West Science Agro
Vol. 2, No. 01, February 2024, pp. 17~27

Analysis of Organic Fertilizer Use in Improving Soil Quality and Agricultural Yields in Indonesia

Dewa Oka Suparwata[1], Fitriah Suryani Jamin[2]
[1]Universitas Muhammadiyah Gorontalo
[2]Universitas Negeri Gorontalo

Article Info

Article history:

Received February 2024
Revised February 2024
Accepted February 2024

Keywords:

Organic Fertilizers
Soil Quality
Agricultural Yields
Sustainable Agriculture
Farmer Perspectives

ABSTRACT

This research investigates the impact of organic fertilizer use on soil quality and agricultural yields in Indonesia through a qualitative analysis. Ten informants, including small-scale and large-scale farmers, agricultural experts, and environmentalists, provided insights into their perceptions and experiences. The study reveals diverse farmer perspectives, with small-scale farmers exhibiting limited awareness and large-scale farmers emphasizing long-term benefits. Organic fertilizers were found to positively influence soil quality, improving structure, water retention, and microbial activity. Crop-specific responses varied, highlighting the importance of considering regional agroecological conditions. Challenges such as access, affordability, and labor intensity were identified, countered by opportunities including government programs, cooperative farming, and consumer demand. Decision-making factors encompassed economic considerations, knowledge, environmental consciousness, and social influences. The synthesis underscores the need for tailored interventions, acknowledging the complexity of factors shaping the adoption of organic fertilizers in Indonesian agriculture.

Corresponding Author:

Name: Dewa Oka Suparwata
Institution: Universitas Muhammadiyah Gorontalo
Email: suparwata_do@umgo.ac.id

1. INTRODUCTION

Agriculture is a crucial sector for Indonesia's economy, but concerns about the sustainability of conventional farming practices, particularly the use of chemical fertilizers, have arisen. Biomass-based fertilizers derived from renewable sources offer a sustainable alternative to synthetic fertilizers, promoting sustainable agricultural practices and reducing reliance on chemical inputs [1]. Transitioning to more sustainable farming practices requires addressing economic incentives, improving market access, leveraging farmers' groups, providing education and support, and designing policies that empower farmers as agents of change [2]. Legal protection for farmers and farmland is also important for ensuring resilience, independence, and food sovereignty [3]. Women play a significant role in the adoption of sustainable agriculture practices, particularly in the use of organic fertilizer and bio-pesticides [4]. The future of sustainable agriculture in Indonesia holds great potential, with innovations in production processes, feedstock

management, and nutrient formulation, as well as government support, circular economy practices, and export potential [5].

The overuse of chemical inputs in agriculture has been associated with soil degradation, environmental pollution, and long-term negative effects on ecosystems and human health. As a result, there is a growing interest in exploring sustainable alternatives, with organic fertilizers emerging as a potential solution. Organic fertilizers, such as sewage sludge, bioresources, and manure, offer a safe and environmentally friendly option for replenishing soil nutrients and promoting healthy soil-microbe-plant relationships. Studies have shown that the use of organic fertilizers can improve soil fertility, increase soil organic carbon, and enhance plant productivity. Additionally, organic farming practices can help maintain the organic matter and nutritive value of the soil, while minimizing the release of harmful chemicals into the environment. By adopting organic fertilizers and sustainable agricultural practices, it is possible to address the challenges of soil degradation and promote safe and sustainable food production [6]–[9]. This research seeks to address the critical need for sustainable agricultural practices in Indonesia by focusing on the impact of organic fertilizer use on soil quality and agricultural yields.

The rationale behind this research lies in the recognition of the pressing issues associated with conventional farming methods and the urgency to adopt practices that not only increase crop production but also promote environmental and agricultural sustainability in the long run. Organic fertilizers, derived from natural sources, offer a promising avenue to reduce the adverse impacts of chemical inputs while potentially improving soil health and overall agricultural productivity.

The main objectives of this study are: (1) To assess the impact of organic fertiliser use on soil quality in different agricultural regions of Indonesia. (2) To assess the effect of organic fertilizer on agricultural yields across different crops and geographical locations. (3) To understand the perceptions, experiences, and challenges faced by farmers, agriculturalists, and environmentalists regarding the use of organic fertilizers.

2. LITERATURE REVIEW

2.1 Organic Fertilizers and Soil Health

Organic fertilizers, such as compost, manure, and plant residues, have been found to enhance soil health by improving soil structure, water retention, and microbial activity [10]. The organic matter in these fertilizers contributes to nutrient cycling and availability, promoting sustainable soil fertility over time [11]. Additionally, the presence of beneficial microorganisms in organic fertilizers further enhances nutrient availability and promotes a conducive environment for plant growth [12]. Studies have shown that the application of organic fertilizers, such as manure, can increase the availability of soil phosphorus (P) by enhancing soil microbial P mineralization [13]. Furthermore, organic fertilizers, such as farmyard manure and vermicompost, have been found to improve the fertility status of macronutrients in the soil, leading to higher biomass yield and nutrient content in crops like onion [14]. Overall, organic fertilizers offer a sustainable approach to improving soil health and fertility, thereby supporting plant growth and productivity.

2.2 Organic Farming Practices in Indonesia

The adoption of organic farming practices in Indonesia has been encouraged by government initiatives and support programs to address concerns about the environmental impact of conventional agriculture. However, challenges such as limited access to resources, knowledge gaps, and market constraints have hindered the widespread adoption of organic farming practices [3]. To overcome these challenges, intensive training programs have been found to be effective in promoting organic farming practices among smallholder farmers, improving their knowledge and perceptions of organic farming [4]. Additionally, the role of women in

sustainable agriculture practices adoption has been highlighted, with women's participation significantly improving the adoption of organic fertilizer and bio-pesticide [5]. Furthermore, the importance of farmer groups and their active involvement in sustainable farming practices has been emphasized, as it significantly influences farmers' decision to adopt more sustainable practices [15]. Overall, addressing economic incentives, improving market access, providing education and support, and empowering farmers as agents of change are crucial for the successful transition to more sustainable agricultural practices in Indonesia [16].

2.3 Factors Influencing Farmer Decision-Making

Farmers' decision-making process regarding organic fertiliser adoption is influenced by many factors. Economic considerations, including the cost-effectiveness of organic fertilisers compared to chemical alternatives, play an important role in shaping farmers' choices [17]. In addition, farmers' knowledge and awareness of organic farming practices, access to resources, and cultural factors also contribute to the complexity of decision-making [18], [19]. Farmers' attitudes, subjective norms, perceived behavioural control, and awareness are significant factors that influence their intention to switch to organic farming practices [20]. The availability of services such as agricultural credit, facilities, infrastructure, and marketing collateral, as well as innovation properties, including relative advantage, compatibility, complexity, and observability, also influence farmers' decision-making in organic rice cultivation [21]. Agronomic factors, such as the amount and distribution of rainfall, are the most sensitive factors affecting rice farmers' fertilisation decisions, followed by logistical factors related to land size and cropping area.

2.4 Soil Quality and Agricultural Yields

Organic fertilisers have been shown to improve soil structure and nutrient content, thereby increasing crop productivity [22]–[24]. However, the impact of organic fertilisers on different crops and regions can vary, highlighting the need for a deeper understanding of this relationship [25]. Long-term use of organic fertilisers has been shown to improve soil fertility and contribute to sustainable agricultural productivity [26]-[29]. Studies have shown that the use of organic fertilisers, such as manure and vermicompost, can increase soil organic carbon, nitrogen, phosphorus and potassium content. In addition, the use of organic fertilisers has been associated with an increase in soil microbial populations, including bacteria, fungi, and actinomycetes. These findings suggest that organic fertilisers have the potential to improve soil quality and contribute to sustainable agriculture.

2.5 Knowledge Gaps and Research Needs

Despite the growing interest in organic fertilizers, there are still knowledge gaps that hinder a comprehensive understanding of their impact on soil quality and agricultural yields in Indonesia. The need for region-specific studies, considering the diverse agroecological zones in the country, and the incorporation of socio-economic factors in research designs are areas that warrant further exploration. Additionally, the development of practical guidelines for farmers and the identification of innovative solutions to overcome challenges are crucial for the successful integration of organic fertilizers into mainstream agriculture.

3. METHODS

This study uses a qualitative research design to explore the experiences, perceptions, and challenges associated with the use of organic fertilizer in improving soil quality and agricultural yields in Indonesia. A phenomenological approach will be used, which aims to understand the essence of participants' experiences and perspectives regarding the adoption of organic fertilizer. A purposive sampling technique will be used to select 10 informants representing diverse perspectives in the Indonesian agricultural landscape. The sample will include:

Farmers: Both small-scale and large-scale farmers from different regions to capture variations in farming practices.
Agricultural Experts: Researchers or extension workers who have expertise in organic farming practices and soil management.
Environmental Experts: Professionals with a focus on environmental sustainability and ecological impacts of agricultural practices.

The sample will be selected to ensure a balance of gender, age, and geographic location, to enhance the representativeness of the research.

3.1 Data Collection

Semi-structured interviews and focus group discussions will be the main methods of data collection. Semi-structured interviews will provide an in-depth exploration of individual experiences and perspectives, while focus group discussions will facilitate the identification of common themes and variations in group dynamics.

Interview and discussion topics will include:
Perceptions and Experiences: Participants' understanding of organic fertiliser, their experiences with adoption, and observed changes in soil quality and agricultural yields.
Challenges and Opportunities: Identification of barriers faced by farmers, insights into potential benefits, and suggestions to overcome challenges.
Decision-Making Factors: Exploration of factors that influence the decision to adopt or not to use organic fertilizer.

All interviews and discussions will be audio-recorded with the consent of participants, and detailed notes will be taken to supplement the recorded data.

3.2 Data Analysis

Data analysis will be conducted using NVivo, a qualitative data analysis software. The analysis process will follow a thematic analysis approach, involving the following steps:
Data Introduction: Transcription of interviews and discussions and familiarisation with the content to gain an overall understanding.
Initial Coding: Identification and coding of key concepts, themes, and patterns in the data.
Theme Development: Clustering codes into broader themes and sub-themes, allowing for comprehensive organization of the data.
Data Exploration: Exploration of relationships between themes and generating meaningful interpretations.
Reporting and Validation: Presentation of findings in a coherent narrative, supported by verbatim quotes. Validation of findings through member checking will be done by sharing the results with the participants to ensure accuracy and authenticity.

The use of NVivo will increase the efficiency and rigor of the data analysis process, enabling systematic exploration of the qualitative data and identification of nuanced patterns within the data set.

3.3 Ethical Considerations

This research will adhere to ethical guidelines, ensure informed consent, and participant confidentiality, and respect participant autonomy. Participants will be informed of the purpose of the study, potential risks, and their right to withdraw at any stage without consequence. The study will be conducted with sensitivity to cultural norms and local practices and ethical approval will be obtained from relevant institutional review boards.

4. RESULTS AND DISCUSSION

4.1 Introduction to Results

This section presents the findings of the qualitative analysis, examining the impact of organic fertilizer use on soil quality and agricultural yields in Indonesia. The results are derived from semi-structured interviews and focus group discussions with 10 informants representing various perspectives within the agricultural sector.

4.2 Perceptions and Experiences of Farmers

A variety of insights were revealed by investigating farmers' opinions and experiences about the application of organic fertilizers in Indonesian agriculture. Different regions' small- and large-scale farmers

showed different levels of awareness and engagement with organic farming practices. Small-scale farmers showed a poor knowledge of organic fertilizers, especially those in isolated areas. Many said it was difficult to get the knowledge and tools needed to switch to organic practices. This group adopted organic fertilizers more slowly due to a variety of factors, including financial limitations, a lack of educational opportunities, and the influence of traditional farming practices.

To be honest, I don't know much about organic fertilizers; I've just heard of them. We don't use it around here. I stick with what I know right now, but maybe if I had more information. - Small-scale cultivator

Even Nevertheless, several small-scale farmers showed signs of responsiveness to sustainable methods, as seen by their willingness to investigate organic fertilizers if given sufficient help, despite their lack of awareness. Large-scale farmers, on the other hand, demonstrated a more sophisticated knowledge of organic fertilizers, frequently attributing their adoption to worries about the long-term health of the soil and sustainable agricultural methods. These farmers understood how critical it was to switch from traditional to more environmentally friendly farming practices.

It's been three years since I started using organic fertilizers. My crops appear healthier and the structure of my soil has improved. Although it requires a little more labor, I believe the benefits will last. - Commercial Farmer

Their observations indicated a deliberate move away from conventional fertilizers and toward organic fertilizers, motivated by the need for improved soil quality and a proactive approach to reducing the environmental impact of farming. Large- and small-scale farmers alike agreed that organic farming methods require a lot of labor. One significant obstacle mentioned was the extra work needed for soil care, application, and composting. Regarding the possible long-term advantages of organic fertilizers, such as increased soil fertility and decreased reliance on outside inputs, a common opinion has evolved among farmers.

"Yes, it takes more labor, but I'm willing to put in the effort if it results in healthier crops and soil. It also feels wonderful to know that we are not damaging the environment. - Small-scale cultivator

The overall idea was that although farmers faced difficulties in adopting organic fertilizers, their attitudes toward these techniques were greatly influenced by the benefits they saw as providing for soil health and environmental sustainability. The contrasting perspectives and experiences of large- and small-scale farmers highlight the necessity of focused teaching programs and easily available materials. By providing specialized training programs and extension services, small-scale farmers can close the knowledge gap and make well-informed decisions about using organic fertilizers. Recognizing the proactive approach of large-scale farmers also emphasizes the possibility of sustainable and scalable organic agricultural methods when backed by resource-constrained policy.

4.3 Impact on Soil Quality

Many interesting results were obtained from the investigation into how the application of organic fertilizer affected the condition of the soil in various Indonesian agricultural districts. Distinct patterns that arose from theme analysis provided insight into farmers' perceptions and experiences of changes in soil quality after the use of organic fertilizers. Applying organic fertilizer has been shown to improve soil structure, according to farmers' reports. Compaction was lessened and soil aggregation was improved by the addition of organic matter through fertilizers like manure and compost.

"Now that the soil has not been as compacted, it feels different. Water seems to permeate more readily, and I can see more earthworms. - Small-scale A farmer

The increase in soil structure was commonly ascribed to the presence of organic matter, which created an environment that was more conducive to root growth and microbial activity. This suggested that the

physical qualities of the soil had improved. Another recurring motif in the stories of farmers was the noted improvement in soil water retention. Crops had better access to water because of the fertilizers' organic matter, which significantly increased the soil's capacity to hold water.

Before, we had to irrigate frequently since the water would simply run off. It appears that the soil now retains the water more effectively. There is undoubtedly a distinction.

4.4 Commercial Farmer

This increase in water retention not only made water consumption more effective, but it also acted as a buffer against droughts, which is especially important given the variability of climate change. Farmers often observed that after applying organic fertilizers, the soil's microbial activity increased. This was linked to the introduction of advantageous microbes via organic inputs, which promoted nutrient cycling and improved the general health of the soil.

"It seemed as though the soil came alive with increased microbial activity," the author said. It appears to be improving the plants' access of nutrients. - Extensive A farmer

A dynamic and symbiotic link between organic fertilizers and the soil ecosystem is suggested by the reported stimulation of microbial communities, which in turn facilitates nutrient mobilization and availability for plant uptake. The results are consistent with theoretical models indicating that fertilizers' organic matter affects soil structure and microbial activity in a favorable way. Enhancement of water retention and improved soil structure lead to a more robust and sustainable agricultural system. The effects on microbial activity that have been found are consistent with the advantages that organic fertilizers may have in fostering nitrogen cycling and general soil health.

Different agricultural regions were found to have differences, despite the overall motifs being consistent. The complex effects of organic fertilizers were shaped by soil types, climate, and current soil health. For example, coastal regions have reported specific issues like salt in the soil, necessitating specialized methods for applying organic amendments.

4.5 Influence on Agricultural Yields

The investigation of the impact of using organic fertilizer on crop yields in various crops and geographical areas in Indonesia produced complex results. Thematic examination of farmers' experiences and perspectives illuminated differences in crop-specific reactions and the variables influencing production fluctuations. The effects of organic fertilizers on crop yields differed greatly amongst crops. Some farmers reported significant increases in agricultural yields, while other farmers saw less dramatic changes. Vegetables and root crops were often mentioned as responding well to the application of organic fertilizer.

"With organic fertilizers, my vegetables are growing a lot better, but my rice output didn't improve all that much. They seem to react to it better. - Small-scale cultivator

This finding highlights the necessity for a comprehensive knowledge of particular crop requirements and response mechanisms by indicating that the efficacy of organic fertilizers varies depending on the crop. Crop yields were found to be influenced by soil conditions and the length of time organic fertilizer was applied, according to farmers' consistent observations. The amount of the yield response was influenced by the soil's fertility state before the start of organic farming operations.

After a few years of utilizing organic fertilizers, I can see an improvement, especially in crops that weren't doing well previously. Although it took some time, the soil now appears healthier. - Commercial Farmer

One important variable that has been identified is the length of time spent using organic fertilizer; long-term users report more significant yield increases. This temporal component emphasizes how crucial ongoing organic practices are to achieving the best possible results. Variations in location also affected how organic fertilizers affected agricultural productivity. Crops that were more adapted to the particular agroecological characteristics of the area showed more

positive reactions, whilst less adapted crops showed inconsistent results.

Comprehending these regional subtleties is essential to customize strategies to correspond with the various agricultural environments found throughout Indonesia. It highlights the necessity of tailored approaches that take into account local cropping patterns and preferences in addition to soil variables. Farmers often indicated that economic issues played a major role in their decision to employ organic fertilizer, even despite documented yield advantages. Some people acknowledged the possible long-term advantages, but others voiced worries about the upfront expenses of adopting organic techniques.

"The yield is higher, but I also need to consider the costs." Investing extra money up front might be difficult, even if it will pay dividends in the end. - Small-scale A farmer

This economic aspect draws attention to the careful balancing act farmers must do between immediate financial restrictions and long-term rewards. The observed differences in crop-specific responses are consistent with the body of research indicating that the effectiveness of organic fertilizers depends on several variables, including crop type, soil conditions, and application period. Recognizing the subtleties of how various crops interact with organic amendments, an understanding of these variances enables more focused recommendations and interventions. Furthermore, the impact of financial factors reflects more general difficulties in implementing sustainable farming methods. A significant obstacle to widespread adoption is balancing short-term financial restrictions with long-term benefits, which emphasizes the need of supportive policies and financial incentives.

4.6 Challenges and Opportunities

The exploration of challenges and opportunities associated with the adoption of organic fertilizers in Indonesian agriculture uncovered a range of complexities. The thematic analysis of farmers' and stakeholders' perspectives unveiled common barriers as well as potential avenues for overcoming challenges and fostering sustainable organic farming practices. Farmers across various regions consistently identified challenges related to the availability and affordability of organic inputs. Limited access to quality organic fertilizers, particularly in remote areas, posed a significant hurdle for small-scale farmers.

"It's not easy to find good organic inputs around here, and when you do, they can be expensive. If there were more support or maybe a cooperative, it could make things easier for us." - Large-scale Farmer

Affordability emerged as a critical concern, with the perceived high costs of organic inputs acting as a deterrent to widespread adoption. The economic viability of organic practices, therefore, remains a key consideration for farmers. The labor-intensive nature of organic farming practices was consistently cited as a challenge by farmers. The additional effort required for tasks such as composting, manual weed control, and application of organic inputs was noted as a factor contributing to the reluctance among some farmers to transition to organic practices.

"It's more work. Sometimes, I think about going back to conventional methods because it's less demanding, but I also see the benefits." - Small-scale Farmer

This perceived challenge underscores the need for supportive measures and interventions that address the labor constraints faced by farmers. Despite the challenges, farmers and stakeholders identified opportunities and support mechanisms that could facilitate the adoption of organic fertilizers. Government programs promoting sustainable agriculture, including organic practices, were acknowledged as potential game-changers.

"If more government programs were supporting organic farming, it could make a huge difference. Maybe subsidies or training programs to make it more accessible." - Agricultural Expert

The establishment of cooperative farming structures was also highlighted as a promising avenue. Collaborative efforts among farmers could not only address

challenges related to the procurement of inputs but also create a platform for shared knowledge and resources. The increasing consumer demand for organic produce emerged as an opportunity that could incentivize farmers to adopt organic practices. The recognition of niche markets for organic products could potentially translate into higher prices for organic produce, creating economic incentives for farmers.

"I've noticed more people asking for organic vegetables. If there's a demand, it makes sense for us to consider organic farming. It's a business opportunity too." - Small-scale Farmer

This market-driven approach aligns with the potential economic benefits of organic farming, offering a pathway for sustainable practices that resonate with consumer preferences. The identified challenges underscore the need for a holistic approach to address barriers associated with the adoption of organic fertilizers. Government interventions, such as subsidies and training programs, can play a pivotal role in enhancing accessibility and affordability. Additionally, the promotion of cooperative farming structures aligns with the principles of collective action, fostering mutual support among farmers.

The recognition of consumer demand for organic produce not only provides economic incentives for farmers but also aligns with broader initiatives promoting sustainable and health-conscious food choices. Leveraging this consumer-driven demand can create a positive feedback loop, encouraging more farmers to transition to organic practices. The exploration of decision-making factors influencing farmers' choices regarding the adoption of organic fertilizers in Indonesian agriculture revealed a complex interplay of economic, knowledge-based, and environmental considerations. Thematic analysis of farmers' perspectives elucidated the multifaceted nature of the decision-making process. Economic factors emerged as pivotal in shaping farmers' decisions regarding the adoption of organic fertilizers. The perceived cost-effectiveness of organic practices over time was a central theme, with farmers weighing the immediate financial implications against the anticipated long-term benefits.

"I attended a workshop on organic farming, and it opened my eyes. It might cost a bit more initially, but I see it as an investment in the future." - Small-scale Farmer

This economic calculus underscores the need for farmers to strike a delicate balance between short-term financial constraints and the potential economic gains associated with sustainable and organic farming practices. Farmers' knowledge and awareness of organic farming practices played a crucial role in shaping their perspectives and decisions. Exposure to training programs, workshops, and extension services contributed to a deeper understanding of the benefits and challenges associated with organic fertilizers.

"I started using organic fertilizers after attending a seminar. I learned about soil health, and it made me reconsider my practices." - Large-scale Farmer

This thematic aspect highlights the significance of educational initiatives in fostering informed decision-making, emphasizing the need for continued efforts to disseminate knowledge among farmers. A recurring theme in farmers' narratives was the environmental consciousness underlying their decisions to adopt organic fertilizers. Concerns about the long-term impact of conventional farming practices on soil health and ecological sustainability motivated some farmers to transition towards more environmentally friendly alternatives.

"I think about the future. I want my children to inherit healthy soil. Using organic fertilizers is my way of contributing to that." - Small-scale Farmer

This environmentally driven perspective aligns with broader global trends emphasizing the importance of sustainable and regenerative agricultural practices.

4.7 Social and Cultural Influences: Peer Networks and Community Dynamics

Social and cultural influences emerged as subtle yet significant factors influencing farmers' decisions. Peer networks,

community norms, and the exchange of experiences within the local farming community played a role in shaping individual perspectives.

"I saw some farmers in my village trying organic methods, and I decided to give it a go. It's like a community effort." - Small-scale Farmer

This community-driven approach highlights the potential ripple effects of organic farming adoption, with positive experiences within the community influencing others to explore sustainable practices. The multifaceted nature of decision-making factors suggests a need for comprehensive and context-specific interventions to promote the adoption of organic fertilizers. Economic considerations, knowledge dissemination, environmental consciousness, and community dynamics all contribute to the intricate decision-making landscape. Educational programs and extension services that focus on the economic benefits of organic practices, coupled with environmental stewardship, can address key decision-making factors. Furthermore, leveraging community networks to showcase successful organic farming stories can create a positive domino effect, encouraging more farmers to transition towards sustainable practices.

DISCUSSION

The findings align with existing literature, emphasizing the positive impact of organic fertilizers on soil quality and crop yields. The variations in reported outcomes highlight the importance of considering crop-specific responses and the need for tailored approaches based on local conditions. The identified challenges underscore the necessity of targeted interventions, including improved access to organic inputs, educational programs, and cooperative farming initiatives.

The thematic analysis, conducted through NVivo, facilitated a comprehensive exploration of qualitative data. Triangulation of findings across different informant groups enhanced the credibility of the study. The limitations of this research include the relatively small sample size, and the focus on qualitative rather than quantitative measures. Future research could incorporate larger sample sizes and quantitative assessments to strengthen the generalizability of findings.

Implications for Policy and Practice

The study's findings have implications for policy and practice in promoting organic fertilizer use in Indonesian agriculture. Policymakers should consider targeted support programs, subsidies for organic inputs, and the establishment of cooperative farming structures. Additionally, educational initiatives aimed at raising awareness among farmers about the long-term benefits of organic fertilizers could contribute to wider adoption.

5. CONCLUSION

In conclusion, the research provides a nuanced understanding of the intricate dynamics surrounding organic fertilizer adoption in Indonesia. Farmers' varying perceptions, the positive impact on soil quality, and the nuanced influence on agricultural yields underscore the multifaceted nature of sustainable farming practices. Challenges related to accessibility, affordability, and labor intensity present barriers, but opportunities in government support, cooperative farming, and consumer demand offer pathways for overcoming these challenges.

The decision-making factors, rooted in economic considerations, knowledge dissemination, environmental consciousness, and social influences, highlight the need for comprehensive and context-specific interventions. Policymakers should focus on targeted educational initiatives, economic incentives, and supportive policies to facilitate a smoother transition to sustainable farming practices.

As Indonesia navigates the complexities of agricultural sustainability, this research contributes valuable insights for informed decision-making. By addressing the identified challenges and leveraging opportunities, the nation can pave the way towards a more resilient, environmentally

conscious, and economically viable agricultural sector.

REFERENCES

[1] G. A. Gina, A. Mariya, C. Natalia, S. Nispuana, M. F. Wijaya, and M. Y. Phalepi, "The Role Of The Agricultural Sector On Economic Growth in Indonesia," *Indones. J. Multidiscip. Sci.*, vol. 2, no. 1, pp. 167–179, 2023.

[2] S. B. Kurniawan, "A REVIEW OF THE FUTURE OF BIOMASS-BASED FERTILIZER IN INDONESIA," *EPRA Int. J. Econ. Bus. Rev.*, vol. 11, no. 7, pp. 27–31, 2023.

[3] Y. Sukayat, I. Setiawan, U. Suharfaputra, and G. Kurnia, "Determining factors for farmers to engage in sustainable agricultural practices: A case from Indonesia," *Sustainability*, vol. 15, no. 13, p. 10548, 2023.

[4] I. Affandi and D. S. H. Marpaung, "Sosialisasi Perlindungan Hukum terhadap Petani atas Ketersediaan Lahan Pertanian di Indonesia serta Sebagai Wujud Menciptakan Ketahanan Pangan Daerah," *J. Pengabdi. Nas. Indones.*, vol. 4, no. 2, pp. 439–446, 2023.

[5] A. W. Muhaimin, D. Retnoningsih, and I. I. Pariasa, "The role of women in sustainable agriculture practices: evidence from east java Indonesia," in *IOP Conference Series: Earth and Environmental Science*, IOP Publishing, 2023, p. 12005.

[6] A. C. Simoes da Mota, "New challenges in organic fertilization: soil quality indicators under long-term sewage sludge application," 2023.

[7] A. O. Akanmu *et al.*, "Bioresources in Organic Farming: Implications for Sustainable Agricultural Systems," *Horticulturae*, vol. 9, no. 6, p. 659, 2023.

[8] S. K. Mishra, K. M. Tripathi, and S. Pandey, "Effect of Chemical Pesticides on Soil Health and Its Physio-Chemical Properties," 2023.

[9] S. Ganesan, "Biotic farming using organic fertilizer for sustainable agriculture," *Phys. Sci. Rev.*, no. 0, 2022.

[10] R. Sun *et al.*, "Substitution of manure for mineral P fertilizers increases P availability by enhancing microbial potential for organic P mineralization in greenhouse soil," *Front. Bioeng. Biotechnol.*, vol. 10, p. 1078626, 2022.

[11] M. Brempong and A. Addo-Danso, "Improving soil fertility with organic fertilizers," *New Gener. Org. Fertil.*, p. 1, 2022.

[12] Mohit, M. L. Verma, J. Thakur, and Ajender, "Effect of inorganic and organic nitrogenous fertilizers on soil nutrient status, plant growth and yield of apricot (Prunus armeniaca L.)," *J. Plant Nutr.*, vol. 46, no. 8, pp. 1808–1821, 2023.

[13] S. Behera, B. Jyotirmayee, U. Mandal, A. Mishra, P. Mohanty, and G. Mahalik, "Effect of Organic Fertilizer on Growth, Yield and Quality of Pisum sativum L.: A Review," *Eco. Env. Cons*, vol. 28, pp. S233–S241.

[14] M. Negi, J. C. Sharma, and Y. R. Shukla, "Effect of organic manures and inorganic fertilizers on dry matter yield, soil and plant nutrient content in onion (Allium cepa)," *Indian J. Agric. Sci.*, vol. 92, no. 6, pp. 680–683, 2022.

[15] S. Sumarmi, H. Masruroh, S. Bachri, and A. Suprianto, "Farmers Participation in Applying Silvopasture Technology for Organic Fertilizer Production as A Sustainable Agriculture," *Geosfera Indones.*, vol. 8, no. 1, pp. 35–45, 2023.

[16] M. Grimm and N. Luck, "Experimenting with a green 'Green Revolution'. Evidence from a randomised controlled trial in Indonesia," *Ecol. Econ.*, vol. 205, p. 107727, 2023.

[17] A. H. Wasil, J. A. Shah, S. M. Kakar, A. R. Ragashtai, M. S. A. Yusuf, and A. Sadat, "The Influential Factors of Organic Fertilizer Adoption among Farmers: A Review," 2023.

[18] P. Singh, P. Satpathy, and C. Vaishnav, "Transitioning from conventional to organic smallholder farming among Indian farmers: a psychological perspective," *J. Agric. Educ. Ext.*, pp. 1–21, 2023.

[19] U. Romadi, F. Adiyanto, and A. Rahmi, "Factors Influencing Farmers' Decision Making in Organic Rice Cultivation at Al-Barokah Gapoktan, Lombuk Kulon Village, Wonosari District, Bondowoso Regency," *J. Penyul. Pertan.*, vol. 18, no. 1, pp. 1–9, 2023.

[20] E. H. Petersen, C. A. Scanlan, M. P. Burton, Y. M. Oliver, D. V Murphy, and F. C. Hoyle, "Agronomic factors are the dominant influence on nitrogen fertilizer strategies in dryland cropping systems," *Agron. Sustain. Dev.*, vol. 43, no. 1, p. 14, 2023.

[21] V. M. Areri, H. W. Obulinji, and C. W. Recha, "Influence of Smallholder Farmers' Socio-economic Characteristics on and Perceived Benefits of Organic Agriculture Farming," *Int. J. Innov. Res. Dev.*, vol. 11, no. 12, 2022.

[22] S. Ranjan, S. Kumar, S. K. Dutta, S. Sow, S. Kumar, and Sushant, "Long-Term Organic Amendment Application Improves Soil Fertility Status, Nutrient Accumulation and Crop Productivity Under Rice-Wheat Cropping System," *Commun. Soil Sci. Plant Anal.*, pp. 1–11, 2023.

[23] F. Gao *et al.*, "Effects of Organic Fertilizer Application on Tomato Yield and Quality: A Meta-Analysis," *Appl. Sci.*, vol. 13, no. 4, p. 2184, 2023.

[24] H. Fan *et al.*, "Effects of Organic Fertilizer Supply on Soil Properties, Tomato Yield, and Fruit Quality: A Global Meta-Analysis," *Sustainability*, vol. 15, no. 3, p. 2556, 2023.

[25] K. V. Kumar *et al.*, "Comparing the effect of organic and inorganic amendments on soil health," *Bhartiya Krishi Anusandhan Patrika*, vol. 38, no. 1, pp. 80–83, 2023.

[26] O. Sedlář, J. Balík, J. Černý, M. Kulhánek, and M. Smatanová, "Long-Term Application of Organic Fertilizers in Relation to Soil Organic Matter Quality," *Agronomy*, vol. 13, no. 1, p. 175, 2023.

[27] D. O. Suparwata, teknologi mulsa vertikal untuk pertanian lahan kering: kajian erosi, aliran permukaan, dan respon tanaman jagung. Penerbit Adab, 2021.

[28] D. O. Suparwata, "Pengelolaan rehabilitasi lahan kritis berdasarkan partisipasi masyarakat di DAS Randangan Kabupaten Pohuwato," 2018.

[29] D. O. Suparwata and M. Djibran, "Pemanfaatan pekarangan bero untuk usahatani buah naga," J. Agritech Sci., vol. 2, no. 2, p. 72, 2018.