Farmers' Behavior in Adopting Innovations: A Study Case on Farmers' Adoption in Organic Rice Farming System in East Kolaka Regency, Southeast Sulawesi Province, Indonesia

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Abstract

Users' motivation towards new technology is a key factor in the success of a new technology transfer. Successful adoption of organic lowland rice cultivation technology is determined, among others, by the farmers' understanding of environmental functions. A team from Halu Oleo University attempted to assist a group of paddy-rice farmers in East Kolaka Regency, Southeast Sulawesi Province, Indonesia to convert from a non-organic 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. By using the Planned Behavior theory, we found that the farmers' interest in organic technology was highly positive, but several factors needed to be resolved such as perceived limited policy support. There, however, was hope that the adoption of an organic rice technology would provide benefits for increasing production and improving the local agricultural environment, but collaborative roles of various stakeholders (e.g., government, universities, and extension workers with a participatory extension approach) were needed. Strong collaborations among farmers as actors, extension workers as universities-facilitated assistants, and the government as policymakers were essential in the technology transfer at the farmer level.

Keywords: innovation transfer; organic technology; participatory counseling, stakeholders

Introduction

Agricultural technology is needed to improve business efficiency. One might assume that once an innovation is introduced, their users would find it beneficial to be adopted (Padel, 2001; Sveiby et al., 2009). These users are pro-innovation who don't mind the impact of innovation. By starting with the needs of the adopters, different designs of the innovation process can lead to different outcomes (Cahyono & Agunga, 2016;

Pannell et al., 2006).. The benefits and costs of any innovation invention are the key to innovation acceptance, but in a social context, the influence of a group, affiliation, status, and power are the main drivers in decision making (Hofstede, 2019). In a social context, adopting and applying organic farming technology, there is a connection among the economy, ecology and farmers (IFOAM, 2009). The interaction between the three components contributes to the achievement of the SDGs (Sustainable Development Goals) indicators, among others, playing a role in mitigating climate change, ensuring food and nutrition security, assisting in limiting biodiversity loss, and supporting sustainable consumption.

The agent factor plays an important role in realizing the occurrence of social change. The principles of the agent theory are to analyze strategic interactions among actors, which are often limited in scope and time, in giving authority to agents (Hawkins at al, 2006; Eisenhardt, 2010). Disputes among agents arise when the agent's actions have different goals or interests, or even when their actions are contra dictionary to the principal interests (Eisenhardt, 2010). The interaction of various parties in the development of organic agriculture can increase organic products. The market for organic products in Europe is very high and consumption of organic products in Asian, Latin American and African countries is increasing dramatically (Willer & Lernoud, 2017).

In Indonesia, the use of organic farming systems is still very low, which is only around 0.4% (261,631 ha) of the total existing agricultural land, with the number of organic farmers around 17,948 (Willer & Lernoud, 2017). The area of organic agriculture is only about 0.4% of the total agricultural land in Indonesia, far below that in Timor Leste which has reached 16.8%.

Our organic farming case study focuses on rice farmers who initially apply conventional (non-organic) cultivation techniques. It began with the pioneering farmers of organic rice development carried out by several farmers. The Halu Oleo University (UHO) team together with Bank Indonesia (BI) assisted in the process of changing its management. UHO researchers proposed to overcome the technical constraints surrounding the low yields of farmers. One of these obstacles is critical paddy fields. In general, our hypothesis is that although farmers view the innovations introduced as good, individual factors and external factors may hinder farmers' intention to continue to practice them.

The specific questions of our research are (1) what do farmers think about organic rice cultivation technology, (2) how this relates to their knowledge and expectations and (3) under what conditions it is favorable for farmers to implement the innovation. We use the reference to the theory of planned behavior to find answers to these questions, as we will explain in the research methods section.

Methodology

The organic rice cultivation technology had been applied by farmers in Mondoke Village, Lambandia District, East Kolaka Regency. Data collection was carried out from June – August 2021. The participants for this survey were 18 farmers from a total of 25 farmers who applied organic rice cultivation techniques. Besides, data were also gathered from the head of the farmer group, the head of the village, and agricultural extension workers.

The study used a four-stage action research approach, i.e., planning, acting, observing and contemplating (Heigham & Croker, 2009), through the mixed method. At the observation stage, the quantitative data (gathered via surveys) and the qualitative data

collection (collected via case studies). The instruments used for the survey were questionnaires handed out to all participants (18 farmers). The questionnaires consisted of intention variables such as (1) attitudes towards the technology; (2) subjective norms, and (3) perceived behavioral control. A five-point Likert scale technique was used, i.e., “strongly disagree” (score 1), “disagree” (score 2), “neutral” (score 3), “agree” (score 4), and “strongly agree” (score 5). Additional information regarding their demographic statuses (e.g., age, education, farming experience, sources of information on organic rice farming) were also gathered. Data was also collected via interviews (to key participants), triangulation techniques (to non participants), and Focused Group Discussions (FGDs). The FGDs were conducted with 10 rice farmers and stakeholders (district officials, village officials, community members, agricultural extension workers and members of the UHO research team). The data were analyzed using the descriptive statistics (frequency, percentage, mean score and standard deviation).

Results

Social Conditions and Demographics

The rice fields managed by respondents covered an area of 30.05 ha, about 7.22% of the total rice fields in Mondoke Village (416 ha). On average, each respondent only managed 0.8 ha. Demographic data shows that 5 out of 18 farmers (27%) had adopted organic rice farming for more than 4 years. Most of the respondents (51%) were less than 50 years of age and 65% of them had limited education. They resided in the village adjacent to the rice fields, relatively far from the municipality town.

Before adopting the organic rice farming, they applied an inorganic-based rice farming. However, due to the continual use of chemical fertilizers, their soil had become more

critical and their rice production remained low. When being questioned about their access to information about organic rice cultivation, all respondents (100%) had participated in how to grow rice organically conducted and supported by finance institution (Bank of Indonesia), universities (the University of Halu Oleo), and agricultural extension service workers. Only 27% gathered such information from other sources.

Attitudes towards Organic Rice Farming

The main objective of this study was to determine farmers' willingness to adopt organic rice farming. We analyzed their attitudes towards the technology, subjective norms (social supports), and perceived behavioral control (obstacles in implementing technology) using the Likert scale. The results showed that 83% of respondents agreed or strongly agreed that organic rice cultivation technology provided benefits for 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 produces were chemically safe for consumption (item #3). In addition, 82% of respondents agree or strongly agree that the adoption of organic rice farming could “increase production and income” (#4, 5).

Table 1. Farmer behavior towards organic rice farming

No.	Farmer behavior	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	Produce 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

It should be noted that the average scores on production and income benefits (#4.5) were slightly lower than other indicators. This could indicate the possibility 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 organic farming adoption. 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 system of rice intensification (SRI) that had been previously introduced was also not been implemented properly.

Social Supports in Organic Rice Farming

The farmers were questioned about the level of social supports (the subjective norm variables) regarding the adoption of organic rice technology (Table 2). It can be seen from the table that the majority of the respondents (82%) agreed or strongly agreed to establish an organic rice farming forum. This is in accordance with the responses to other statements regarding the existence of higher education support with an average of 79%; BI support, and support from key farmers in the adoption of cultivation techniques (indicators #2; 3 and 4) agree or strongly agree. At a lower level, only 74% of respondents agree or strongly agree that the adoption of organic rice technology is supported by the local government" (indicator # 7).

Table 2. Social supports towards organic rice adoption

No.	Social supports towards organic rice farming	Agree & highly agree (%)	Means	(SD)
1	Establishment of group discussion forum	81.72	4.10	0.33
2	Bank assistance in the technology adoption	80.91	4.05	0.40
3	Key farmers assistance in technology adoption	80.91	4.05	0.34
4	University supports	79.83	3.92	0.58
5	Fellow farmers assistance	8.16	3.83	0.39

6	Training by extension officers	76.78	3.76	0,60
7	Local government supports	74.18	3.64	0.70

Source: Field Survey, 2021

Table 2 shows that the respondents received supports 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. The local government support in organic rice farming adoption was still lacking.

Mr. Arif, a key farmer, stated:

"The organic rice farming was first adopted in 2017. The rice production of the first planting 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, his organic rice production significantly increased and triggered some farmers to follow him to adopt organic rice farming system."

Perceived Behavioral Control from Adopting Organic Rice Farming

The perceived behavioral control affects farmers' willingness to adopt organic rice farming. We used two main variables to measure this, i.e., self-efficacy (individual factors) and non-self-efficacy (other factors). Indicators of self-efficacy included farmers' confidence to adopt a technology because of the hope of improving their income, the technology 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 respondents agreed and strongly agreed to adopt organic rice technology if funds were available (84%), if the technology was cheap (81%), and if experts were available to help them adopt the technology (80%). In non-self-efficacy indicators (i.e., the technology ease of adoption, organic rice farming suitability, farmers life improvement, ease of maintenance, and ease to get production inputs), however, the number of respondents who agreed and strongly agreed were somewhat lower ranging from 78.83 % to 66.36%.

Table 3. Perceived behavioral controls in adopting organic rice farming technology

No.	Farmers confidence in organic rice farming technology	Agree & highly agree (%)	Means	(SD)
1	Fund availability	83.63	4.15	0.33
2	Technology adoption affordability	81.00	4.05	0.40
3	Accompanying expert existence	80.61	4.00	0.65
4	The technology 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 get production inputs	66.36	3.35	1.05

Source: Field Survey, 2021

The more statements that include follow-up or practical aspects, the less intention of farmers to apply organic rice cultivation technology "I will apply organic rice cultivation technology if it is easy and suitable to be applied" agree or strongly agree = 78%). Less than 77% of respondents agree or strongly agree that organic rice cultivation technology can improve their lives. "The lowest statement is for the ease of obtaining production inputs (#8), which indicates the potential risk of failure if farmers have difficulty procuring raw materials for making organic fertilizers.

Key farmers highlight this case:

“Due to their slight *success in organic rice farming, the interest of other farmers to start to implement arise. The main problem is the scarcity of resources for organic fertilizer and organic pesticide productions. ……Up to now, farmers only use liquid organic fertilizer (cow urine) without solid organic fertilizer (compost). The rice production would have been higher if they had applied organic fertilizers more optimally and if the pest infestations had been controlled more appropriately……* "

Only 55% of the farmers applied fertilizers as recommended. 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 organic rice cultivation technology.

Finally, there is a strong indication that external factors are also important points in relation to farmers' intentions. The statement “if funds are available”, then they will be confident to apply organic rice technology (84%). Similarly, when technology adoption was linked to other external resources, such as technology easy to apply (#4), and suitability to local conditions (#5), and availability of inputs (#8) (79%; 79% and 66%). This indicator shows conditions that can hinder the adoption of organic rice cultivation technology, as expressed by a farmer:

"*Honestly, I am interested in organic technology, but due to the limited raw materials for inputs such as organic fertilizers and pesticides, I have doubts that I can develop organic rice continuously*."

Discussion

Changes in individual behavior can be seen from the existence of technological innovations whose acceptance tends to be more careful even though the new

technology is considered better than the previous ones (Rogers, 2010). 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 have accumulated evidence showing that the adoption of organic rice cultivation technology is quite complex from the farmer's point of view. 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 farmers in Kolaka Timur. Using the theory of planned behavior as a lens to understand the intention of farmers to innovate in rice cultivation. We found that the values of the three intention factors varied.

Attitude/behavioral beliefs: the measurement of the attitude aspect shows that, in some respects, economic benefits are an important element in shaping the attitude of farmers to organic rice cultivation. However, stability of income and production costs are also important factors of crop productivity. The additional cost of implementing organic rice cultivation technology can be a sensitive factor as a limitation. Fulfillment of raw materials for organic fertilizers, organic pesticides and farmer resources (sufficient labor) is a major issue. Additional cost sensitivity for small businesses has long been identified as a sensitive factor for marginal farmers [50]. From an ecological perspective, the adoption of organic rice cultivation technology is considered useful for (1) improving and increasing soil fertility; and (2) fertilization with organic fertilizers increases the habitat of soil-burrowing animals.

Subjective norm: We already know that subjective norms are beliefs to meet social expectations. BI's support through the CSR program and UHO's support is shown by the demonstration plot as a sample plot to help raise awareness and interest of farmers

in organic rice cultivation. However, limited assistance makes the process of implementing organic cultivation technology still running slowly. This was revealed from the interview session, that farmers have not been fully able to apply organic rice cultivation technology due to limited capacity, such as the procurement of very limited fertilizers and pesticides. Even though they already have a group-managed cattle farm, the farmers believe that it is not enough to meet their needs. In addition, the rules for distributing fertilizers through groups are not very clear. 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.

Perceived behavioral control: As mentioned, self-efficacy is the belief to do something. Generally, farmers believe that organic rice cultivation can improve their standard of living from previous technologies. In this case, farmers realize that conventional technology in rice cultivation tends to damage the environment, especially when the soil becomes more critical so that crop production decreases. Organic rice cultivation techniques are considered easier and cheaper if organic raw materials are available. Farmers are no longer dependent on fertilizers from outside their area, which is a condition often experienced by farmers in the application of conventional technology (chemical fertilizers) whose availability is uncertain. In addition, the presence of supporting agents (i.e., BI and UHO) makes farmers more confident that they will continue to apply organic cultivation techniques. However, the practice of organic rice cultivation for some farmers had experienced problems. In the case of farmers in Mondoke Village, some farmers were unable to fully meet the needs of organic fertilizers and pesticides. The data shows that farmers with a limited number of family workers and old age and availability of funds are obstacles in meeting the needs for raw materials for organic fertilizers and pesticides. New farmers are able to

meet the needs of liquid organic fertilizer (LOF) which is intended for fertility and pest control. In addition, local government support felt by farmers is still limited. With these limitations, farmers feel they are not able to expand their rice planting area with an organic system.

Furthermore, the non-self-efficacy factor, namely a combination of externality aspects (Neila Ramdhani, 2011; Sparks & Guthrie, 1997) is also a significant consideration. We found that organic rice cultivation was considered expensive (if organic fertilizers and pesticides had to be purchased); despite having ecological benefits. Therefore, the adoption of organic rice cultivation techniques is considered a bit complicated due to technical problems and limited support from stakeholders (especially local governments), apart from crop productivity and ecological benefits. Discussions with farmers revealed suggestions, namely organic fertilizer assistance for farmers. Another alternative is with the help of cattle. The existence of cattle is a source of raw materials for organic fertilizers and pesticides. Farmers are given cattle which are managed in groups of 5-7 farmers. Through farmer groups, they can process cow manure in the form of cow urine into liquid organic fertilizer (LOF) and cow feces into solid organic fertilizer. Farmer institutions (farmer groups) can contribute to increasing food production capacity (Limi et al., 2018). An advanced farmer said that the adoption of organic rice cultivation techniques is very suitable to be applied in paddy fields, considering that fertility is decreasing due to the continuous use of chemicals. He recommends that in the future the use of natural fertilizers is a hope for improving soil structure. The research team also found out about other farmers' innovations in meeting plant nutrient needs and for controlling pests using plant raw materials known as botanical pesticides. Therefore, farmers need government and local institutional supports in their management (Bande et al., 2020).

Conclusion

The adoption of organic rice farming is quite prospective but requires some adaptations. The adoption of organic rice farming is believed to increase the rice productivity, especially the ecological benefits of innovation in improving soil structure. However, there are inhibiting factors, namely the limited ability of farmers' resources and the practicality of technology, especially in the procurement of organic fertilizers and pesticides which indicate the problem of psychosocial burden. Practically, the adoption of organic rice cultivation techniques found several obstacles for improvement interventions, namely: short-term subsidies or loans for farmers in terms of fulfilling organic fertilizers and pesticides. A further option is the development of cattle in groups to meet the raw material for fertilizers. Intervention should not only be on technical assistance, but also information or knowledge sharing and collaboration between stakeholders.

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