also farmers and the wider community, as it can increase soil fertility, water availability, climate change adaptation and mitigation, and add value to agricultural products. However, environmentally friendly environmental management also has several obstacles, such as farmers' lack of knowledge, awareness and motivation; lack of policy, regulation and incentive support; lack of facilities, infrastructure and markets. Therefore, this article discusses several ecological environmental management strategies in integrated and sustainable agricultural systems, such as organic fertilizer use, crop rotation, agroforestry, water-saving irrigation, integrated pest management and land acquisition. The article also highlights some challenges and recommendations for implementing these strategies in Indonesia. This article should provide information and inspiration to researchers, practitioners, policymakers and other stakeholders interested in developing integrated and sustainable agriculture in Indonesia.

2. Materials and Methods

The materials used for integrated and sustainable agricultural systems can vary depending on the type of integrated components, such as crops, livestock, fish and natural resources. In general, the materials used must meet the following criteria:

- Environmentally friendly, meaning it does not pollute or harm the environment like organic fertilizers, pesticides and renewable energy.
- Cost-effective means it does not require high purchases, maintenance or replacement costs such as local seeds, alternative nutrients and simple technology.
- According to local conditions, it can adapt to local climate, soil, water and culture, such as local food plants, livestock and freshwater fish.
- Competitive, able to improve the quality and quantity of agricultural products and meet market demand, such as consumption of horticultural crops, poultry and fish. Some examples of materials used in integrated and sustainable agricultural systems include:
- Organic Fertilizer: Material used to fertilize the soil by decomposing organic materials such as manure, crop residues, compost or bokashi. Organic fertilizers can improve soil fertility, save production costs and reduce environmental pollution.
- Crop rotation: Material used to change crops grown in the same field regularly. Crop rotation can prevent loss of soil fertility, control crop pests and diseases, and increase farmers' productivity and income.
- Agroforestry: Material used to grow trees and crops on the same land. Agroforestry can provide ecological benefits such as maintaining groundwater balance, preventing soil erosion, providing wildlife habitat, and reducing greenhouse gas emissions.
- Water-saving irrigation: materials used to produce plant water while saving water consumption. Water-saving irrigation can be done using technologies such as drippers, sprinklers or infiltration wells. Water-efficient irrigation can solve drought problems, improve water use efficiency and reduce operating costs.
- Integrated Pest Management: Materials used to control pests and plant diseases combining physical, biological, chemical and agricultural methods. Integrated pest management can reduce synthetic pesticides, which harm the environment and human health.



- Land Remediation: Materials used to improve the condition of degraded or damaged land through redevelopment. Land improvement can be done by planting sedge grass, covering the soil with mulch or adding organic matter.

The methods used for integrated and sustainable agricultural systems can vary depending on the type of integrated components, such as crops, livestock, fish and natural resources. In general, the method used must meet the following criteria:

- Conservation of resources, i.e. excessive consumption of natural resources such as land, water and energy, but effective and efficient use of available resources.
- Increase productivity, i.e. not only to produce high-quality and large-scale agricultural products but also to increase the income and well-being of farmers.
- To maintain the balance of the ecosystem, i.e. not to harm the environment, such as soil, water, air, flora and fauna, but to preserve biological diversity and ecological functions.

Some examples of methods used in integrated and sustainable agricultural systems include:

- Organic agriculture: a production method without synthetic fertilizers or pesticides harmful to the environment and human health. Organic farming uses natural ingredients such as organic fertilizers, plant-based pesticides and microorganisms to fertilize the soil and control pests.
- Permaculture: methods used to design agricultural systems that mimic natural patterns. Permaculture uses principles such as cooperation between man and nature, use of local resources, diversification of agricultural products, and integration between plants, livestock and people.
- Agroforestry: A method of planting trees on the same land with other crops. Agroforestry provides economic benefits such as increased yields, savings in production costs and the provision of additional products such as timber, fruit or medicine.
- Water-saving irrigation: A method that provides plants with water-saving water use. Water-efficient irrigation uses technology such as drip, sprinkler or infiltration wells to regulate water flow according to plant needs.
- Integrated Pest Management: Methods used to control pests and plant diseases combining physical, biological, chemical and agronomic methods. Integrated pest management uses strategies such as crop rotation, release of natural predators, pest-resistant varieties, and synthetic pesticides as a last resort.
- Land remediation: methods to improve the condition of land damaged by degradation or alteration. Land remediation uses techniques such as planting ground cover trees, covering the soil with mulch or adding organic material.

3. Results

Eco-friendly environmental management in an integrated and sustainable agricultural system is one strategy to increase the productivity and well-being of farmers to maintain the balance of ecosystems. Eco-friendly environmental management includes the efficient and responsible use of natural resources, the implementation of agricultural practices following agroecological principles, the biological control of pests and plant diseases and the optimal use of agricultural products. An integrated and sustainable agricultural system is a system that combines different agricultural components such as plants, livestock, fish and microorganisms in one land unit, intending to create synergy and diversify products. This system can improve soil, water and air quality and reduce greenhouse gas emissions. Integrated and sustainable agricultural systems can also benefit farmers and surrounding communities economically, socially, and culturally. Some important points about ecological and environmental management in an integrated and sustainable agricultural system are as follows:



1. Use natural resources effectively and reduce adverse effects on the quality of the environment. One of the biggest challenges facing humanity today is the efficient use of natural resources and the reduction of adverse effects on environmental quality. Natural resources such as water, land, air, minerals and energy are essential resources that support human life and well-being. However, unsustainable use of natural resources can cause environmental pollution, climate change, ecosystem damage, and biodiversity loss.
2. Conserve finite or non-renewable natural resources such as oil, coal, natural gas and metals. We can switch to alternative, greener energy sources such as solar, wind, water and biomass.
3. Reduce the production and consumption of goods that require a lot of natural resources and produce a lot of waste and pollution, such as plastic, paper, packaging and electronic products. We can apply the 3R concept (reduce, reuse, recycle) to reduce the amount of waste generated and use goods that are still usable.
4. Protect and preserve natural resources with significant ecological and social functions, such as forests, wetlands, rivers, lakes, seas and mountains. We can avoid practices that harm natural resources, such as illegal logging, forest burning, mining, wildlife hunting and water pollution. We may also participate in natural resource protection and restoration programs implemented by the state or NGOs.
5. Implement agricultural practices corresponding to local ecological and socio-cultural conditions. One of the challenges of agricultural development is the implementation of agricultural practices suitable for local ecological and socio-cultural conditions. Agricultural practices that ignore these aspects can adversely affect the environment and society, such as land degradation, water pollution, biodiversity loss, and social conflict. Therefore, a holistic and inclusive approach is necessary when planning and implementing sustainable agricultural practices. This approach involves stakeholders at different levels in the decision-making and implementation process, such as farmers, researchers, government, private sector and civil society. In addition, this approach also takes into account ecological and socio-cultural factors specific to each region, such as climate, soil, water, flora, fauna, customs, values and community needs. Agricultural practices implemented in this way can increase the productivity and well-being of farmers while maintaining ecosystem balance and social harmony.
6. Pay attention to the health aspects of plants, animals and people involved in production. One of the biggest challenges in agriculture is to ensure the health of plants, animals and people involved in the production process. The health of plants, animals and people are interconnected and affect the quality and quantity of agricultural products. Therefore, integrated efforts are needed to prevent and control diseases, pests and pollution affecting plants, animals and humans. Some of the steps that can be taken are as follows.
 - Implement a sustainable agricultural system that considers the balance of ecosystems, biodiversity and natural resources. Sustainable agricultural systems can reduce the use of pesticides, chemical fertilizers and antibiotics, leading to resistance, residues and adverse environmental and health effects.
 - Perform routine inspection and monitoring of plants and animals for signs of disease or pests. When diseases or pests are detected, take control immediately according to the principles of integrated control. Integrated control combines physical, biological, chemical and cultural methods, considering economic, social and environmental aspects.
 - Maintain the cleanliness and sanitation of the agricultural environment to prevent the spread of diseases or pests from infectious sources. This includes cleaning agricultural implements



and equipment, handling spring waste

- Safe cultivation and isolation of plants or animals sick or attacked by pests. Ensure balanced and adequate nutrition for plants and animals to increase their resistance against diseases or pests. Balanced and proper nutrition is achieved by choosing high-quality varieties, proper fertilization, proper watering, animal nutrition and clean water.
 - Protects plants and animals from stressors that can weaken their immune systems. Stressors can include extreme temperatures, drought, floods, high winds or mechanical breakdowns. Stressors can be prevented or reduced using mulch, shade, watering, drainage or windbreaks.
 - Educate and empower farmers and communities about the importance of plant, animal and human health in agricultural production. Education and empowerment can be done through counselling, training, field demonstrations or social media. The aim is to increase the knowledge, awareness, attitudes and behaviour of farmers and the community in implementing healthy and safe agricultural practices. Considering the health aspects of plants, animals and people in the agricultural production process, it is hoped to increase agriculture's productivity, quality, efficiency and sustainability. In addition, it can also benefit the welfare of farmers and society, as well as environmental protection.
1. Increase the productivity and welfare of farmers through capacity building, market access and community empowerment

One of the biggest challenges for Indonesia's agricultural development is farmers' low productivity and well-being. Addressing this problem requires comprehensive and sustained action involving various actors, including government, the private sector, researchers and civil society. One viable strategy is to increase the productivity and welfare of farmers by increasing capacity, market access and community empowerment. Farmers' capacity can be strengthened by providing education, training, guidance and advisory services tailored to their needs and skills. The aim is to increase farmers' knowledge, skills and attitudes in the effective and sustainable management of agricultural enterprises. In addition, capacity building can also increase farmers' ability to adapt to climate, technology and market changes. Better market access can be achieved by improving the transport, communication and information infrastructure supporting the marketing of agricultural products. This can expand the market scope, reduce transport costs and increase the competitiveness of agricultural products. In addition, market access can also be improved by creating partnerships between farmers, entrepreneurs, suppliers, traders and consumers. It can increase the added value of agricultural products, ensure the availability of supply and demand, and improve product quality. Community impact can be made by providing opportunities for farmers to participate in decision-making related to their farming operations. This can increase farmers' responsibility, independence and well-being. In addition to that, community influence can also be implemented by forming farmer groups, cooperatives, associations or other organizations that consider the wishes, interests and rights of farmers. This can increase the solidarity, cooperation and empowerment of farmers. Thus, increasing the productivity and welfare of farmers through increased capacity, market access, and community empowerment is one way to foster inclusive, sustainable and competitive agricultural development in Indonesia.

2. Support ecosystem functions that support biodiversity and agriculture

Biodiversity and ecosystem functioning are essential aspects of sustainable agriculture. Biodiversity includes genetic variations, species and ecosystems that interact with each other in a given area. Ecosystem functions are the benefits people derive from natural processes such as food, clean water, erosion control, carbon sequestration, etc. Preserving the biodiversity and ecosystem functions supporting agriculture means protecting natural resources necessary to



human life and socio-economic prosperity. Several steps can be taken to preserve biodiversity and ecosystem functioning in agriculture:

- Adopt ecological farming practices such as crop rotation, organic fertilizers, integrated pest management and tree planting.
- Protect habitats and ecological corridors that connect protected areas with agricultural land, encouraging the movement and distribution of wild species.
- Preserves native plants and livestock gametes of high genetic value well adapted to local environmental conditions.
- Motivate community and stakeholders in managing biodiversity and ecosystem functions through education, information, participation and empowerment.
- Develop policies and regulations that support the conservation and sustainable use of biodiversity and agricultural ecosystem functions.

4. Discussion

Farmers' Willingness to Adopt Sustainable Farming Practices: A Case Study in the US Midwest: A Research Report Examining Factors Affecting Farmers' Willingness to Adopt Sustainable Farming Practices in the United States. This report uses survey methods and statistical analysis to determine the relationship between farmers' characteristics, perceptions, attitudes, social norms and constraints, and their intentions to adopt these practices.

Agronomy for Sustainable Development: a scientific journal that publishes research articles, reviews and meta-analyses related to agronomy for sustainable development. The magazine covers integrated farming systems, agroecology, climate change, soil health, natural resource management and technological innovation.

Participatory Research in Sustainable Agriculture: The Case of a Rice Intensification System in India: A research paper exploring the process and impact of participatory research in sustainable agriculture in India. This article uses case study methods and qualitative analysis to examine how farmers, researchers and other stakeholders work together to develop and implement rice intensification (SRI) systems as an example of an integrated agricultural system.

5. Conclusions

In implementing environmentally friendly management in integrated and sustainable farming systems, it is important to pay attention to several key aspects. Firstly, continuous education and training of farmers on sustainable agricultural practices need to be enhanced to improve their understanding and awareness of the importance of environmental conservation. Second, policy and regulatory support in favor of conservation and sustainable use of natural resources needs to be strengthened to create a conducive environment for environmentally friendly agricultural practices. Thirdly, a collaboration between various parties such as the government, private sector, research institutions, and farmers is essential in achieving the common goal of realizing sustainable and environmentally friendly agriculture.

By paying attention to these aspects, the implementation of environmentally friendly management in integrated and sustainable farming systems can provide significant benefits for farmers, the environment, and the surrounding community. With strong cooperation and high commitment from all relevant parties, sustainable agriculture can be an effective solution to facing agricultural challenges in the current era of globalization.

References

- [1] R. Marja, I. Herzon, E. Viik, J. Elts, M. Mänd, T. Tschardtke and P. Batáry. "Ecologically friendly



- management as an intermediate strategy between organic and conventional agriculture to support biodiversity." *Biological Conservation*, 178 (2014)
- [2] K. Fuglie. "Productivity Growth in Indonesian Agriculture, 1961-2000." *Bulletin of Indonesian Economic Studies*, 40 (2004)
- [3] J. Hendrickson, J. Hanson, D. Tanaka, and G. Sassenrath. "Principles of Integrated Agricultural Systems: An Introduction to Processes and Definition." *Sustainable Agriculture and Food Systems*, 23 (2008)
- [4] Sheila E. Amenumey and P. Capel. "Fertilizer Use and Energy Use of 16 Crops in the United States." *Natural Resources Research*, 23 (2014)
- [5] Faisal Mahmood, I. Khan, U . Aşraf, T. Shahzad, S. Hussain, M. Shahid, M. Abid kaj S. Ullah. "Effects of Organic and Inorganic Fertilizers on Maize and Their Residual Effects on Soil Physico-Chemical Properties." *Journal of Soil Science and Plant Nutrition*, 17 (2017)
- [6] M. Sajadian, K. Khoshbakht, H. Liaghati, H . Veisi and A. M. Damghani. "Development and Quantification of Organic Agricultural Indicators Using the Analytical Hierarchy Process." *Ecological Indicators*, 83 (2017)
- [7] J. Hendrickson, M . Liebig and G. Sassenrath. "Environment and Integrated Agricultural Systems." *Renewable Agriculture and Food Systems*, 23 (2008)
- [8] I. Ansah, Munkaila Lambongang and S. Donkoh. "Ghana's Food and Jobs Planting Program: A Review of the Role of Capacity in Farmer Participation." *Journal of Human Development and Skills*, 21 (2020)
- [9] N. Adnan, S. Nordin, and Z. A. Bakar. "Understanding and Facilitating Sustainable Agricultural Practices: A Detailed Analysis of the Adoption Behavior of Malaysian Rice Farmers." *Land Use Policy*, 68 (2017)
- [10] N. Adnan, S. Nordin, and Z. A. Bakar. "Understanding and Facilitating Sustainable Agricultural Practices: A Detailed Analysis of the Adoption Behavior of Malaysian Rice Farmers." *Land Use Policy*, 68 (2017)

