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The Collaborative Roles of Stakeholders in Advancing Sustainable Organic Rice Farming in Yogyakarta

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Abstract: The roles of stakeholders in the development of sustainable organic rice farming in Yogyakarta, Indonesia, were investigated, along with the patterns of collaboration among them. The study was conducted in the Special Region of Yogyakarta through purposive sampling to identify key informants. A qualitative methodology was employed, utilizing data collection through structured observations and in-depth interviews. The data were analyzed using an interactive model combined with thematic analysis, involving iterative stages of data gathering, reduction, presentation, and conclusion drawing. Stakeholder roles identified included those in education and socialization, technical mentoring, organic farming training, marketing facilitation, organic fertilizer production, organic rice production, policy formulation, scientific research contributions, and the establishment of association institutions. Collaborative linkages were identified among various actors, including academic institutions, business units, farmer groups, government bodies, and media organizations. Collaborative linkages were observed between academic institutions and business units, farmer groups, government agencies, and media organizations; business units and academic institutions; farmer groups and academic, business, governmental, and media stakeholders; government agencies and academic, business, farmer, and media sectors; and media organizations with academic, business, governmental, and farming communities. These findings underscore the complexity and significance of multi-stakeholder cooperation in advancing sustainable organic agriculture. Strengthening these collaborations is considered essential for the long-term success and resilience of organic farming initiatives in the region.

Keywords: Collaborative role; Organic rice farming; Stakeholders; Sustainability

1. Introduction

Organic farming is one of the farming systems that is free from synthetic chemical inputs (inorganic) and uses natural materials such as organic fertilizers and organic pesticides. Organic rice is rice that is cultivated by carrying out organic principles and processed through an organic approach. The condition of agriculture in Indonesia presents several challenges, including security, sustainability (availability) of food for a growing population, environmental damage, climate change, increased incomes, living standards of small-scale farmers, and an aging workforce in the agricultural sector. Average per capita consumption of foodstuffs containing rice was about 0.30% from 2019 to 2023, while the supply, utilization, and per capita availability were about -2.05% (Secretariat General - Ministry of Agriculture Republic of Indonesia, 2023). In 2023, climate change had an impact on the

decline in agricultural businesses, namely a decrease in crop area, as much as 11.3% of which was caused by drought factors. In addition, a decrease in production occurred in as many as 7.44% of agricultural business units due to the flood disaster (Badan Pusat Statistik [BPS - Statistics Indonesia], 2024). The results of the 2023 Agricultural Census show that the percentage of young Indonesian farmers under the age of 34 is only 11.5% and almost 70% of Indonesian farmers are over 45 years old. Organic farming has the potential to attract younger generations by being perceived as a modern and sustainable agricultural practice. Studies indicate that younger people show a high interest in organic farming, particularly when it is presented as a new and innovative technology (Wulandari & Rahadi, 2024). The integration of modern technologies such as drones, sensors, and robots in organic farming can further enhance its appeal to the youth by demonstrating its potential for efficiency and sustainability. These technologies can help address some of the challenges associated with organic farming, such as pest control and yield optimization, making it a more viable and attractive option for young farmers (Petrovic et al., 2025). Indonesia's organic statistics show that the total area of organic product cultivation has reached 261,400 hectares, and the certified area is 79,800 hectares. The demand for organic agricultural products supports the increase in the growth of the investment value of organic products in the world. It is predicted that the demand for organic products will continue to increase to reach $327,600 million in 2022, which was previously $115,984 in 2015, or will experience an increase in the compound annual growth rate (CAGR) of 16.4% (Statistik Pertanian Organik Indonesia, 2023).

The current reality in the field shows a contradictory condition, where various efforts have been made by farmers to achieve a high level of productivity, such as the use of pesticides and fertilizers that are not wise. Therefore, the fear that pesticide residues can contaminate food products and endanger health is well-founded (Abtahi et al., 2025; Munir et al., 2024). Meanwhile, efforts to implement organic agriculture, especially organic rice farms in the Special Region of Yogyakarta, are still slow and tend to decline.

If examined in depth, organic farming involves various parties who must play a synergistic role. So far, organic agriculture has only involved farmers as the main actors and the government as the initiator of the work program. Meanwhile, the role of other parties, such as mass media, business units, and research institutions, can be considered to have played a role, but they are still working partially and have not collaborated synergistically in organic agriculture. In fact, the agricultural development program implementation cannot be separated from the social system of stakeholders, which plays an important role in the sustainability of these development activities. The sustainability of organic agriculture requires cooperation between stakeholders with the goal of developing sustainable organic rice agriculture.

Stakeholders in this study consist of academic institutions, business units, farmer groups, the government, and the media. Based on the description of these problems, the roles of the stakeholders in the organic rice agriculture development and the cooperation relationship among the stakeholders in the Special Region of Yogyakarta need to be investigated. Therefore, the study discusses the roles of stakeholders in the organic rice agriculture development in the Special Region of Yogyakarta.

Organic agriculture studies have been carried out from technical, economic, social, and ecological aspects. Research in Poland highlights the development and effects of organic farming by considering locations in areas that face natural constraints or other specific constraints. The results show that organic agriculture is still low compared to conventional agriculture (Zieliński et al., 2024). However, in the long term, organic farming is beneficial for plant biodiversity in arable land. This maintenance system appears to be compatible with the agroecological transition. The significant increase in insect-pollinated plant cover suggests that organic management can also support ecosystem function. Long-term organic farming can increase the conservation value of fertile flora only with a moderate decline in crop yields (Constancis et al., 2023; Krieger et al., 2020). Therefore, secure agricultural succession motivates long-term operational planning with operational changes and investments, while unsecured agricultural succession often leads to stagnation and eventual closure of family farms (Schläger et al., 2020). The above research shows that competence in managing agricultural operations is becoming more important, which makes training and management consulting services more necessary. Organic farming can improve with the succession of farms and the joining of newcomers in the agricultural sector. Supporting these newcomers without a peasant family background should receive extra consideration (Väre et al., 2021). In the meantime, a study published in Organic Agriculture Denmark shows that communities of practice and socially situated learning can help farmers, who want to create, implement, and enhance cow-calf contact (CCC) systems in various dairy farming contexts, learn more (Vaarst & Christiansen, 2023).

The findings of Chinese research provide producers, inspectors, and certifiers with helpful references to lower the risk of regulatory non-compliance and enhance integrity and credibility during organic production and certification (Zhen et al., 2020). Meanwhile, organic farming in the Netherlands has not shown significant results in reducing residues of rice residues. Therefore, the government needs to review the regulations and practical guidelines for organic farming (Buijs & Mantingh, 2021). There is proof that there are issues with the regulation, and one significant but often ignored aspect is the structure of the processing industry. Therefore, more studies on the connections between producers and processors are required to enhance the comprehension of the dynamics of the organic agricultural production industry (Dimitri & Nehring, 2022). According to the findings of European

research, future investigations should thoroughly examine the advantages and disadvantages of different policy options and offer solutions for resolving the disparities in stakeholder interests in public discourse (Krieger et al., 2020).

Research in Italy states that relational capital (RC) is very important in all organizations, including businesses in the field of organic agriculture (Paoloni et al., 2022). Consequently, it is essential to comprehend the roles of stakeholders and the collaboration that can be developed between them (Sartika et al., 2023). However, the study is still limited to the role of the government as the compiler of programs and policies, and farmers as implementers of organic agriculture. In terms of financial capital, it shows that funding for organic farming supports producers to change from conventional to organic farming practices. The information discovered validates the European approach, confirming the value of these two distinct policies and encouraging organic farming to launch and expand organic enterprises (Casolani et al., 2021).

According to a different study conducted in India, agricultural productivity, entrepreneurial aim, governance, environmental awareness, and health concerns are the primary drivers of organic farming among family-based farms. The acceptance of organic farming was found to be significantly influenced by the sharing of information, both formally and informally. The study also identified important obstacles that prevent the commercial adoption of organic farming, such as market-related worries, a lack of government support and assistance, and agricultural difficulties like declining yields and difficulty obtaining inputs (Lone & Rashid, 2024). Therefore, the prospect of establishing a short supply chain of organic agricultural products is considered (Dibirova, 2023).

Although multiple stakeholder-led initiatives have been implemented to support organic agriculture, these efforts have largely been fragmented and uncoordinated across institutional boundaries. Therefore, this study aims to determine the roles of stakeholders in the organic rice agriculture development in the Special Region of Yogyakarta and to find out the cooperation and collaboration relationship among them.

Agricultural cooperatives serve as pivotal intermediaries, bridging gaps between farmers, governments, and private entities. Studies highlight their contributions to the Sustainable Development Goal (SDG) implementation, multi-sector partnerships, and collective actions. Capacity-building programs and input distribution drive poverty reduction, gender equality, and sustainable resource management. About 55.1% of partnerships in Saudi Arabia were classified as strategic, combining independent value creation with integrative goals (Alotaibi & Kassem, 2022; Herab et al., 2023). Cooperative participation increases farmers' adoption of water-saving technologies by 5.6%, demonstrating enhanced capacity for climate-resilient practices (Zhu & Wang, 2024).

Two prominent frameworks dominate current research, namely the analytical partnership framework (APF) and the country partnership model (CPM) of the World Economic Forum. The former assesses partnerships through nine dimensions: configuration, stakeholders, objectives, types, stages, communication, outcomes, evaluation, and sustainability (Alotaibi & Kassem, 2022). However, only 9.1% of surveyed partnerships in Saudi Arabia met "strong partnership" criteria, underscoring the complexity of sustained collaboration (Herab et al., 2023). Meanwhile, CPM employs an 8-step process (engage, align, structure, plan, implement, advance, scale, and review) for multistakeholder coordination. This model prioritizes market-driven approaches with six stakeholder groups: governments, private companies, Non-Governmental Organizations (NGOs), farmers' associations, academia, and international organizations (Nabarro & Nayyar, 2016). The collaborations built have been able to develop communication infrastructure as regional pilot farming networks increase knowledge exchange, as demonstrated by the DAIRYMAN project's 131 farm network across Northwest Europe (Aarts et al., 2014). However, this is often an asymmetry of power, namely the dominance of the public sector in partnerships, which risks marginalizing smallholders (Alotaibi & Kassem, 2022; Herab et al., 2023). Therefore, this study highlights the synergistic collaboration of all stakeholders involved in the development of sustainable organic farming.

2. Methodology

A qualitative descriptive method with a phenomenological approach was used in this study. This study describes stakeholders' roles in the organic agriculture development and the linkage of their cooperation. The research location was chosen purposively based on certain considerations adjusted to the purpose of the research. The research location covers the Special Region of Yogyakarta, namely, Sleman and Bantul Regencies, as rice production centers and sustainable agricultural food land areas. In this region, some universities are interested in organic agriculture research. In addition, there is a business unit as an entity that facilitates the marketing of organic food products. Thus, all stakeholders involved in organic farming activities become complementary research subjects. The determination of informants aims to dig up information as the basis of emerging designs and theories (Rahman, 2021). Deliberate sampling is expected to get accurate and in-depth information by interviewing nine informants, as shown in Table 1.

In this study, the informants were chosen purposively to represent each stakeholder, thereby describing their relationship comprehensively. Data collection was carried out by focus group discussions and in-depth interviews with all informants or participants. An interactive analysis was conducted as data analysis in this study, which

was carried out both before and after concluding this study. This method contains a set of analyses, including four parts, i.e., data collection, reduction, presentation, as well as conclusions. The qualitative analysis process includes four stages: coding, classification, structuring, and synthesis (Leavy, 2017).

Table 1. Information on informants

No.	Stakeholders	Name of Institution	Number of Informants
1	Academics/Scientists	Universitas Gadjah Mada	1
		Universitas Muhammadiyah Yogyakarta	1
2	Business units	Lingkar Organik	1
		Eka Farm	1
3	Community	Organic Farmers Group Sleman Regency	1
		Organic Farmers Group Bantul Regency	1
4	Government	Department of Agriculture, Food Security and Fisheries of Sleman Regency	1
		Food Security and Agriculture Service of Bantul Regency	1
5	Mass media	Radio Republic of Indonesia (RRI)	1
		Total	9

3. Results

3.1 Characteristics of Participants

The characteristics of the informants as stakeholders, including gender, age, and roles in organic rice development, are outlined in Table 2, which provides an overview of the participants' demographics and positions. The majority of participants are male. The age ranges from 30 to 60 years old. This shows that most agricultural actors in Indonesia are elderly because young people are not interested in continuing agricultural business (Triyono et al., 2023). They occupy both formal and informal positions as government officials, lecturers, researchers, radio producers, business unit directors, and farmer group chairmen.

Table 2. Characteristics of participants as stakeholders in organic rice farming development

No.	Initial	Gender	Age	Position
1	P1	Female	54	Head of Food Crops Division of the Agriculture, Food and Fisheries Office of Sleman Regency
2	P2	Male	51	P3UHP Data Coordinator of the Bantul Regency Food Security and Agriculture Office
3	P3	Female	39	Producer of the RRI Yogyakarta
4	P4	Male	39	Director of Lingkar Organik
5	P5	Male	50	Chairman of ICS Organic Farmers Group Ngudi Raharjo Bantul
6	P6	Male	39	Director of Eka Farm
7	P7	Male	58	Lecturer and Researcher of Universitas Muhammadiyah Yogyakarta
8	P8	Male	30	Chairman of the Setia Maju Organic Farmers Group
9	P9	Male	60	Lecturer and Researcher of Universitas Gadjah Mada

3.2 Stakeholders' Roles in Organic Rice Farming

3.2.1 The role in community education

Stakeholders involved in this role are academics and scientists, the media, the government, business units, and organic farmer groups. Organic rice farming education is a form of learning about science or insights related to organic rice farms that can be applied in the field.

The role of academics and scientists in community education is in accordance with the three services of higher education that must be carried out by research lecturers, namely, education and teaching in the field of sustainable agriculture. Research lecturers carry out their duties based on specialization, knowledge, and competence in a certain field of science, including agriculture. In carrying out their duties, lecturers also contribute to educating the community by transferring their knowledge. Educational activities in the form of course learning carried out by research lecturers certainly positively influence students and the community in efforts to develop organic

agriculture.

"Based on teaching, there are courses related to cultivation technology, such as plant cultivation technology. Therefore, even though they are not specifically organic agriculture courses, in each of those courses, it is likely that organic agriculture will also be mentioned." (P7)

"Then also in the course insert aspects related to organic agriculture." (P9)

Research lecturers play a strategic role in this process by extending their impact beyond formal education through community service, an essential mandate of higher education where they facilitate targeted, trust-driven knowledge transfer that fosters innovation and sustainable transformation (Houlfort et al., 2015; Sundari & Manoj, 2020).

"Community service has indeed been introduced for a long time, and it also includes the use of organic fertilizers, such as the use of organic fertilizers for the System of Rice Intensification (SRI) rice technology, for both research and service." (P7)

In community education, business units also play the role of education and socialization for farmer groups who have not implemented organic farming but have the willingness to learn. Activities carried out are in the form of learning classes. The business unit plays the role of social responsibility as a voluntary action, showing the nature of a company's or institution's concern for the wider community as a commitment to continuous responsibility regarding the impact of the company's activities.

"We continue to go around every day for agricultural socialization, even though we already have a group that has been certified organic. But we still do socialization so that we can spread and learn together with people who want to learn about organic." (P4)

The role in community education of organic farmer groups is also carried out for farmers around them who are still implementing conventional rice farming. The role of organic socialization includes efforts to introduce and provide socialization information about organic rice to develop organic agriculture. The organic farmer group said that, with the reality in the field, there are still many traditional rice farmers who do not know about organic rice.

"We provide a little information for farmers who can communicate. We convey the advantages and differences between organic rice and conventional rice based on our experience. For example, organic rice is cooked more durably than conventional rice." (P8)

Media play their role in community education and socialization through direct learning and radio broadcast programs by the mass media RRI. The mass media role is in the form of disseminating information on the results of scientific developments and increasing development, especially in the agricultural sector. Educational and promotional activities carried out in the form of events with the theme of organic agriculture play a very important role in organic rice farming, and more people can be educated and know organic agriculture, especially organic rice.

Social media content presents a picture of agriculture that is up-to-date and reliable. With media histories, including radio, television, and the press, social media is still unmatched. They list information about agricultural production methods, including those pertaining to the production of crops and livestock, as one of the most sought-after types of content on social media.

"I know organic farming because I am a producer at an event of RRI, namely the Indonesian Journey event. Therefore, I need information about it. I explained that Indonesia's work is an event about agriculture, community empowerment, and also about the potential of villages, including organic agriculture." (P3)

In general, the role of the government is to solve problems that plague agriculture, such as low profitability, farmers' difficulties, rapid land degradation, water ownership, etc. (Vyas, 2022). In terms of organic farming, government agencies or the Agriculture Service play a role in community education and socialization. Government institutions conduct education and socialization about the cultivation process. In particular, the Agriculture Service conducts education from upstream to downstream.

"Organic rice is a concrete step to overcome the scarcity and the high cost of fertilizers. To get a higher price will not be easy, because agriculture in Indonesia is still traditional farmers. Our focus is on those areas. For example, how farmers are educated with socialization that provides education on how products can be marketed and can get added value. We also convey the use of organic fertilizers and market conditions that require certification to add value." (P2)

In the statement submitted by the Agriculture Office, organic farming is a concrete step to overcoming the scarcity of fertilizers and getting a higher selling price. But in that direction, it is certainly not easy, especially since the majority of rice business actors are still traditional farmers. This is the focus area of the Agriculture Office in the development of organic rice farming, where the agency provides socialization and educational activities about the use of organic fertilizers, organic rice marketing, and organic certification.

3.2.2 The role in community mentoring

Organic rice farming assistance is a role carried out by stakeholders involved, namely, government institutions and business units. The government, through extension institutions, collaborates with farmer groups to assist farmers in organic rice farming. Assistance activities are carried out during the organic rice production process,

ranging from land and seed preparation, planting, weeding, irrigation, organic fertilizer production, fertilization, biopesticide production, and pest and plant disease control to harvest activities.

The Agriculture Office has a task in coaching and mentoring. Organic rice farming assistance has the goal of getting maximum results. The reality in the field is that many farmers are still implementing organic rice farming with narrow land, leading to the possibility of contamination by landowners who still use chemicals. Therefore, assistance in organic rice farming is important to get maximum results.

"There are still many farmers who use chemical spraying on rice that is close to farmers who apply organic, which can cause imperfect organic application. Now this is the role of the agency, especially the Field Agricultural Extension (FAE), to provide assistance to the implementation of organic agriculture carried out by organic farmer groups." (P1)

The role of assisting with organic rice farming is also carried out by the business unit, i.e., Lingkar Organic, one of the business units in Sleman Regency. Its mentoring activities aim to make the process of implementing organic rice farming align with the conditions that should be carried out. Business units have encountered many problems. For example, many organic farmers have not complied with the implementation rules in the organic farming process. Assistance in organic rice farming is important because many farmers are still not orderly in the application of organic rice farming.

"We have a procurement division that has a role in assisting farmer groups to carry out maintenance on the Internal Control System (ICS) used in the implementation of organic rice farming. Therefore, later it will be known whether or not it is necessary to upgrade the ICS." (P4)

3.2.3 The role in training

Organic farm training is an organic learning activity that is packaged with various forms of activities. Organic training is usually carried out before farmers practice directly in the field, aiming to enable farmers to better understand and succeed in their application.

The Agriculture Office carries out the role of organic training before farmers head towards the implementation of organic rice farming. Organic training is in the form of organic field school activities. In the organic field school, training concerning organic agricultural cultivation techniques is provided, especially for organic rice. Then the training is directed to the practice of applying organic agriculture. Therefore, farmers need technical training in the preparation of organic inputs, marketing, crop protection, and organic certification procedures (Paramasivam, 2022).

"Before applying organic farming, we have training first in organic field schools. In this organic training, they will be trained on how to practice organic farming, and then there will be an agreement for action or real application in this organic rice farming." (P1)

3.2.4 The role in marketing

Marketing is promoting a product to make a profit. The development of organic rice farming requires a role in marketing to promote organic agricultural products. The business unit plays the role of marketing. The business units, namely Lingkar Organic and Eka Farm, have a function in marketing a certain product. They play the marketing role for local organic farmers with or without organic certification.

"We help market both certified and uncertified farmer groups because we have Lumbung Lestari. Lumbung Lestrari is a business place to accommodate products that are still not certified organic but have been run organically." (P4)

3.2.5 The role in organic fertilizer production

Organic fertilizer production is one of the roles in organic rice farming development. Since organic farmers make their own organic fertilizer, organic farming is considered to be one of the practical solutions to the fertilizer shortage. Organic farmer groups play the production role.

"I also make fertilizer myself by using a kind of rotten fruit. I also ferment it with EM4 and molasses." (P8)

3.2.6 The role of organic food producers

The primary factor in the growth of organic rice growing is organic farming. Stakeholders in organic rice production are connected to their communities of organic farmers. Organic farmer groups are representatives of the community in developing organic rice farming through organic rice growing, which is a novel and sustainable agricultural technology due to its nutritious goods and environmental friendliness (Kareem et al., 2021).

"Yes, of course, we cultivate organic rice because with organic agriculture, the results will be beneficial for the health of our bodies and for our children and grandchildren. We can inherit an environment that is still maintained." (P5)

3.2.7 The role in research of organic rice farming

Organic rice farming research is one of the scientific applications used to produce new innovations in organic

rice farming development. Academic institutions play the research role, i.e., university academics and scientists. They are supported by government institutions. Research lecturers conduct research in organic agriculture, especially organic rice.

"Yes, I am a lecturer and researcher. Of course, I do research related to organic. For example, if I carry out region-based organic development with the Sleman office, we get funding from RISPRO Research Innovation and Productivity of the Ministry of Finance." (P9)

In carrying out their duties, lecturers contribute to the nation and state through research as an effort to implement and develop science. Lecturers who are also agents of change must be sensitive to social conditions and phenomena that occur in society. Furthermore, they analyze the problem and formulate solutions through research based on their intellectual abilities.

They said that the existence of organic rice agricultural research activities can be a guide for farmers in implementing organic rice cultivation in accordance with the findings of the studies that have been conducted and tested as an innovative work in the agricultural sector.

3.2.8 The role in organic agriculture policy formulation

Policy is a set of legal norms imposed by the government to establish rules that govern the economic and social behavior of companies, government agencies themselves, and between the governments of different countries. Government policies are urgently needed to regulate organic farming in Yogyakarta. Government institutions and academic institutions play the role of policy formulation. The Agriculture Office formulates organic agriculture policies, which is the right step for the organic agriculture condition in the Special Region of Yogyakarta. With a policy in place for organic agriculture, it will be more structured regarding the rules that govern organic farming. The Agriculture Service prepares the policy content, and other government agencies are responsible for issuing this policy for the wider community.

"I am drafting regulations or policies to encourage the regent to issue regulations. This policy is being discussed together. The discussion will involve other agencies, even with the regent." (P9)

Academic institutions also play the role of formulating government policies.

3.2.9 The role in organic association institutions

An organic association institution has a group of people engaged in the organic field, such as organic farmers, organic activists, organic product business units, researchers, and agricultural offices. The purpose of the establishment of an organic association institution is to collaborate in organic rice farming development. University academics and scientists play the role of forming relevant organic association institutions, such as forming and organizing businesses that have the same goal, and gathering them in an organization or institution in the form of associations.

Table 3. Summary of stakeholders' roles in organic rice farming

Role	Stakeholder	Activity
Community education	Academic institutions	Community services by organic farming training and education for the farmer community.
	Business units	Consumer community education about organic food as a quality product.
	Farmer groups	Introduce and provide socialization information about organic rice farming.
	Media	Broadcast programs of educational and promotional activities about organic farming.
Mentoring	Government agencies	Training and extension about organic farming.
	Business units	Check periodically the implementation of organic rice farming processes for the quality and productivity of organic rice.
Organic training	Government agencies	Organic field school activities for organic rice production and certification.
Product marketing	Business units	Promotion, distribution, and marketing of organic rice.
Organic fertilizer production	Farmer groups	Making organic fertilizer farmers use organic waste such as rotten fruits and animal manure.
Organic food producer	Farmer groups	Organic rice cultivation and production.
Research and innovation	Academic institutions	Analyze the problem and formulate solutions through research based on their intellectual intelligence.
Policy formulation	Government	Formulating and implementing organic agriculture policies.
	Academic institutions	Prepare a regent regulation on organic agriculture based on a study that has been carried out previously.
Organic association	Academic institutions and others	Organize businesses that have the same goal and gather them in an organization or institution in the form of associations.

"I formed an appropriate institution, maybe in the form of an association, because there are many places that have organic applications. Then, later, the institution will unite organic actors in the same forum with the aim of becoming an educational place. That's why I will invite appropriate institutions such as the Association of Farmer Groups, Organic Farmer Groups, Organic Activists from Business units, and the Agriculture Office. We also often conduct comparative studies for other association institutions. For example, we used to go to Boyolali Organic Farmers Association (BOFA)." (P9)

The establishment of organic association institutions is initiated by academic institutions, i.e., academics and scientists collaborating with other institutions (government agencies, business units, organic farmer groups, and organic activists). Table 3 presents briefly the roles of various stakeholders described above.

4. Discussion

The result describes the cooperation between five stakeholder groups: farmer groups, the government, business units, academia, and media. However, there is no international organization such as the World Economic Forum. Each stakeholder plays a role according to their interests. The roles include educator and trainer, mentor, marketer, organic fertilizer and food producer, researcher, policy formulator, and initiator of an organic association institution.

Table 3 and Table 4 outline the primary roles and responsibilities of various stakeholders involved in organic farming development:

Academic institutions play a crucial role in research, innovation, and community education (Zhu & Wang, 2024). They provide training, conduct studies, and formulate policy recommendations to improve organic farming practices. Education and training activities for farmers provide the basic knowledge needed to design organic farming pest control strategies (Montiel Cáceres et al., 2023). Trainees' understanding and proficiency in a variety of organic agricultural topics, including organic standards, certification and marketing networks, technology packages, and general knowledge, have significantly increased (Bhanu et al., 2022). Social interaction and codification-based learning make it easier for organic farmers to acquire technical knowledge, which promotes environmental sustainability (Sáenz et al., 2024). In scientific contexts and policymaking, these organic farmers' vast place-based knowledge of their regional farming systems serves as a valuable resource for innovation and adaptive management (Klein et al., 2024).

Table 4. Matrix of cooperative relationships among stakeholders

Stakeholder	Business	Community	Government	Media
Academy	Organic rice research Marketing of organic farming products Establishment of organic association institutions	Marketing of organic rice farming products Establishment of organic association institutions	Regional governance Initiation of organic association institutions Organic farming policymaking Farming application development Research	Organic farming education
Business		Marketing of organic rice farming products	Marketing of organic rice farming products Certification assistance	Publication of organic farming information
Community			Marketing assistance	Education and socialization of organic rice farming
Government				Publication of organic farming information

Research and education activities must be conducted, aiming to improve production quality, increase the financial returns from soil fertility amendments and land renovations, introduce new and mixed products that meet agronomic, economic, and environmental needs, and promote climate change resilience related to commodity diversity adapted to local and regional climate conditions (Hatungimana et al., 2024). In Science, Technology, Engineering, and Mathematics (STEM) education-based agriculture, more sophisticated research can expand knowledge and comprehension of smart farm control systems and effectively apply them to other smart control systems (Sonthitham & Thongchaisuratkrul, 2020).

Production, processing, and marketing technology innovations based on information technology need to be introduced to the community to implement smart technology in sustainable agriculture (Santiteerakul et al., 2020). The dissemination of agricultural innovations is carried out among academics through community empowerment programs such as the introduction of certified seed quality and the use of internet applications for young farmers

in pioneering agribusiness start-ups (Manik et al., 2021). Higher education and training, including informal learning like field schools, enhance farmers' adoption of organic practices. As adoption increases, so does the sustainability of organic rice production and vice versa (Sujianto et al., 2024).

Education is also needed for the organic product consumer community. Consumers' purchasing decisions are influenced by several factors, including the quality of the product, the shopping experience, and others. The most crucial factor in customers' comprehension of purchasing organic products is their awareness of leading a healthy lifestyle (Wibowo et al., 2023). Astute buyers are prepared to shell out more money for high-quality, ecological products. However, when people are thinking about purchasing organic food, they search for recyclable packaging (De Canio & Martinelli, 2021). Such quality labels statistically significantly determine consumer preferences when making decisions to purchase organic foods and products. Simultaneously, to lower expenses and guarantee better positioning of domestic goods for the final consumer, a vertical integration environment must be established by enhancing collaboration among domestic farming, processing, and trading businesses as possible holders of verified origin certification (Končar et al., 2019).

Business units engage in marketing, distribution, and quality control of organic farming products (Aarts et al., 2014). Additionally, they contribute to consumer awareness initiatives about the benefits of organic food. Depending on how long they have been working with the retailer, what kind of product they offer, and what proportion of their total sales they sell through the retailer, manufacturers have different opinions about how collaboration and trust affect overall success. This can work as a resource for all parties involved in the supply chain for organic products by motivating them to take part in initiatives that can improve cooperation and trust, which are necessary for enhancing the organic food supply chain's performance (Gajdić et al., 2021).

In marketing, one of the responsibilities is to assist organic rice producers in promoting their business model and its outcomes. Marketing strategies have been designed to reach both the general public with an interest in organic consumption and specific consumer segments identified as key markets for organic rice products. This involves the identification of evolving consumer preferences and their implications for the growth trajectory of organic agriculture (Semenova, 2023). Thus, identifying the elements that influence the purchasing process and motivation can assist stakeholders in creating a successful organic food marketing plan. The growth and diversity of the organic food industry may benefit from this, as its production may enhance the quality of life and the natural environment while also supporting regional food producers (Chrobocińska & Lotkowska, 2023) in keeping with the tastes and expectations of consumers, which is acknowledged as one of the primary requirements for the adoption and acquisition of organic food items (Melovic et al., 2020). This is an effort to implement an effective marketing strategy to overcome changing consumer preferences (Jiang et al., 2023).

Organic rice farming is indeed not an instant farm. In the application of organic rice farming, patience must be used. Therefore, the business unit performs a mentoring role to be able to periodically check the implementation of organic rice farming processes to get maximum results. Furthermore, the development of a business model with an emphasis on design thinking can improve the performance of the organic rice business. The requirements for boosting sales of organic rice products, the capability to create innovative derivative products, and the development of community economic and intellectual capacity all demonstrate this (Karyani et al., 2019; Purnomo et al., 2020; Suswadi et al., 2021). Therefore, rice planting using organic methods can be a breakthrough to be tried by providing information on the advantages of organic methods compared to other farming methods to the trainees. Organic farming systems help reduce production costs through the use of organic fertilizers, which improve soil fertility, increase rice yields, support healthier crop varieties, and address challenges during the second planting period. As a result, the agricultural ecosystem becomes more efficient, resilient, and sustainable (Haque & Biswas, 2020). Consequently, farmers are much more likely to use organic fertilizers if they take part in technical training offered by agricultural cooperatives (Liu et al., 2022).

Farmer groups serve as the primary implementers of organic farming. They are responsible for organic fertilizer production, certification processes, and actual crop cultivation (Herab et al., 2023). The results of studies in Central Java prove that the majority of organic rice farming technology is still at the moderate category level (Sumarsono et al., 2020). Even farmer groups have been classified as lagging behind (Firdauzi et al., 2024). A tiny percentage of farmers do not continue to use technology, even though most of them embrace its use. Consequently, it is critical to provide intensive counseling (Indardi et al., 2021).

Farmers play a role in organic fertilizer production, including providing insight and learning for those who have not used organic fertilizers in farming. The organic farmer group said that the production activity of organic fertilizers can be a new innovation to help create the latest innovations that bring benefits to many people because the use of organic waste such as rotten fruits and animal manure reduces environmental waste (zero waste program) and supports the circular economy (Sari et al., 2024). Independent organic fertilizer production can also overcome the scarcity of fertilizers. Economically, this is a perfect initiation of a circular bio-economy (Patil et al., 2022) in group empowerment through organic fertilizer processing units (Ramaiyulis et al., 2020). Meanwhile, farmers understand that organic rice farming has advantages for their own health and the well-being of the environment, which will be passed down to their children and grandchildren, laying the foundation for awareness of the need to switch to organic rice farming. This can also be used to evaluate how well domestic farmers are performing in

terms of enhancing food security (Plotnikova et al., 2020).

Socialization and education carried out by farmer group administrators can add to the insight of traditional farmers that organic rice farming provides better benefits economically, socially, and environmentally. Organic rice farming replaces chemical fertilizers with organic manure, promoting soil health and reducing environmental harm. This method also produces rice with higher antioxidant content and no synthetic chemicals, making it a healthier option (Sedana et al., 2025). In the meantime, there are comparatively many social, economic, institutional, and environmental advantages to joining these groupings when it comes to collective marketing. Specifically, compared to other benefits, the environmental benefits are greater (Methamontri et al., 2022).

Government agencies are involved in policymaking, capacity-building programs, and governance structures that regulate and promote organic farming. In addition, they formulate lead policies, provide mentoring, and organize organic certification programs (Nabarro & Nayyar, 2016). Farmers are strongly encouraged to adopt sustainable agriculture practices (SAP) due to the perceived utility, convenience, and compatibility. These elements must be ingrained in farmers in order to boost their adoption of SAP because there is a statistically substantial and positive correlation between SAP adoption and incentives and extension services (Swami & Parthasarathy, 2024). The interaction between perceived usability, personal attitudes, personal innovation, government support, and performance expectations increases farmers' acceptance of technology (Ngan et al., 2024). It is anticipated that this condition will boost agricultural output, which in turn can mediate the relationship between poverty reduction and sustainable agricultural practices in a favorable and meaningful way (Sikandar et al., 2022).

Training and mentoring farmers through agricultural extension services play a crucial role in enhancing their capabilities and increasing rice production. Extension programs are designed to disseminate information on farm technologies, support rural adult learning, and assist farmers in developing their technical and managerial skills, which are essential for improving farm productivity and income (Danso-Abbeam et al., 2018). To motivate farmers to increase crop productivity, extension workers always conduct and provide assistance in theory and direct practice so that the food self-sufficiency program can be achieved successfully. By helping farmers apply Integrated Crops Management (ICM) technology, Bali Province's sustainable agriculture may be supported by raising rice productivity and farmers' incomes (Aryawati et al., 2021). Furthermore, initiatives that prioritize extension support, involve farmers' needs, and integrate current community-adaptable practices can promote more desirable climate change prevention strategies (Goodwin et al., 2022). Meanwhile, to increase agricultural production, traditional agriculture can adopt a workable strategy. Thus, implementing precision agriculture's scientific and technological advancements helps to guarantee food security (Montalvo-Romero et al., 2023). In order to increase organic market channels, governments at the district, township, and village levels can also help to formalize and institutionalize financial and technical support, act as a mediator between farmers and businesses, and draw in investment (Qiao et al., 2019).

Media act as an information dissemination channel that educates the public, promotes organic farming initiatives, and bridges communication between stakeholders (Alotaibi & Kassem, 2022). Farmers' social media presence helps them establish a reputation as reliable individuals, facilitates the execution of marketing campaigns, and raises customer interest in goods produced on their farms (Kramarz & Runowski, 2023). Furthermore, social media can improve the ability and interaction of farmers with extension officers (Ramavhale et al., 2024). This can foster a positive mindset that is particularly focused on agricultural intelligence, green development, and international collaboration and innovation (Wu & Qiu, 2024). Extension managers can use this tactic to communicate with farmers more effectively and make better decisions for agricultural enterprises (Yadav et al., 2023). Therefore, the support of information and communication technology infrastructure in rural areas is very significant for the sustainability of the agricultural sector (Kamaludin & Qibthiyyah, 2022).

The stakeholders interact at various levels, forming a cooperative network that supports the development and sustainability of organic farming initiatives. Table 4 presents a matrix of cooperation relations between stakeholders in organic rice farming development. Research collaboration between academics and the agricultural office in Yogyakarta has prepared a regent regulation on organic agriculture based on a previous study (Dima & Inzé, 2021). The findings are adequate for policymakers and regional managers to decide on strategies and activities in sustainable development based on the potential for bio-based energy and agriculture-based energy efficiency (Pamučar et al., 2021). This regent regulation will contain the protection of organic farming, prices, government duties, and certification. The preparation of this regent regulation is expected to be a policy for all stakeholders involved in organic agriculture, so that in its implementation, there will be fewer obstacles faced, such as emission reduction, making agricultural and environmental policies more closely aligned (Leach, 2022).

The role in policymaking is included in efforts to help organic rice farmers prosper in developing their businesses. The academics said that the existence of district-level policymaking activities such as regent regulations, organic agriculture, especially organic rice, would be more directed in carrying out the role of organic crop development. The government must be more agile in overcoming the obstacles felt by the wider community in the organic rice farming development. The policy formulation is a concrete step in overcoming obstacles regarding organic agriculture. In addition, academics assist in the initiation of establishing the organic association

institution as a forum for communication and cooperation among organic agriculture activists. This enables stakeholders, especially farmers, to obtain more direction in running the organic rice farm because it is under the auspices of the official institution of the association. Thus, there is a fair partnership, and stability is maintained in the event of changes in agricultural policies and regulations (Feldhoff, 2019).

The integrated and synergistic collaborative cooperation among stakeholders is illustrated in Figure 1. It describes the holistic cooperation of all stakeholders in the organic farming development. This finding can be used as a model to build a partnership system that integrates all stakeholders as actors in the development of sustainable organic agriculture.

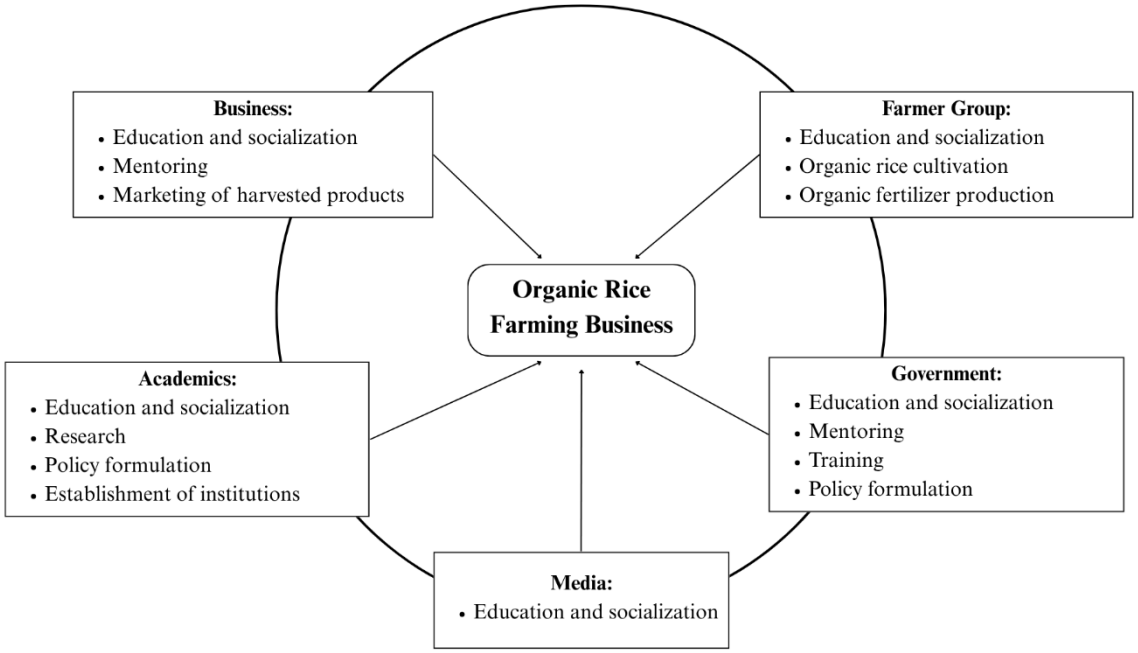

Figure 1. The integrated and synergistic cooperation of stakeholders

The APF analysis emphasizes structured collaboration built on trust, shared vision, and well-defined engagement mechanisms (Aarts et al., 2014). The stakeholder roles identified in Table 3 align with APF principles in the following ways:

(a) Knowledge-sharing and innovation: Academic institutions facilitate research and education to improve organic farming practices.

(b) Institutional support: Government agencies establish policies and provide resources to support organic farming development.

(c) Market integration: Business units contribute to the commercialization of organic products and ensure market sustainability.

Despite these strengths, the current stakeholder collaboration model exhibits certain limitations:

(a) Limited feedback mechanisms: The absence of structured feedback loops between farmers, businesses, and policymakers reduces the ability to refine organic farming strategies (Herab et al., 2023).

(b) Lack of financial incentives: Many smallholder farmers struggle to transition to organic farming due to high initial investment costs and limited government subsidies (Zhu & Wang, 2024). Meanwhile, Germany and Japan have established strong financial incentives to support organic farming (Klinkmann et al., 2024; Liang & Meng, 2024; Tanaka & Tanaka, 2022).

(c) Weak accountability structures: Stakeholder coordination lacks an overarching monitoring and evaluation framework to track progress and ensure transparency (Nabarro & Nayyar, 2016).

The CPM analysis framework emphasizes the need for collaboration among three key sectors:

(a) Public sector leadership, i.e., policymaking, regulatory frameworks, and subsidy provisions. China utilizes a top-down policy approach where the government incentivizes organic farming through direct subsidies and technical training programs (Zhu & Wang, 2024). In Saudi Arabia, government-driven policies have facilitated large-scale organic farming adoption through subsidy programs (Alotaibi & Kassem, 2022).

(b) Private sector investment, i.e., market-driven solutions, certification processes, and supply chain management. Denmark uses cooperative-based certification systems to ensure fair-trade pricing and increase market confidence (Jaffee & Howard, 2010). Government-led cooperative models ensure that organic farmers

receive fair prices and access to stable markets (Le et al., 2017). In Japan, regional branding strategies have improved the marketability of organic products and enhanced consumer trust (Tangnatthanakrit et al., 2021).

(c) Community empowerment, i.e., farmer-led initiatives, cooperatives, and training programs. China implements a top-down policy approach where the government incentivizes organic farming through direct subsidies and technical training programs (Zhu & Wang, 2024).

5. Conclusions

The roles of stakeholders in the development of organic rice agriculture are played by five key institutions. Academic institutions play a crucial role in education, socialization, research, policy formulation, and the establishment of organic association bodies. Business units are involved in education, socialization, marketing of agricultural products, and providing support through mentoring. Farmer groups contribute by engaging in education, socialization, organic rice farming, and the production of organic fertilizers, along with conducting socialization education. Government institutions support the process through education, socialization, mentoring, training, and policy formulation. Lastly, the media plays a significant role in education and socialization by disseminating information and raising awareness.

To improve stakeholder collaboration in organic farming, the following is recommended:

(a) Enhancing financial support mechanisms: By drawing from Germany's model, policymakers should implement subsidies and financial assistance to encourage farmers to transition to organic practices. It can be initialed by a pilot project for feasibility and adjustment as a fundament of future planning.

(b) Improving accountability mechanisms: Inspired by Denmark's cooperative system, organic farming initiatives should establish structured feedback loops between farmers, businesses, and government agencies.

(c) Strengthening farmer-led certification models: By adopting Japan's cooperative certification approach, farmers can be empowered to have greater control over organic certification processes.

(d) Expanding media engagement in consumer awareness campaigns: By following China's example, the media should play a larger role in educating consumers about the benefits of organic farming, ultimately driving higher demand for organic products.

By integrating these best practices, organic farming systems can be more sustainable, resilient, and economically viable while fostering stronger multi-stakeholder collaboration. In addition, efforts to develop organic rice farming need to increase the role of each stakeholder, synergistically complete with performance indicators that are determined together in coordination. The performance achievement of each stakeholder could be monitored and evaluated to improve the sustainable development of organic rice farming.

Author Contributions

T. contributed to research design, data analysis, and final manuscript preparation. T.L.J. was responsible for data collection and literature review. Z.R. assisted in the statistical analysis and interpretation of research findings. N.A. contributed to methodology development and data validation. W. was responsible for data processing and visualization of research results. M.F.K. provided academic insights and assisted in manuscript editing. E.W.R. played a role in developing the research concept and discussing the findings. Y. contributed to manuscript preparation. All authors have read and agreed to the published version of the manuscript.

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Informed Consent Statement

Informed consent was obtained from all subjects involved in the study.

Data Availability

The data used to support the findings of this study are available from the corresponding author upon request.

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Conflicts of Interest

The authors declare no conflict of interest.

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