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Environmental and Technological Dimensions of Sustainable Rice Farming Practices in Jonggat Subdistrict, Central Lombok Regency

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Abstract: This study aims to analyze the environmental and technological dimensions of sustainable rice farming practices among rice farming communities in Jonggat Subdistrict, Central Lombok Regency. The research focuses on the integration of cultivation technologies, post-harvest processing, environmental sustainability practices, and the strengthening of farmer institutions to support sustainable agriculture. A descriptive qualitative approach was employed through field observations, in-depth interviews with 20 farmers, and secondary data analysis. Strategic analysis was conducted using the SWOT approach. The results indicate that the adoption of technologies such as the System of Rice Intensification (SRI), organic fertilizers, and the jajar legowo planting system can increase rice productivity by approximately 5–10%. Furthermore, these environmentally friendly agricultural practices contribute to improved soil quality, reduced dependence on chemical fertilizers, enhanced water-use efficiency, and lower greenhouse gas emissions, thereby supporting sustainable environmental management. Nevertheless, technology adoption remains constrained by limited capital, low technological literacy, and continued dependence on subsidized chemical fertilizers. Therefore, strategic efforts such as agricultural digitization, strengthening farmer institutions, continuous extension services, and the development of healthy food certification systems are recommended to improve environmental sustainability and increase the economic value of agricultural products.

Keywords: Sustainable Agriculture; Environmental Sustainability; Rice Farming; Agricultural Technology; Food Security; Central Lombok.

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Introduction

The agricultural sector plays a strategic role in supporting national food security, particularly in the supply of rice as the primary staple food for the Indonesian people. However, in recent decades, this sector has faced various challenges, such as land conversion, climate change, and population growth, which have led to an increase in food demand (Badan Pusat Statistik Kabupaten Lombok Tengah, 2025; Budiman & Santu, 2024).

On the other hand, conventional farming practices that rely on the intensive use of chemical fertilizers and pesticides have had negative impacts on the environment and human health. Excessive use of chemical inputs can lead to soil degradation, water pollution, and chemical residues in food products that may pose health risks (Badan Standardisasi Nasional Indonesia, 2016; Tumpu et al., 2021). This situation indicates that increasing food production can no longer rely solely on conventional intensification approaches, but must instead be directed toward sustainable agricultural systems.

The concept of sustainable agriculture emphasizes a balance between economic, social, and

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environmental aspects within agricultural production systems (Bi et al., 2024; Grzelak & Borychowski, 2022; Oge, 2025; Pretty, 2008). Sustainable rice farming practices also play an important role in maintaining ecosystem services, improving soil fertility, conserving water resources, and reducing greenhouse gas emissions generated from agricultural activities. One emerging approach is the adoption of healthy food technologies, which encompass the entire production chain from cultivation and harvesting to post-harvest processing. These technologies aim to produce food that is not only sufficient in quantity but also safe and highly nutritious (Abbas & Suhaeti, 2016; Hainiyah et al., 2025).

Jonggat Subdistrict, as one of the major rice-producing areas in Central Lombok Regency, has great potential for the development of healthy food technologies. However, previous research indicates that the adoption of such technologies remains limited and is not yet sustainable (Kurniawan et al., 2025). The Healthy Crop Cultivation Program (BTS), which was previously implemented, showed an increase in rice productivity; however, this has not yet been accompanied by widespread changes in farmers' behavior due to various economic and technical constraints (Efendy & Hutapea, 2010; Irwanto, 2021; Sunandar et al., 2021).

In addition, advancements in modern agricultural technology such as the System of Rice Intensification (SRI), digital farming, and the use of organic fertilizers offer significant opportunities to improve production efficiency while preserving environmental quality, enhancing resource-use efficiency, and supporting climate-resilient agricultural systems (Basso & Antle, 2020; MOOCs, 2024). However, the implementation of these technologies requires the right strategies to ensure they are accepted by farmers, particularly within the socioeconomic context of rural communities.

Given these circumstances, a comprehensive analysis is needed regarding strategies for implementing healthy food technologies among rice-farming communities, particularly in Jonggat Subdistrict. This study is expected to contribute to the formulation of policies and strategies for sustainable agricultural development based on healthy food technologies (Ayu1 et al., 2025; Hamyana et al., 2020; Sugita et al., 2025)

Method

This study employs a descriptive qualitative approach, with the aim of understanding the social phenomena associated with the adoption of healthy food technologies within farming communities (Sugiyono, 2013). This approach was chosen because it allows for an in-depth examination of the social and economic conditions, as well as the behaviors of farmers, in adopting agricultural technological innovations.

Study Area

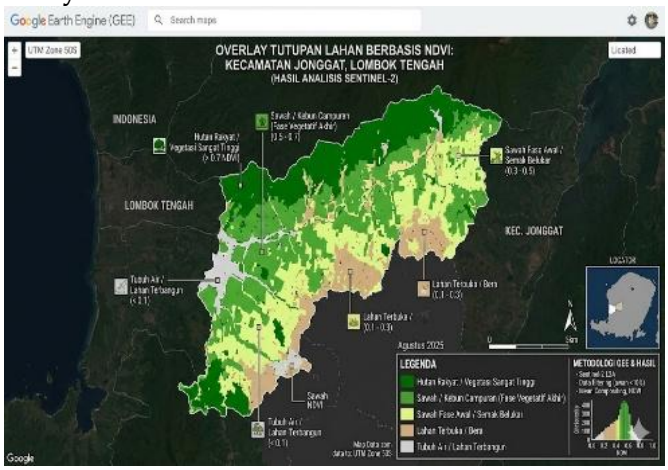

Figure 1. Map of the Study Location

The study was conducted in Batu Tulis Village and Puyung Village, Jonggat Subdistrict, an area dominated by the rice farming sector and possessing potential for the development of sustainable agricultural systems**.**

Data Collection

Data collection was conducted using several techniques, namely:

Field Observations

These were conducted to directly observe rice cultivation practices, the use of agricultural inputs, and post-harvest technologies applied by farmers.

In-depth Interviews

Interviews were conducted with 20 farmers selected using simple random sampling from the total farmer population. The interviews aimed to gather information regarding experiences, perceptions, and challenges in the implementation of healthy food technologies.

Secondary Data

Data was obtained from relevant agencies such as the Department of Agriculture and regional statistical publications to support the analysis.

Data Analysis

1. Data analysis was conducted through the following stages:
2. Data reduction
3. Data presentation
4. Drawing conclusions

Additionally, a **SWOT** analysis (**Strengths, Weaknesses, Opportunities, Threats**) was used to formulate strategies for the development of healthy food technologies based on the internal and external conditions of the farming community.

Result and Discussion

Environmental and Sustainable Cultivation Technology Dimension

The farming community in Jonggat Subdistrict has demonstrated a shift in cultivation practices toward agricultural systems with lower chemical inputs. This is evidenced by the implementation of ecosystem-based agricultural extension programs that promote the use of high-yielding rice varieties that are relatively resistant to pests and diseases. The implementation of environmentally friendly cultivation technologies contributes to reducing environmental degradation caused by excessive chemical input use. These practices improve soil health, maintain biodiversity within agricultural landscapes, and support long-term sustainability of rice production systems.

This approach reduces reliance on synthetic pesticides and contributes to improvements in agricultural environmental quality. Additionally, some farmers have begun adopting cultivation techniques such as the jajar legowo planting system and the use of liquid organic fertilizer. Observations indicate that the application of these technologies not only improves input efficiency but also enhances soil fertility in the long term. However, adoption rates remain limited, as some farmers perceive these methods as more complex than conventional systems.

Post-Harvest Processing Strategy

The scope of healthy food technology extends beyond the cultivation stage to include post-harvest processing. At the community level, innovations include the use of modern rice milling equipment capable of preserving the aleurone layer (bran) of the rice. The result is brown rice, which has higher fiber, vitamin, and micronutrient content compared to polished white rice. This strategy offers two main benefits:

1. Improved nutritional quality of food
2. Increased economic value of the product

Thus, post-harvest technology is a key factor in supporting community-based healthy food systems.

Strategic Matrix Analysis

Based on the results of the field analysis, strategies for the development of healthy food technology can be formulated in the following matrix:

Table 3. Strategy Matrix for Healthy Food Technology Development

Dimension	Main Strategy	Objective
Input	Conversion of chemical fertilizers to organic/semi-organic inputs	Improvement of soil structure and grain quality
Process	Digitalization of water management (intermittent irrigation)	Water efficiency and methane emission reduction
Output	Local healthy/organic food certification	Increased product value and consumer trust

The implementation of intermittent irrigation not only improves water-use efficiency but also contributes to climate change mitigation through methane emission reduction from flooded rice fields. The table above shows that the strategy for developing healthy food technologies encompasses three main dimensions: inputs, processes, and outputs.

In the input dimension, the transition from chemical fertilizers to organic fertilizers represents the first step toward improving soil quality and promoting sustainable agricultural practices. Organic fertilizers enhance soil fertility by increasing organic matter, improving soil structure, and supporting beneficial microbial activity. In the process dimension, the implementation of digital-based intermittent irrigation improves water use efficiency by optimizing irrigation according to crop requirements and environmental conditions. This approach not only conserves water resources but also reduces greenhouse gas emissions associated with agricultural production. Furthermore, digital technologies enable farmers to monitor and manage irrigation more accurately and efficiently. In the output dimension, healthy food certification plays a crucial role in ensuring product quality and safety while strengthening consumer confidence. Certified products are more likely to gain wider market acceptance and achieve higher economic value.

Consequently, healthy food certification enhances the competitiveness of agricultural products in both domestic and international markets. Overall, the integration of sustainable inputs, efficient production processes, and certified outputs contributes to the development of a more resilient, environmentally friendly, and competitive agricultural system.

Barriers and Strategic Solutions

Despite its great potential, the implementation of healthy food technology in Jonggat Subdistrict still faces various barriers.

Barriers

Economic Constraints

The cost of transitioning from conventional to organic systems is relatively high, especially for small-scale farmers.

Technological Literacy

Farmers' limited understanding of digital technology poses a challenge in adopting modern agricultural innovations.

Perceived Risk

Many farmers are concerned about a decline in productivity during the initial phase of transitioning to organic systems.

Strategic Solutions

To address these barriers, the following strategies are required:

Table 4. Strategic Solutions for Healthy Food Technology Implementation

Strategy	Description	Expected Impact
Government Intervention	Subsidies for organic farming equipment and inputs	Reducing transition costs
Digital Farming	Use of IoT-based soil moisture sensors	Improving efficiency and precision
Farmer Institutional Strengthening	Strengthening farmer groups/cooperatives	Increasing collective capacity
Continuous Assistance	Sustainable agricultural extension programs	Increasing adoption rate

Conclusion

The implementation of environmentally sustainable agricultural technologies in rice farming communities in Jonggat Subdistrict demonstrates strong potential to support sustainable agriculture and environmental conservation. Based on interviews with 20 farmers, the adoption of the System of Rice Intensification (SRI), organic fertilizers, and the *jajar legowo* planting system increased rice productivity by approximately 5–10%, improved soil fertility, and reduced dependence on chemical inputs. Modern post-harvest rice milling technology also enhanced the nutritional quality and economic value of rice products, particularly brown rice. However, technology adoption remains constrained by limited capital, low technological literacy, and concerns about productivity during the transition to organic farming. Strengthening collaboration among government agencies, extension services, farmer groups, and technology providers is therefore essential to accelerate sustainable agricultural development in Central Lombok Regency.

Government support should prioritize subsidies for organic farming inputs, sustainable extension services, and digital farming training to improve farmers' capacity and accelerate technology adoption. In addition, sustainable farming practices contribute to improved soil quality, more efficient water use, reduced chemical fertilizer dependence, and lower greenhouse gas emissions. Future research should quantitatively evaluate the long-term environmental and economic impacts of these technologies, including emission reductions, resource-use efficiency, soil health, and farmer income.

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