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Adoption of Organic Rice Farming in East Kolaka Regency, Indonesia: Factors and Stakeholder Collaboration

Putu Arimbawa[1*], I. Made Widana Arsana[2], La Ode Santiaji Bande[3], Hartina Batoa[1], Yani Taufik[1], Safril Kasim[4]

[1] Department of Agricultural, Extension, Faculty of Agriculture, Halu Oleo University, Kendari 93232, Indonesia
[2] Department of Agrotechnology, Faculty of Agriculture, Halu Oleo University, Kendari 93232, Indonesia
[3] Department of Plant Protection, Faculty of Agriculture, Halu Oleo University, Kendari 93232, Indonesia
[4] Department of Environmental Sciences, Faculty of Forestry and Environmental Sciences, Halu Oleo University, Kendari 93232, Indonesia

Corresponding Author Email: putu.arimbawa_faperta@uho.ac.id

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ABSTRACT

Farmers' motivation towards a new technology is a key factor in the success of a new farming system adoption. The farmers' understanding of environmental functions and other factors determines the successful adoption of an organic lowland rice farming system. We, accompanied by the Bank of Indonesia, tried to help a group of paddy-rice farmers in East Kolaka Regency, Southeast Sulawesi Province, Indonesia, convert from a conventional to an organic rice farming system. Data were collected using surveys through interviews. The case study analysis used in-depth interviews, focus group discussions, and non-participatory observation. Using the Theory of Planned Behaviour, we found that farmers' interest in the organic farming system was highly positive. Farmers will decide to implement an organic farming system after seeing other farmers' success, but several factors, including limited policy support, must be resolved. However, adopting the organic rice farming system would be beneficial in increasing production and improving the local agricultural ecosystems. Still, collaborative roles of various stakeholders (e.g., government, universities, and extension workers with a participatory extension approach) were required. Strong collaborations among farmers as actors, extension workers as university-facilitated assistants, and the government as policymakers were essential in adopting technology at the farmer level.

1. INTRODUCTION

Conventional farming, an agricultural system highly dependent on the intensive use of chemical compounds (e.g., synthetic fertilizers and pesticides), has been well known to cause widespread negative environmental and social impacts [1]. Therefore, organic farming systems have been introduced as an alternative to produce healthy food and environment. Unlike the former, the latter avoids using synthetic inputs and applies crop cultivation techniques that have been used for thousands of years, such as through manure, compost, green manure, and crop rotation. It emphasizes the system's health and employs various strategies to increase and maintain biodiversity and soil fertility [2]. Healthy soil is key to sustainable agriculture because it is the foundation for present and future growth. Organic farming is far superior to conventional systems regarding building, maintaining, and replenishing soil health. Organic agriculture is more sustainable than the traditional system for soil health alone. When one also considers yields, economic viability, energy usage, and human health, it is clear that organic farming is sustainable, while current conventional practices are not [2]. Organic agriculture contributes to the achievement of almost all the SDGs (Sustainable Development Goals) indicators set by the United Nations, including its role in mitigating climate change, ensuring food and nutrition security, helping limit biodiversity loss, supporting sustainable consumption, and so forth [3].

Despite the presidential policy "*Go Organic 2010*" and "*1,000 Desa Pertanian Organik*" by the last two Indonesian presidents, the acreage of organic farming in Indonesia has not significantly increased. From 2015 to 2018, for instance, the acreage only increased by 0.1% (from 247 ha to 261,631 ha) [4]. The total area of organic agriculture is only about 0.4% of the total farmland in Indonesia, far below Timor Leste, a country previously part of Indonesia, which has reached 16.8% [4]. The number of Indonesian organic farmers is only around 17,948 [5]. In comparison, the regions with the largest organic farmland are Oceania (36 million ha, which is half (50%) of the world's organic farmland) and Europe (15.6 million ha, 22%). Latin America has 8 million ha (11%), followed by Asia (6.5 million ha, 9%), North America (3.3 million ha, 5%), and Africa (2 million ha, 3%) [4]. The low adoption rate in Indonesia is due to several factors, including

scepticism [6], initial higher cost [7, 8], limited access to information on organic farming, high certification cost [8], as well as instant culture, limited market for organic products, and the absence of a standard price for organic products [9].

The agent factor plays an important role in realizing social change. The principles of the Agent Theory analyze strategic interactions among actors, often limited in scope and time, in giving authority to agents [10]. Agent disputes arise when agents' actions have different goals or interests or even when their actions contradict the principal interests [10]. The interaction of various parties in developing organic agriculture can increase organic products.

This study focused on lowland rice farmers who had adopted and applied the organic farming system. Financially assisted by the Bank of Indonesia (B.I.), we assisted the farmers with their conventional-to-organic farming transfer to overcome their technical constraints. In this case, B.I. assisted with equipment in the form of a soil nutrient tester and pest observation tool, as well as cultivation assistance such as using organic fertilizer from cow dung and pest control using liquid organic fertilizer from cow urine (Figure 1). University of Halu Oleo (UHO) conducted farmer training in pest control methods and marketing. We hypothesized that although a farmer has perceived the introduced farming system well, other internal factors (e.g., individual behaviour) and external factors (e.g., intervention) could either hinder or boost the successful adoption of the system. Intervention could be technological assistance, market certainty, yield protection, and governmental policies. States that can address these roles could accelerate or hinder such an adoption. When an actor, for instance, introduced rice direct seeding, which is easily implemented and requires less labour and cost without production reduction, other farmers started to adopt such a technique and left the rice transplantation method. A similar case occurred in organic rice farming after being introduced by B.I. and the UHO team, although its adoption rate still needs to be higher.

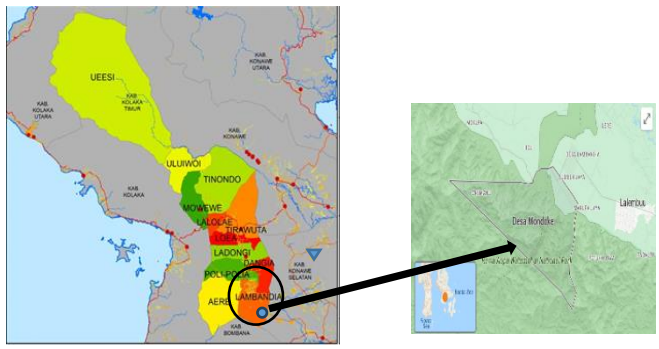
Figure 1. Farmers are trained on how to make liquid organic fertilizer by a team of experts

The specific questions of this study are: (1) How did farmers perceive the organic rice farming system? (2) How did their knowledge and expectations relate? and (3) What would encourage them to adopt the organic farming system? The Theory of Planned Behaviour (TPB) was referred to address those questions. The theory can reveal the cognitive, affective, and motivational aspects of the dynamics of farmers facing new techniques [11].

2. METHODOLOGY

2.1 Research setting and participants

This study was conducted in the Village of Mondoke, Lambandia District, East Kolaka Regency, where 25 rice farmers practised the organic farming system. Data was collected from June to August 2021 (Figure 2). All 25 farmers were asked to be key participants in the study, but only 18 were willing to participate. Several informants were purposively chosen, including the head of the farmer group, the head of the village and his staff, and local agricultural extension workers. Their involvement in the study was based on the assumption that they had knowledge and information regarding the history, benefits, and challenges of adopting and implementing the organic rice farming system.



(a) (b)

Figure 2. Location of the study area in the Village of Mondoke (b), Lambandia District (a)

2.2 Research design

The study used a four-stage action research approach, i.e., planning, action, observation, and reflection [12]. At the planning stage, we conducted site visits, socialized the research objectives, and conducted discussions with the farmers to identify problems that should be resolved through the study. At the action stage, we intervened and communicated with the key participants. The discussions focused on practising organic rice farming properly and motivating them to farm rice organically continuously. The communication strategies used were (1) advocacy through personal communication and (2) behaviour change through farmer group meetings, counselling, training, and demonstrations of the integrated organic farming system. The advocacy strategy was designed so the key participants realized the benefits of organic rice farming and its supporting strategies. Later, each individual could spread this beneficial system to non-organic farmers. At the observation stage, data and additional information were collected at the study site. Farmers' responses were measured using a mixed method, which consisted of two stages, including (1) quantitative data, which was collected through a survey (in Juni – Juli 2021), and (2) qualitative data, which was collected through a case study (in August 2021). The data collected were farmers' perceptions of organic rice farming compared to the conventional system. Qualitative data collection facilitates a deeper understanding of the quantitative data related to farmer's intentional behaviour and the influence of demographic factors. At the reflection stage, the reflection was carried out based on the research findings through (1) individual evaluation by the

research team, (2) discussion among researchers, and (3) opinions from stakeholders through seminars. To clarify the findings, we used the Theory of Planned Behaviour and other references to provide recommendations for further studies and to provide intervention approaches for future implementation.

2.3 Data collection and analysis

Quantitative data were collected using a survey and structured interviews to answer the research hypothesis. Qualitative data were collected and analyzed to provide further strengthening and explanation related to the quantitative data findings. The instrument used for the survey, namely a questionnaire, was given to all key participants (18 organic farmers). The questions in the questionnaire consisted of intentional variables, including (1) behaviour towards technology, (2) subjective norms, and (3) perceived behavioural control. A five-point Likert scale technique was used: "strongly disagree" (Score 1), "disagree" (Score 2), "neutral" (Score 3), "agree" (Score 4), and "strongly agree" (Score 5). Additional questions were also addressed regarding farmers' demographic status (i.e., age, education, farming experience, and sources of information on organic rice farming). Data was collected through key participant interviews, triangulation techniques (i.e., non-participant observation), and Focus Group Discussions (FGD). The FGD was conducted with ten rice farmers and several stakeholders (i.e., local district officials, village officials, community members, agricultural extension workers, and the researcher team). The quantitative data were analyzed using descriptive statistics (i.e., frequency, percentage, mean score, and standard deviation) to summarise the study. This data analysis was carried out in several stages, including data reduction (i.e., sorting and summarizing data based on categories or themes) and data processing (i.e., categorizing/coding data based on themes). The qualitative data were analyzed using the main theory to interpret the existing cases and data. It was conducted to answer research questions and to provide recommendations.

3. RESULTS

3.1 Social conditions and demographics

The rice fields managed by participants covered an area of 30.05 ha, about 7.22% of the total rice fields in Mondoke Village (416 ha). On average, each participant only managed 0.8 ha. Demographic data shows that 5 out of 18 farmers (27%) had adopted organic rice farming for over four years. Most participants (51%) were younger than 50, and 65% had limited education. They resided in the village adjacent to the rice fields, relatively far from the municipality town.

Before adopting organic rice farming, they applied inorganic-based rice farming called conventional agriculture. However, due to the continual use of chemical fertilizers, their soil has become more degraded, and their rice production remained low. When being questioned about their access to information about organic rice cultivation, all participants (100%) had participated in how to grow rice organically conducted and supported by a finance institution (i.e., Bank of Indonesia), universities (i.e., the University of Halu Oleo), and agricultural extension service workers. Only 27% gathered such information from other sources.

3.2 Behaviours towards organic rice farming system

The main objective of this study was to determine farmers' willingness to adopt organic rice farming. Using the Likert scale, we analyzed their behaviours towards the new farming system, subjective norms (e.g., social support), and perceived behavioural control (e.g., obstacles in implementing the system). The results showed that 83% of participants agreed or strongly agreed that organic rice farming systems benefited them (Table 1). The perceived benefits were mainly related to changes in their soil structures (item #1); benefits were expected to arise from local resources-based organic fertilizers (item #2); and the products were chemically safe for consumption (item #3). In addition, 82% of participants agree or strongly agree that adopting organic rice farming could increase production and income (#4, 5).

It should be noted that the average scores on production and income benefits (#4 and 5) were slightly lower than other indicators. This could indicate that the farmers still wanted to increase their rice production. The lower scores happened because the rates of organic fertilizer application were still limited, far below the rate for optimal rice growth. In addition, pest and disease infestations also hindered the adoption of organic farming. An in-depth interview with a farmer revealed some uncertainties in adopting organic rice farming regarding the scarcity of organic fertilizers and limited pest and disease control. The rice intensification (SRI) system that had been previously introduced needed to be implemented properly.

3.3 Social support for the organic rice farming system

Table 2 represents the level of social support (i.e., the subjective norm variables) for adopting organic rice farming technology. The table shows that most participants (82%) agreed or strongly agreed to establish an organic rice farming forum. This is based on the responses to other statements regarding higher education support with an average of 79%; B.I. support and support from key farmers in the farming system (indicators #2, 3, and 4) agree or strongly agree. At a lower level, only 74% of participants agree or strongly agree that the local government supports adopting organic rice technology" (indicator # 7).

Table 2 also shows that the participants received support in adopting organic rice farming from various stakeholders, including finance institution (Bank of Indonesia), universities, and their families. The bank provided cows whose dung and urine could be used as organic fertilizers. However, the local government's support for adopting organic rice farming still needed to be improved.

Table 1. Farmer behaviour towards organic rice farming

No.	Farmer Behaviour	Agree & Strongly Agree (%)	Means	SD
1	Improved soil fertility	85.56	4.25	0.49
2	The use of locally derived organic fertilizers	84.82	4.15	0.51
3	Product Safety	83.72	4.12	0.53
4	Increased production	81.81	4.09	0.68
5	Increased income	81.81	4.09	0.57

Source: Field Survey, 2021

Table 2. Social support for the adoption of an organic rice farming system

No.	Social Support for Organic Rice Farming	Agree & Strongly Agree (%)	Means	SD
1	Establishment of a group discussion forum	81.72	4.10	0.33
2	Bank assistance in the technology adoption	80.91	4.05	0.40
3	Key farmer's assistance in technology adoption	80.91	4.05	0.34
4	University support	79.83	3.92	0.58
5	Fellow farmers assistance	8.16	3.83	0.39
6	Training by extension agents	76.78	3.76	0,60
7	Local governmental support	74.18	3.64	0.70

Source: Field Survey, 2021

Mr. Arif, a key participant, stated:

"The organic rice farming was first adopted in 2017. The rice production for the first growing season was completely disappointing due to pest attacks. I did not give up, I continued to seek information and attended trainings of how to cultivate rice organically from various sources. The involvements of the Bank of Indonesia and the University of Halu Oleo were beneficial in providing the farming system training, as well as the solid and liquid organic fertilizer and biopesticide production. Because of this, my organic rice production significantly increased and triggered some farmers to adopt organic rice farming system."

3.4 Behavioural control perceived from organic rice farming adoption

The perceived behavioural control affects farmers' willingness to adopt organic rice farming. Two main variables were used to assess this, i.e., self-efficacy (individual factors) and non-self-efficacy (other factors). Indicators of self-efficacy included farmers' confidence in adopting the farming system because of the hope of improving their income, the system's ease of use, and its suitability to local conditions. On the other hand, the non-self-efficacy indicators included the availability of funds, time, information or other resources. As seen in Table 3, the majority of the participants agreed and strongly agreed to adopt the organic rice farming system if funds were available (84%) if the system was cheap (81%), and if experts were available to help adopt the system (80%). In non-self-efficacy indicators (i.e., the system ease of adoption, organic rice farming suitability, farmers' life improvement, ease of maintenance, and ease of getting agricultural inputs), however, the number of participants who agreed and strongly agreed were somewhat lower, ranging from 78.83% to 66.36%.

Table 3. Behavioural controls perceived from adopting an organic rice farming system

No.	Farmer's Confidence in the Organic Rice Farming System	Agree & Strongly Agree (%)	Means	SD
1	Fund availability	83.63	4.15	0.33
2	Farming system adoption affordability	81.00	4.05	0.40
3	Accompanying expert existence	80.61	4.00	0.65
4	The system's ease of adoption	78.83	3.87	0.85
5	Organic rice farming suitability	78.83	3.87	0.57
6	Farmers life improvement	76.48	3.76	0.64
7	Ease of maintenance	70.00	3.50	0.60
8	Ease to obtain organic agricultural inputs	66.36	3.35	1.05

Source: Field Survey, 2021

The more statements that include follow-up or practical aspects, the fewer farmers intend to practice the organic rice farming system. Around 78% of participants agree or strongly agree to practice it if it is easy and suitable for them; Less than 77% of participants agree or strongly agree that the farming system could improve their lives. The lowest agreement is whether organic agricultural inputs are easy to- obtain - (66%). This indicates the potential risk of crop failure due to the limited access to obtain- raw materials for organic fertilizer and biopesticide production.

Key farmers highlight this case:

"*Due to the slight success of organic rice farming, the interest of other farmers in adopting the organic farming system has increased. The main problem is the scarcity of organic materials for fertilizers and organic pesticides. Therefore, we only produce and apply liquid organic fertilizer to the rice crops (i.e., cow urine-based) without solid organic fertilizer (e.g., manure or compost). The rice production would have been higher if we had applied organic fertilizers at a recommended rate and if we had controlled pest infestations more appropriately…… "*

Only 55% of the farmers applied fertilizers at the recommended rate. However, further analysis showed that agricultural extension methods (e.g., discussions with fellow farmers, especially discussions with appropriate experts) and the provision of fertilizer raw materials from various parties became the method of choice to increase farmers' willingness to apply the organic rice farming system.

Finally, there is a strong indication that external factors significantly affect farmer intentions. If funds are available, they will be confident in practising the organic rice farming system (84%). Similar trends were also found when the system adoption was linked to other external resources, such as the system's ease of application (#4), suitability to local conditions (#5), and availability of agricultural inputs (#8) (79%; 79% and 66%, respectively). These indicators show the conditions that can hinder the adoption of the organic rice farming system, as expressed by a farmer:

"*I am interested in organic farming system but due to the limited raw organic materials for organic fertilizers and biopesticides, I am doubtful that the organic rice farming system can be practice continuously*."

4. DISCUSSIONS

Changes in individual behaviour can be seen from technological innovations whose acceptance tends to be more careful even though the new technology is considered better

than the previous ones. One of the problems is that for the individuals being targeted, the nature of technology is perceived to be complex, as this research proves enough. However, our findings show that adopting an organic rice farming system from the farmers' point of view is quite complex. Individual intentions are also influenced by considerations of individual capacities, including technical complexity and availability of resources to support its implementation. This fact is especially evident when the innovation is linked to marginal farmers, as in the case of the farmers in East Kolaka. Using the Theory of Planned Behaviour to assess farmers' intention to innovate in rice farming, we found that the values of the three intention factors varied.

Behavioural beliefs. Our assessment of the behaviour aspect shows that economic benefit is an important element in shaping farmers' behaviour towards the organic rice system. Besides, income stability and production costs are also important factors of crop productivity. The higher cost of applying the organic rice system can be a limiting factor. Scarce organic materials (for organic fertilizers and biopesticides) and a limited labour force are other major obstacles. Additional costs for smallholder farmers have long been identified as a sensitive factor. Ecologically, the organic rice farming practice is considered beneficial for improving soil fertility and biodiversity due to the application of organic fertilizers and biopesticides [13-15].

Subjective norm. Subjective norms are beliefs that meet social expectations. The cow procurement and cow barn building aid by B.I. and the organic rice farming demonstration plot by UHO have helped raise awareness and interest of farmers in practising the organic rice farming system (Figure 3). However, limited assistance makes transitioning to organic farming still at a low rate, as revealed from the interview session. The five cows B.I. provided are insufficient to produce organic materials for biofertilizer. In addition, the rules for distributing fertilizers through groups could be clearer. Therefore, the technology of organic rice cultivation itself may be simple in practice, but there are socio-psychological barriers due to consideration of the previous rules.

Figure 3. The organic rice farming demonstration plot

Their perceived behaviour could be clear efficacy, the belief to do something. Generally, farmers believe that the organic rice farming system can improve their standard of living compared to the conventional rice farming system. They realize that the traditional system tends to degrade the environment. The soil, for instance, becomes less healthy for crop production [14]. The organic rice cultivation technique is considered easier, cheaper, and more nutritious if raw organic materials are available. Farmers are no longer dependent on fertilizers from outsiders, which is often experienced by farmers practising the conventional farming system. In addition, supporting agencies (i.e., B.I. and UHO) make farmers more confident that they will continue to apply the organic rice farming system. However, some farmers have encountered several obstacles. For instance, some farmers need help meeting organic fertilizers and pesticide requirements. They also have limited labour forces and limited funds, and some are already beyond productive age. Besides, the support from local governments could have been improved. Therefore, they can only produce liquid organic fertilizers, which need help and biopesticides.

The non-self-efficacy factor, a combination of external aspects [16, 17], is also a significant consideration. Although they perceived the organic rice farming system as a cheap and easy farming technique, they found it expensive because of the need to purchase organic fertilizers and biopesticides, technical problems, and limited support from stakeholders, especially local governments. Therefore, they requested help from local governments and other agencies to make organic fertilizers and biopesticides available for rice farming at a recommended rate. There needs to be more than the five cows provided by B.I. to offer organic materials for organic fertilizers. Therefore, through BUMDES (i.e., village-owned enterprises), the village government could or should allocate a fund to procure additional cattle, for example, through a profit-sharing system. Through farmer groups, they would process cattle faeces and urine to produce solid and liquid organic fertilizer. The farmer groups could, therefore, contribute to increasing food production capacity [18]. One farmer said that adopting organic rice cultivation techniques was very suitable for paddy soils, considering that their fertility had decreased due to the continuous use of chemical compounds. He recommended the use of organic fertilizers to improve soil health.

Besides organic fertilizer production, our team also found that they could produce biopesticides to control rice pests. However, they still need local government and agency support in their management, as also found in another study [19, 20]. Local governments can provide financial, equipment, regulation, and market access. Agricultural extension agents can play a role through counselling, training, and mentoring so farmers become more aware of the benefits of organic farming and more motivated to practice it. Farmers need to be given training through field schools, training, seminars and extension programs. Training materials include Good Agricultural Practices (GAP), seed procurement, competitive organic fertilizer production, and integrated pest management (IPM) systems, as well as subsidizing organic certification costs and strengthening farmer institutions to adopt organic farming [21]. Farmer groups can act as an information and discussion centre to mitigate any existing problem.

5. CONCLUSION

Adopting an organic rice farming system is quite prospective, but it faces several challenges. Adopting a

farming system is believed to increase rice productivity and provide ecological benefits, especially in improving soil health and biodiversity. However, there are inhibiting factors, including the limited ability of farmers' resources and the practicality of technology, especially in producing organic fertilizers and biopesticides, which indicate the problem of psychosocial burden. Its practicality will be one of the considerations for adopting agricultural innovation. Positive attitudes and social support significantly influence farmers' intentions in an organic rice farming system.

Practically, adopting organic rice cultivation techniques has found several obstacles to improvement interventions: short-term subsidies or loans for farmers to fulfil organic fertilizers and pesticides. A further option is the development of cattle in groups to meet the raw material for fertilizers. Intervention should include technical assistance, information or knowledge sharing, and stakeholder collaboration. The government can make regulations to encourage farmers to believe in their decision to grow organic paddy rice. Extension officers and farmer groups play a role in counselling, training, access to information, and consultation for farmers. This collaborative approach is essential because stakeholders have specific roles and interests in decision-making. Therefore, participatory communication can be a means of uniting the parties' interests. Because this study has a relatively small number of participants, further studies with more participants are required. Besides, studies on the economic and environmental impacts of organic rice farming are also essential.

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