Research Article

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Farmers' perception, awareness, and constraints of organic rice farming in Indonesia

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Abstract: The green revolution and climate change have become a promising Indonesian rice production strategy to reach self-sufficiency through the application of improved agricultural technology such as organic rice farming (ORF). ORF is an eco-friendly agricultural practice that increases production, income, and sustainable agriculture. This study assessed farmers' perception, motivation, constraints, awareness, and belief in adopting ORF. The study used a multi-stage sampling procedure. The primary data were collected from 203 households in West Java Province using a structured questionnaire. Weighted average index (WAI) was used to assess the farmers' perception, motivation, awareness, and belief regarding the adoption of ORF. The results reveal a significantly different perception between ORF and conventional rice farming (CRF) farmers on production, quality, health and safety, market price, environmental concern, and certification aspects. ORF farmers had a more positive perception than conventional farmers. The results of the WAI reveal that CRF had a lower yield (0.63), risk-averse (0.70), and no cash compensation (0.62), whereas ORF had a higher price (0.82) and organic farming lifestyle (0.83). The ORF farmers also still have a strong positive belief in organic farming for the future, even though they lack organic fertilizer resources and certification. The strategies for adopting ORF are infrastructure improvement and community empowerment, compensation and incentive strategy, more intensive socialization, provision of assistance and training related to ORF, marketing facilitation, and subsidies on the prices and certification of organic rice.

Keywords: farmers' perception, motivation, constraints, organic rice farming, sustainable agriculture

1 Introduction

Rice (*Oryza sativa*) is a staple food with total world production of about 501.2 million tons (MT) annually for feeding the world population. In Asian countries, rice is the primary carbohydrate resource for nearly 2.4 billion people and is processed as food in various forms such as puffed rice, flour, noodle, cake, and other snack food. Asia produced 90% of the total world rice production, which is mostly consumed in the region [1]. Rice also plays an essential role in the international trade market, especially for Asian staple food consumption and stock of the nation. It is estimated that in 2018, the production of rice in Asia will increase 1.3% to 461 MT milled bases of rice with the amount of rice traded in the international market of about 9% of the total rice production [2,3]. Indonesia is the third-largest producer of paddy rice (*Oryza sativa*) in the world with a total production of 55.160 MT, followed by China, which produced 210.2 MT, and India produced 164.2 MT in 2020 [3]. In 2020, the total harvested area of rice in Indonesia was 10,786,814 ha, with an average yield of 5.11 ton ha^{-1} dry paddy [4]. Moreover, rice commodity becomes subsistence agriculture for 17.35 million Indonesian farmers' households. Most of them depend on rice farming as a source of income [4].

The green revolution becomes a promising Indonesian rice production strategy to reach self-sufficiency through the application of improved agricultural technology such as high-yield varieties (HYVs), intensive chemical fertilizer, pesticide, and mechanical labor. Genetic improvement

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directly impacts rice productivity and is indirectly related to poverty reduction prior to the lower food price. The use of HYVs to the yield achievement has a strong response to external input [5]. In Indonesia, the government supported the rapid campaign of this transformation in the form of pesticide subsidy, chemical use, and extension of the system of rice intensification [6]. The adverse effect of this system was that the intensification has negative externalities due to emerging pest resistance and environmental contamination [7,8]. Farmers' addiction to chemical pesticides and fertilizer causes excessive use in pursuit of a high yield, resulting in ecosystem degradation [9,10].

Due to those reasons, some Indonesian farmers have shifted their farming toward more sustainable farming. Conventional rice farming (CRF) practices have shifted toward the system of rice intensification [11]. The system still allows particular considered chemical inputs and imposes the integrated pest management system [12]. Many farmers start to be more environmental concern, awareness, and demand niche by finding alternative agricultural practices not only for short interest but also maintaining a prominence to the future generation. For those reasons, organic rice farming (ORF) becomes an alternative for the farmers not only hoping for additional value in accordance with market demand but also making an effort to find a way to mitigate emissions from the rice agriculture system. ORF sustainability will be conserved in the integrated dimension of Indonesian farmers' environmental concern, economic feasibility, and social acceptability [13]. This action aligns with the Indonesian national program, namely "Go Organic 2010" [14]. Moreover, providing food production has been transforming from production-oriented chains to consumer-oriented chains [15]. In this regard, global demand for healthy food, including organic rice, tends to increase, which becomes an opportunity for Indonesia to fulfill the organic rice export market [16–18].

Some previous studies show that the change from conventional to organic farming has resulted in better soil fertility, better selling prices and income, better and healthier rice, fewer pests and diseases, biodiversity conservation, and more efficient nonrenewable energy and land use [19–24]. The economic benefits gained are around Rp 12,300,000 (US$1,367) and Rp 14,400,000 (US $ 1,600) per hectare per season with a benefit/cost ratio of 4.5 and 6.0 for semi-organic and fully ORF, respectively. Besides, this system is socially accepted and encourages collective action among farmer group members [19].

The structure of the ORF system consists of four subsystems, namely the input subsystem, farming, processing and marketing, and the supporting subsystems [25]. Farmers will shift to the organic system when they have full support. However, the adoption of ORF tends to be a temporary governmental project. Even the move from conventional to organic farming has been a subject of contention, particularly in developing countries [26]. This made the conversion of conventional to ORF run relatively slow, and the program implemented to accelerate adoption frequently ends with switching back to the conventional rice system. They could not continue maintaining organic farming due to technical challenges and certification [27,28] as well as market constraints [29,30]. Some farmers argue that even though the yield of organic rice could be equal to that of conventional rice, it is lower in the conversion stage [31,32]. The first 2 years of conversion were a period of transition and failure, with lower yields [33]. Other studies elaborated the barrier of farmers to engage in organic farming, such as risk aversion [34,35], shortage of quality organic inputs [36], doubting the environmental benefits [37], marketing issues to assuring profitability [38], and policy issue [39].

Understanding the farmers' behavior due to particular agricultural adoption, including demographic characteristics and environmental perspective, is essential for the sustainability of agriculture [40]. The influencing factors of farmers in making a decision are based not only on profitability factors but also on ethnographic-socioeconomic drivers that frame farmers' perceptions [41]. Assessing those variables is expected to accelerate organic adoption due to the research gap. However, to our knowledge, there has been no research focusing on farmers' perceptions of specific ORF.

Therefore, this study is focused on investigating and understanding the farmers' perception of ORF, motivations, and constraints faced in adopting the ORF system, the level of awareness of organic farmers, and their belief in organic rice in the future. The hypotheses of this study are as follows: (i) ORF farmers had more positive perception than conventional farmers, (ii) factor which becomes the strong motivation on ORF was a higher price, and the main constraint was lower yield, and (iii) farmers still have a strong belief in a better future of ORF.

This study provides an insight into why the above-mentioned aspects should be understood in accelerating the adoption of ORF. By revealing the farmers' perceptions, constraints, and beliefs in organic rice agriculture in the future, the particular strategy could be applied. This study is presented in four subchapters: (1) demographic characteristics, (2) perceptions, (3) constraint and motivation, and (4) awareness, experiences, and beliefs.

2 Materials and methods

2.1 Study area

This study was conducted in the two biggest centers of organic rice in Tasikmalaya and Subang Regency, West Java Province, Indonesia, in 2019 (Figure 1). The location was selected purposively based on some main reasons. First, the province has some regencies in which ORF is developing well. Second, in the perspective of the market and consumers, organic rice is produced not only for the domestic market but also for the global market. Third, cultivating organic rice using some varieties depends on the suitability of land and climatology.

2.2 Sampling methods, population, and sample size determination

In West Java Province, farmers cultivate some local and national varieties. The survey focused on ORF in the two largest rice organic producing regencies with national varieties, introduction variety, and good market demands. This study employed a multistage sampling procedure as follows. First, purposive sampling was used to select the two regencies in the West Java Province due to the reasons described previously. Second, stratified sampling was employed to determine farmers who were doing ORF and CRF. Third, proportional simple random sampling was employed to select the respondent farmers based on the number of farmers in each regency according to those doing ORF as compared with those doing CRF.

The primary data were collected by interviewing two types of rice farmers doing organic and conventional rice cultivation. In each location, the selected group of farmers was determined randomly based on the data from the certification board. The number of respondents was determined based on the calculation of the total population of organic farmers in West Java. The estimated number of total organic farmers was 1,332 households, and the total number of conventional farmers was 2,318,323 farmers. From that number, the samples were taken based on the formula from Yamane [42]. The calculation was at least 93 samples of organic rice respondents, and conventional farmers were at least 100 respondents. Referring to the minimum number of respondents, the obtained questionnaires were 100 respondents from organic farmers and 103 from conventional farmers (Table 1). The secondary data were obtained from the

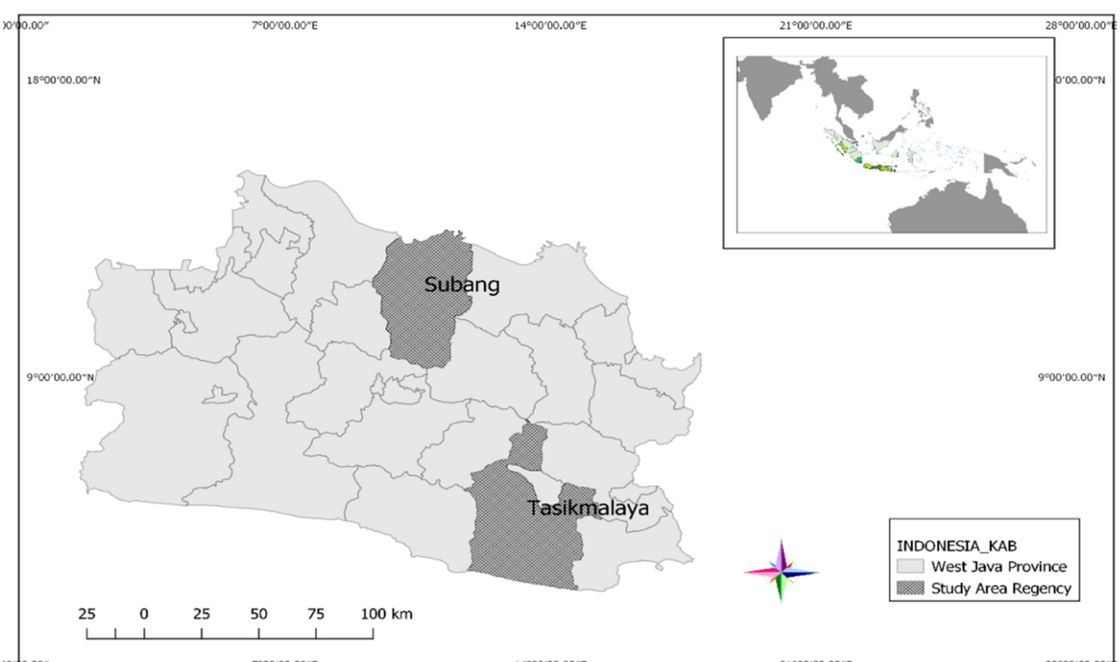

Figure 1: The study locations.

Table 1: Sampling design in the research sites

	Tasikmalaya	Subang	Total
Population of organic farmers	257	178	
Proportional samples of organic farmers	60	40	100
Population of conventional farmers	282,463	157,102	
Samples of conventional farmers	63	40	103
Total samples in each regency	123	80	
Total sample		203	

extension officer, local government, and the Ministry of Agriculture, which were selected and categorized based on their importance and urgency.

2.3 Methods of analysis

This study aims to describe the following aspects: explanation as mentioned in the result regarding (1) demographic characteristic, (2) perception, (3) constraints and motivation, (4) awareness, (5) experience, and (6) beliefs. Demographic characteristics consist of age, household size, farm size, membership of an organization, extension service, experience, education (formal and informal), rice farming income, and household income per month. Regarding perception, both organic and conventional rice farmers were given the questionnaire related to their perception of organic farming. The perception was categorized into production view, quality, market, environment, and certification. Farmers were asked about their agreement related to the details of perception. Perceptions can be used to check their perceived view on organic agriculture. The results were then compared between ORF and CRF and explained descriptively.

Regarding the motivation-constraint aspect, the organic farmers were asked about their reasons or motivations to adopt ORF, whereas CRF was asked about why they did not adopt organic farming. The motivation of the organic farmers was measured to know the primary reasons they adopted the ORF system. To obtain this information, we identified and listed the reasons that might become a strong motivation for the farmers to shift to organic farming. Then, we gave the farmers questions and asked them to give scores from 1 to 5 to gain the level of farmers' agreement motive and constraints, indicated in five points: (1) very disagree; (2) disagree, (3) neutral; (4) agree; and (5) very agree. Some of the reasons were health consideration, soil fertility, reducing cost, nonchemical input, biodiversity, premium price, quality food, and supporting governmental programs.

Regarding awareness, experience, and belief, organic farmers were asked about their awareness of the principle of the organic rice system. Referring to that method, the percentage was used to measure the level of awareness of organic and conventional rice farmers. The scale of 0, 1, or 2 was set to indicate farmers' awareness due to their knowledge that denotes no understanding, slight understanding, and complete understanding, respectively. Organic farmers were asked about the possible advantages or experiences of adopting the organic rice system, such as enhancing soil fertility, more biodiversity, nonchemical input, increased health, reduction cost, higher price, and assured market. The organic farmers were also questioned about their belief regarding ORF in the future, especially in Indonesia. The questions were such as the belief of ORF would be more popular, more profit, more consumers, general farmers will not adopt the organic system, better quality of organic rice, and environment-friendly.

The demographic characteristics of farmers' perception, awareness, experience, and belief were analyzed descriptively by percentage. *The weighted average index* (WAI) was applied to estimate farmers' motivation and constraints to adopting ORF [43]. The formula of WAI is as follows:

$$\text{WAI} = \sum \frac{S_i F_i}{N}$$

where F_i is the frequency of results to the i category of the statement, S_i is the scale value assigned at the I level of reasons or motivation, W_i is the weight of the i category of the statement, and N is the total number of respondents. To the degree of constraints and motivation, five scales were set with the following weights to measure the level of reason or motivation. The constraint index and motivation index were used to analyze how strong the reason given by farmers is. The index included five levels: very weak (0), weak (0.25), medium (0.5), strong (0.75), and very strong (1) of reasons or motivations. For comparing the demographic characteristic, the t-test statistical method was used by statistical software. The results indicate the significant difference of each variable with the probability level ($P < 0.1$). The *Chi-square* test was used to see differences in the distribution patterns of variables in both organic and conventional systems [44].

All methods and statistical analysis used to obtain the research objective are presented in Table 2. Methods were categorized based on a group of objectives.

Table 2: Summary of the method and statistical data analysis by objective

Categorical objectives	Statistical method
1. Demographic characteristic	Descriptive statistic and *t* test
2. Perception	Descriptive by giving a percentage
3. Motivation and constraint	WAI
4. Awareness, experience, and belief	Descriptive by giving a percentage

3 Results and discussion

3.1 Demographic characteristic

The characteristics of organic and conventional rice farmers are shown in Table 3. Statistical analysis of *t* test and chi-square test were used to test the significant difference between ORF mean and CRF mean on age, number of household members, farm area, participated member, experience, informal education, and income from rice farming. There were no different characteristics of the respondent on age, the number of member households, farm size, and farmers' experience between organic and conventional farmers. The average household head's age of ORF is 52.7 and 52.3 years old of CRF. The family size of the respondents was four persons, generally. The rice field sizes range is from 0.05 to 2.35 ha, and the mean of experience in rice farming is about 18 years.

The average education variable shows that the majority of the household heads' education background is junior high school. However, there were significant differences in terms of a participating family member in rice farming, several extensional services per season, formal education, informal education, rice farming income, and total household income. The number of family members who participated in organic farming is higher than those in conventional farming at 95%. Organic farmers visited the extension officer more frequently to consult at least twice per season. They used to participate in informal education such as a seminar, coaching program, and workshop to improve their farming and market. Similarly, with the formal education condition, CRF had a higher frequency of elementary education than ORF farmers. It means that ORF farmers were more educated than CRF farmers. Additionally, in ORF, farmers also obtained more income from rice farming at 90%. There is a significant difference between ORF and CRF for total income at a significant 99% level. ORF farmers had a higher household income than CRF. ORF household had a total income approximately in the range of US$ 104.74–139.65 per

Table 3: Demographic characteristics of organic (ORF) and conventional rice farmers (CRF)

No. (CRF)	Variables	ORF (*n* = 100)		CRF (*n* = 103)		Significance
		Mean	Std Dev	Mean	Std Dev	
1	Age (years)	52.7	10.1	52.3	9.9	ns
2	Household size	4.0	1.0	3.9	1.4	ns
3	Farm size (ha)	0.5	0.5	0.4	0.3	ns
4	Participated members	1.8	0.5	1.6	0.6	**
5	Extension service per season	2.0	1.1	1.0	0.9	***
6	Experience (years)	18.6	9.9	18.2	10.8	ns
7	Formal education[a]	1.9	0.9	1.6	0.8	**
8	Informal education	4.8	3.5	1.1	2.6	***
9	Rice farming Income ($) per month[b]	103.0	94.5	74.0	54.1	*
10	Household income per month[c]	3.9	1.2	2.6	1.2	***

Note: [a]formal education category, elementary school – 1, junior high school – 2, high school – 3, diploma – 4, and bachelor – 5.
[b]Dollar exchange rate, 1 US$ = Rp 14231.05 was based on international rate spot at the time of analyzing.
[c]Income category, 1 = <US$ 34.91, 2 = US$ 34.91– 69.82, 3 = US$ 69.82–104.74, 4 = US$ 104.74–139.65, 5 = 139.65–174.57, 6 = >US$ 174.57.
The variables were analyzed by *t* test, except the formal education and household income, which used the Chi-square test for seeing a more detailed distribution of education in both systems.
***, **, and * indicate statistical significant different at 1, 5 and 10% respectively. ns is nonsignificant.

month, while CRF had a total income of US$ 69.82–104.74 monthly. The total income of CRF's farmers was majority merely in US$ 34.91–69.82, whereas the ORF farmers had more income with a higher income frequency of >US$ 174.57. It might be because ORF needs more cash for the cost of farming.

The other important socioeconomic variables are the type of land ownership, membership of the farmer group, extension service, access to credit, and infrastructure availability. Table 4 indicates the different percentages of land tenure between ORF and CRF. In ORF, farmers generally had private rice fields (70%), but in CRF, the majority of the field was shared (44%). Farmers who owned private land had control over their rice fields. They can make a decision whether they would adopt ORF or CRF. Because shifting to the organic needs a conversion time, and if the farmer uses land sharing, it means that they need certainty from the landowner. One of the other variables was farmers' membership in the farmer group in ORF. It was higher than in CRF. Almost all ORF farmers were a member of a farmer group (99%), while CRF farmers were only 72%. The main general occupation was almost the same: Working as a farmer, even though the number of household heads who work as traders in ORF (8%) was higher than that in CRF (3%).

In addition, supporting facilities such as credit access and infrastructure facilities of ORF were higher than those of CRF system. However, farmers had limited credit access, which indicated that only 37% of ORF farmer households and 12% of CRF households had credit access. The main reason is farmers have a reluctance to submit loans due to their incapability to pay back the capital to the providers. Meanwhile, 88% of ORF farmers mentioned that they have supporting infrastructures such as a dam, an irrigation channel, and road access. In opposite, only 71% of CRF farmers have infrastructure availability. In terms of infrastructure availability, it is evident that there is a difference at a level of 99%. Such conditions will cause a difference in economic impact in both types of farmers.

Table 4: The percentage of farmers by land ownership, farmer group, extension, credit access, and infrastructure availability between organic (ORF) and conventional (CRF)

	ORF (n = 100)		CRF (n = 103)		*P*-value of Chi-square test
	Freq.	(%)	Freq.	(%)	
Land ownership					0.297 ns
Private	54	54	61	59	
Sharing	44	44	42	41	
Land's village	2	2	0	0	
Member of farmer group	95	95	79	77	0.007***
Occupation					0.011**
Farmer	66	66	81	78	
Labor	22	22	12	12	
Trader	3	3	8	8	
Other	9	9	2	2	
Extension access	91	91	78	76	0.048**
Credit access	37	37	12	12	0.000***
Infrastructure facilities	88	88	73	71	0.003***

Note: A Chi-square test was used for determining the distribution of variables between ORF and CRF.

3.2 Perception

All perceptions of farmers, both organic and conventional farmers, are shown in Table 5. In this study, the perceptions assessed include the following aspects: production, quality, health and safety, market and price, environment, and certification. Farmers' responses are divided into three categories: yes, no, and do not know.

3.2.1 Perception of production

Perception of farmers related to ORF difficulty was totally different between ORF farmers and CRF farmers at two regencies in West Java Province. In Tasikmalaya regency, only 38% of respondents of ORF and 60% of CRF claimed that ORF was difficult. It means that it is easy for ORF farmers to implement the system. In contrast, in Subang regency, 75% of the respondents of ORF and 80% of CRF farmers argued that it was difficult. It was based on the experience of organic farmers who shifted into organic, which is higher in Tasikmalaya than in Subang regency. The mean of experience both in Tasikmalaya and Subang regency are 8.8 ± 0.3 and 5.3 ± 0.2 years, respectively. Tasikmalaya's farmers initiated ORF almost one decade ago. They have been learning and working together under *Simpatik* farmer group association. Through the association, the farmers have exported their organic rice to some Asian, European, and Middle East countries [45]. On the other hand, CRF farmers claimed that organic farming was difficult, and the percentages of perception were 75 and 80%, respectively.

Table 5: Farmers' perception of the ORF and CRF on production, quality, and market price in Tasikmalaya and Subang Regency, 2019

Items (in percentage)	ORF						CRF					
	Tasikmalaya (n = 60)			Subang (n = 40)			Tasikmalaya (n = 63)			Subang (n = 40)		
	Y[a]	N[b]	D[c]	Y	N	D	Y	N	D	Y	N	D
A. Production												
ORF is completely difficult	38	62	0	75	25	0	60	11	29	80	0	20
Low input cost	55	42	3	85	15	0	38	30	32	12	55	33
Low yield	25	72	3	48	52	0	52	11	37	87	13	0
ORF needs more labor	95	3	2	90	7	3	67	6	27	88	2	10
B. Quality, health, and safety												
Better taste, flavor, and appearance	95	3	2	95	2	3	62	2	36	65	10	25
Safe from pesticide residue	92	3	5	97	3	0	60	4	36	80	5	15
Organic rice is better nutrient	80	5	15	78	2	20	59	2	39	10	8	82
Better health of organic farmers	85	2	13	98	3	0	51	3	46	60	8	32
C. Market and price												
Higher price	85	13	2	98	2	0	27	25	48	20	3	77
Having assured market	72	26	2	73	28	0	16	46	38	0	22	78
Profit is more fairly distributed	78	18	4	78	17	5	10	36	54	0	23	77
D. Environmentally perception												
Soil fertility is better	95	2	3	97	3	0	60	2	38	63	17	20
ORF is more efficient-water	93	2	5	98	2	0	55	10	35	45	15	40
ORF enhance biodiversity	78	15	7	98	2	0	59	2	39	42	8	50
ORF could reduce the emission	70	17	13	70	3	27	46	0	54	0	0	100
E. Certification												
Certification fee is costly	47	17	36	97	3	0	40	5	55	20	0	80
Complicated process	70	15	15	95	5	0	46	6	48	20	0	80
Easiness obtains the information	18	50	32	57	35	8	13	33	54	5	15	80

Note: ORF – Organic rice farming, CRF – Conventional rice farming, [a]Y – Yes, [b]N – No, [c]D – Do not know.

The input cost of ORF, especially fertilizer and pesticide used, was assumed to be low by the farmers of both regencies. This finding is in accordance with the perception of Turkey farmers who mentioned that organic agriculture was a useful low-cost innovation [46]. Meanwhile, CRF farmers had the perception that ORF has a higher cost. The yield of organic was not too low, assumed by the ORF farmers. In contrast with the conventional farmer's opinion, it will decrease the yield. But the essential finding is that for the labor used in organic farming, all farmers agreed that the organic system needs more labor than the conventional one because of more intensive farming.

3.2.2 Perception of quality, health, and safety

There is no different perception between two regencies in quality, health, and safety of organic farming, such as better taste, flavor, and appearance, safe from pesticide, better health of farmers, except on the perception of contained nutrients. It was caused by the difficulties of farmers in identifying organic products from conventional ones [47]. Generally, organic farmers' perception percentage had a higher value than conventional farmers. In Tasikmalaya, the range of ORF farmers' perception was 80–95%, and CRF farmers' perception was 51–62%. In Subang, the perception of ORF farmers was slightly similar, with a range of 78–98%. Meanwhile, the perception range was wide for the CRF farmers in that regency, 10–80%. Ten percent of ORF in Subang did not perceive that organic rice has better nutrients. This is different from other respondents who believed that organic products have a more nutrient-like *glycemic index* because organic rice uses a particular variety. It was due to the lack of conventional farmers' knowledge related to the quality of the organic product.

3.2.3 Market and price perception

The market perceptions between organic and conventional farmers on price, assured market, and fairly distributed market were definitely different. The percentage of organic farmers' perception was higher than the conventional. For example, 85% of ORF farmers in Tasikmalaya believed that organic rice product has a higher price than the other one. On the contrary, only 27% of CRF farmers perceived that organic products have a higher price. This pattern of perception is the same as other farmers' perception of assured market and profit. The different results were obtained in Subang regency. Organic farmers believed that there was an available assured market and equal profit between factors in the supply chain. It indicates the importance of the market and a fair profit for adopting rice farming. Farmers will adopt organic farming if it is supported by market demand and also lucrative profit.

3.2.4 Environmental perception

Most organic farmers positively perceived soil fertility, water efficiency, biodiversity, and reducing emission. It is in line with the previous study, which mentioned that semi-organic farmers have more positive perceptions than conventional ones related to the environmental facet [48]. This study also mentioned that environmental concern positively had affected farmers' attitudes and intention to adopt ORF. In terms of emission reduction, various studies reported the contribution of organic farming. The previous study evaluated the effects of organic and inorganic fertilizers on carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O) emissions. The findings revealed that chemical fertilizers caused a greater emission rate than organic fertilizers, and hence the use of organic fertilizers was strongly advised [49]. The conversion of organic farming might reduce energy use and greenhouse gas (GHG) emissions in Denmark. These reductions must also be examined in conjunction with other criteria for a sustainable future agricultural output [50]. Meanwhile, the previous research revealed that there is a 40% reduction in N_2O emissions in organic systems compared with nonorganic systems on a per-hectare basis [51]. Aside from *N* input, quality factors such as pH, soil organic carbon, and microbial biomass had a significant impact on N_2O emissions. This study demonstrated that organic farming techniques could be a realistic approach for reducing GHG emissions in the agriculture sector.

For the soil fertility and water efficiency, the percentage values of ORF farmers were more than 93%, whereas CRF farmers had only 45–63%. They had a more fertile soil perception due to shifting to organic farming. The soil structure and composition from additional organic matters created better soil fertility. Slightly dissimilar with the conventional farmers, they had a lower perception of soil fertility. In water-efficiency perception, CRF farmers that agreed to water more efficient in organic was approximately only half of the ORF farmers' perception. It means that conventional farmers considered no difference in water consumption between organic and conventional farming. Most of them used the intermittent water system and controlled water for their farming.

The organic farmers had a higher biodiversity perception (78%) than conventional farmers (59%) in Tasikmalaya regency and had the same result in Subang regency. They claimed that ORF had more biological diversity because of stopping pesticide application and using other inputs naturally. Finally, the perception of the emission was that only organic farmers had a high percentage that assumed the organic system could reduce the emission. On the opposite, conventional farmers had a small percentage, and they did not know whether ORF could reduce emissions or not. This finding is in line with previous studies that organic farming promotes soil fertility, preserves moisture, and has a substantial organism [52]. Therefore, organic farming is extremely crucial from the standpoint of agroecological and environmental health as well as a sustainable crop production system. Relative to conventional agriculture, organic farming is more efficient in its use of nonrenewable energy, maintains or improves soil quality, and has less of a detrimental on water quality and biodiversity [53]. On the other hand, the previous study uses life cycle assessments in particular have indicated that organic farming can often result in higher GHG emissions per unit product due to lower yields [54]. Organic farming reduces GHG emissions, but net emissions increase when increasing overseas land usage to compensate for domestic supply shortages. Enhanced soil carbon sequestration could only offset a small portion of the advanced foreign emissions.

3.2.5 Certification perception

The farmers' perceptions of the certification cost, the complexity of the certification process, and the easiness of information were significantly different between organic and conventional ones. The percentage of organic farmers' perception was higher than that of conventional farmers. The perception of the certification cost of the organic farmers in Tasikmalaya was lower (47%) than that in Subang (97%). This was due to the certification cost in Tasikmalaya being paid by the middle trader who bought their organic paddy, so they were not aware of the certification cost. In contrast, certification cost in Subang regency was imposed together by farmers' community, so they generally could determine that certification cost was expensive. Similar to the certification process, the one who submitted for certification was the middle trader, and farmers only conducted farming in Tasikmalaya. In Subang, organic farmers knew how to proceed with the certification. So, the percentage value of perception in Tasikmalaya was less than that of Subang's farmers. For the information needed, generally, they still had a difficult perception to gain knowledge related to how to obtain a certificate for ORF.

3.3 Constraints and motivation

The main constraints were coming from conventional rice farmers. Meanwhile, the motivations were merely asked from the organic rice farmers. The results were analyzed by WAI and categorized into the level of constraints and motivation. From those variables, a depiction state could be obtained for accelerating the conversion from conventional to organic rice systems.

The main constraints of organic conversion in West Java Province, which were the strong result of WAI, were low yield, reluctance to take a risk, and unavailable compensation cash support (Table 6). At the same time, the other medium barriers were low level of knowledge, unsuitable topographic and climatic conditions, lack of organic fertilizer, pest control difficulty, buyers, labor, fragmented land, land tenure, infrastructure, and complexity of certification.

The main constraints faced by conventional rice farmers were different between CRF farmers in Tasikmalaya and Subang regency. The barriers to converse into ORF in Tasikmalaya regency were only two out of five categories found level constraints, namely weak and medium barriers. There were no very strong, strong, and very weak constraints. The medium constraints consisted of control pest difficulty, lower yield, reluctance to take the risk, lack of market demand, limited labor, land tenure, lack of infrastructure, cash compensation, and complexity of certification. Meanwhile, the remaining constraints such as knowledge, topographic and climatic condition, organic fertilizer availability, and fragmented land were categorized into weak barriers. Related to the lack of market demand, access to markets is crucial for the sustainability of ORF. Without adequate market access and price incentives, farmers will switch back to conventional/semi-organic farming systems [29]. In other words, the adoption of ORF will continue if it is economically feasible to increase productivity and income as well as raise a social attribute. In this matter, the development strategy should be focused on finding a broader target market, both segment and market objectives [55]. The marketing aspect is essential to be taken into account because farmers encounter difficulty in marketing their products. It is also suggested that development strategies strengthen farmer group institutions, especially in searching for a broader target market.

Table 6: The farmer's constraints of conversion to organic rice farming (ORF) system in West Java Province (n = 103)

Barriers	The frequency of constraints level					WAI index					Total	WAI	Category*
	1	2	3	4	5	0	0.25	0.5	0.8	1			
1. No knowledge of ORF	20	13	23	27	20	0	3.3	11.5	20	20	55	0.53	M
2. Unsuitable climate	18	26	28	24	7	0	6.5	14.0	18	7	46	0.44	M
3. No organic fertilizers	19	19	37	17	11	0	4.8	18.5	13	11	47	0.46	M
4. Difficult to control pest	18	13	19	19	34	0	3.3	9.5	14	34	61	0.59	M
5. Low yield	13	24	7	13	46	0	6.0	3.5	10	46	65	0.63	S
6. Reluctant to take risk	15	17	5	4	62	0	4.3	2.5	3	62	71	0.70	S
7. No buyer or market	13	22	23	10	35	0	5.5	11.5	8	35	59	0.58	M
8. Lack of labor	34	17	20	12	20	0	4.3	10.0	9	20	43	0.42	M
9. Fragmented land	47	19	12	9	16	0	4.8	6.0	7	16	34	0.33	VW
10. Land tenure	33	7	15	20	28	0	1.8	7.5	15	28	53	0.51	M
11. Lack of infrastructure	28	15	28	12	20	0	3.8	14.0	9	20	47	0.45	M
12. No initial cash support	28	4	8	17	46	0	1.0	4.0	13	46	62	0.62	S
13. Certification	25	17	12	9	40	0	4.3	6.0	7	40	57	0.55	M

Note: *For constraint's level category, the fonts are to represent qualitative value, namely Very Strong (VS) = 0.8–1, Strong (S) = 0.6–0.79, Medium (M) = 0.4–0.59, Weak (W) = 0.2–0.39, and Very Weak (VW) = <0.2 from the value of WAI.

In Subang regency, conventional farmers still assumed that the control pest was difficult to handle, the yield was low, and it was risky. This result is in line with the previous study that organic agriculture still had low productivity due to particular factors, such as knowledge, insufficient input supply, lack of technique, labor shortage, and infrastructure support [56,57]. The yield constraint needs to be solved by formulating the standard operational procedure of conducting organic rice agriculture, especially the standard of the input recommended to farmers. The knowledge of farmers regarding organic agriculture is essential to be improved. The lack of knowledge, market demand, and certification could be eliminated by giving them a workshop and providing information. To solve other barriers such as landform and tenure need extra government support. The remaining medium constraints were mostly the same as the constraint in Tasikmalaya regency.

In West Java Province, farmers had two very strong motivations and had six strong motivations (Table 7). The very strong motivations were higher price motive and organic lifestyle motive. Whereas the strong motivation was to reduce input cost, aspiring healthy family, soil fertility improvement, following the government's program, improving biological diversity, and assured market. The essential reason they were converting to ORF was that they wanted not only to obtain a higher price and finally gain higher profit but also to provide healthy food for their family, indicated by a high WAI score in the organic farming lifestyle.

Generally, farmers were motivated to obtain a higher price for shifting to ORF. They also made an effort to decrease their cost for fertilizer resources by utilizing manure, incorporated by organic matters, and traditional market waste for improving soil fertility and biological diversity. Moreover, organic farmers in this region had the assured market to buy their product during the harvesting season at a higher price. Due to the experience of almost one decade, they used to practice organic farming as a lifestyle for their healthy family. Only two variables, i.e., following government programs and hoping for additional income, were obtained as medium motivation. In this region, the local government encouraged farmers to adopt ORF by giving support through extensional service and other informal education.

Farmers also aspired to a higher income by practicing intercropping system on their rice field using the long bean, taro, mung bean, and other vegetables, albeit not conducting the rotational cropping system. Farmer did not consider the rotation system because they thought that there would be unpredictable climate conditions, especially water availability and lack of supporting facilities. We found a weak motivation due to the difficulty of obtaining inorganic fertilizer. It can be said that it was accessible to find organic fertilizers, although it was not a strong reason to hold an organic system.

Farmers in Subang regency had stronger motivation than those in Tasikmalaya regency. Variables analyzed had become a very strong motivation for farmers in Subang regency to practice ORF, except assured market

Table 7: Farmers' motivations to shift to organic rice farming (ORF) in West Java Province

Motivations	West Province ORF (n = 100)										Total	WAI	Category*
	Frequency					WAI index							
	1	2	3	4	5	0.0	0.3	0.5	0.8	1.0			
Higher price	0	5	13	32	50	0.0	1.3	6.5	24.0	50.0	81.8	0.82	VS
Reduce the input cost	9	5	26	19	41	0.0	1.3	13.0	14.3	41.0	69.5	0.70	S
Healthy family and labor	6	6	10	24	54	0.0	1.5	5.0	18.0	54.0	78.5	0.79	S
Soil fertility improvement	3	5	18	24	50	0.0	1.3	9.0	18.0	50.0	78.3	0.78	S
Difficulty inorganic fertilizer	57	16	18	5	4	0.0	4.0	9.0	3.8	4.0	20.8	0.21	W
Available of organic inputs	11	8	40	24	17	0.0	2.0	20.0	18.0	17.0	57.0	0.57	M
Following government	8	11	29	28	24	0.0	2.8	14.5	21.0	24.0	62.3	0.62	S
Biological diversity	8	12	17	23	40	0.0	3.0	8.5	17.3	40.0	68.8	0.69	S
Assured market	13	5	20	33	29	0.0	1.3	10.0	24.8	29.0	65.0	0.65	S
Additional income	44	16	16	6	18	0.0	4.0	8.0	4.5	18.0	34.5	0.35	W
Organic farming lifestyle	3	7	5	24	61	0.0	1.8	2.5	18.0	61.0	83.3	0.83	VS

Note: *For motivation's level category, the fonts are to represent qualitative value, namely Very Strong (VS) = 0.8–1, Strong (S) = 0.6–0.79, Medium (M) = 0.4–0.59, Weak (W) = 0.2–0.39, and Very Weak (VW) = <0.2 from the value of WAI.

(medium motivation) and additional income (weak motivation). In Subang regency, all organic farmers were a member of the community that produced organic fertilizer, managed green manure availability, fermented organic juice from fruit waste even isolated beneficial microorganisms by their selves. Hence, farmers argued that the price, input cost, healthy, soil fertility, and lifestyle were very strong reasons to adopt the organic rice system. On the opposite, additional income was a very weak reason. It might be due to no rotational and intercropping system they applied.

3.4 Awareness

Based on Table 8, most farmers had two dominant levels of understanding of organic agricultural practices, namely slightly and completely. In spite of knowing several variables, they did not apply them practically. For example, they understand that crop rotation and intercropping have a beneficial advantage to their farming. Adversely, they did not adopt it due to a particular reason. Generally, some organic farming practices have been acknowledged by farmers. Such practices prohibit synthetic herbicide, fungicide, insecticide; chemical fertilizer is forbidden; water should be contaminated, and bio-filter is used to remove chemically polluted water. Most farmers (more than 80%) stated that they have entirely understood these practices. However, some farmers had some knowledge of organic agricultural practices but did not know how to perform for growing certified organic commodities [57,58].

Some respondents answered "none" to the knowledge of practices related to the following issues: prohibition of genetic modified organism (GMO) seed, natural fertilizer resource, self-claim certification, and certification providers. In the organic system, the seed must be produced not only from the origin of the seed parent that is obviously organic but also from the way it was produced organically through organic agricultural practices. Generally, the seed was obtained from the group of farmers and provided to their members. Therefore, not all farmers understood whether the GMO seed was allowed or not. Some GMO rice varieties have been innovating in Indonesia's research scale, even though they have not been released yet for public farmers [59]. This can be used for growing critical awareness of farmers preventing GMO seeds in organic farming.

Genetic engineering is prohibited in organic products. It means that an organic farmer cannot plant GMO seeds [60]. The previous study in Western Australia stated that organic farmers lost their organic certification because of GMO contamination. A total of 325 hectares of their 478-hectare farm were contaminated with genetic Modified canola blown from a neighboring property, resulting in the decertification of most of the farm [61]. Similarly, farmers had less percentage of understanding

Table 8: The percentage of the understanding level of organic rice farmers to the organic agricultural practices in West Java Province

	Organic agricultural system practices	Percentage of understanding		
		None	Slightly	Completely
1	Crop rotation with legume will increase soil fertility	3	54	43
2	Intercropping system for controlling the pest and disease	5	45	50
3	GMO seed is not allowed to organic farming	30	33	37
4	Synthetics herbicide, fungicide, insecticide are not allowed	0	5	95
5	Pest management using mechanic, bio-pesticide, and predator	1	24	75
6	Chemical fertilizers are forbidden	0	3	97
7	Application of crop residue	1	14	85
8	Bio-charcoal, natural phosphate, and Bordeaux are allowed	18	47	35
9	Organic system concern about water efficiency	3	35	62
10	Water must not be contaminated chemical from conventional	0	19	81
11	Water from the main source can be filtered using bio-filter	0	12	88
12	Harvesting organic product must be avoided from conventional	0	21	79
13	Concerning physical, biological, and chemical hazard	2	29	69
14	Related to fairness, profit and labor wage were fairer	7	71	22
15	The conversion period limit is at least 3 years	2	40	58
16	Uncertified self-claim farming is prohibited using an organic logo	15	32	53
17	Certification bodies providing organic certification	18	57	25
18	Reinspection is essential for organic credibility	4	34	62

on the natural resource of fertilizer such as bio-charcoal, natural phosphate, guano and other natural sources of phosphates, and Bordeaux using. Farmers only utilized all organic matters as fertilizers from nearby their farms. Moreover, approximately 15% of farmers did not understand uncertified self-claim farming that prohibited using the organic logo and lacked information about the certification body.

3.5 Experiences

Organic farmers' experience was comprised of experience on production, market, price and partnership, institution, and environmental issues. All of the experiences can be seen from Table 9. First, on the production experience, it was found that 75% of farmers claimed that they encountered difficulty in buying organic seed. Hence, the farmer group bred the seed for their community member and bought their commencing varieties from the Indonesian Center for Rice Institute, Ministry of Agriculture. In other production experiences, most farmers did not change their cropping models, such as rotation and intercropping. General farmers argued that ORF needs more high organic fertilizer voluminous quantity input. They stated that pest control experience was easy to manage due to the farmers' tradition of controlling pests using biopesticide such as neem (*Azadiracta indica* leaves extracts) and refugee plants. Moreover, since the average land size is 0.5 ha, organic farmers were able to pull out the weed manually. These results are in contrast to other research finding that organic agriculture had changed the cropping system, which improves farmers' food security, and had a major production experience on control difficulty [62,63].

The second categorized experience was price, market, and contract partnership. Eighty-five percent of farmers had an experience that the price of paddy was high. It can be said that only 15% of farmers were not satisfied with the current price. It was confirmed that 65% of organic farmers had experience in improving market access, 70% of them had experience with the assured market, and 73% of farmers agreed that contract partnership has a positive advantage to the profit due to the contract market. However, for the profit fairness, only 61% of people stated that the profit was already fairly distributed between drivers, and almost a fifth of organic respondents had not sure answered to the fairness. In other words, they still had dissatisfaction about profit fairness. This finding aligns with the previous study that

Table 9: The experience of organic farmers adopting the organic rice farming (ORF) in West Java Province

Experiences	Percentage		
	Yes	No	Not sure
Production			
The seed was easy to be bought	18	75	7
After adopting, the cropping pattern had changed	35	62	3
ORF had low input of organic fertilizer	29	70	1
Pest and weed control were easy to be managed	64	27	9
Market, price, and partnership			
Price of organic rice was low	14	85	1
Improving market access	65	30	5
Assurance market of rice produced	70	25	5
Contract partnership had a positive advantage to profit	73	18	9
Profit fairer between producer, medium trader, and seller	61	20	19
Institutional issues			
Looking for credit was very difficult	42	29	29
Getting extensional help and service from the government	88	9	3
Infrastructure facilities	80	12	8
Environmental issues			
After shifting, the rice field had more ecological biodiversity	94	3	3
The soil was more fertile	94	3	3
Water was more efficient	93	2	5
Soil structure was better	95	1	4
Holding water capacity of the soil was better	90	4	6

farmers who joined in contract farming had the better-received price [64]. On the other hand, this result is in contrast to a previous study that stated that joining in conventional farming was not sufficient for improving farmers' income [65].

The third group of experience was related to institutional issues such as credit access, extensional services, and infrastructure facilities. No more than half of the respondents said that the capital credit was arduous access. On the contrary, almost a third of organic farmers had good access and had doubts about gaining capital from providers. From more confirmation to the respondents, it was found that they were worried whether they could return the loan back or not. In the other experiences, the majority of the organic rice farmers had fundamental government support in the form of extensional programs (88%) and infrastructure facilities (80%). In the last category, a critical finding of environmental concerns, organic farmers conceded that ORF has more ecological biodiversity, such as an increasing number of herons, eels, worms, bugs, and predators on their rice fields. Additionally, the soil becomes more fertile, has efficient water, and has better soil structure and water holding capacity.

3.6 Beliefs

The most remarkable result of beliefs in ORF was a significantly different percentage between organic and conventional farmers. It can be seen from Figure 2 that in most cases, the percentage of the "belief" aspect of ORF is generally higher than CRF, except for the question of whether the general farmer would convert to organic farming and its popularity. Due to their experience in practicing the organic system, ORF had a higher belief in the organic system in the future. The ORF farmers had a belief that the market and price of organic products would increase. The previous study by ref. [66] showed that the organic farming system is profitable compared to the conventional one. The majority of organic farmers believed it was suitable for small farmers to increase their profit with limited land and vice versa. Unfortunately, there was a different belief on better yield in the future. Organic farmers had an optimistic belief in the improvement that the yield of rice will be better in the future, but the conventional did not have it. The certification process, environmental concern, and government support had the same belief pattern. They will be better in the future.

On the other hand, both farmers had a pessimistic belief that it would not be popular in the future. For the converting variables, the discrepancy between organic and conventional was possibly erroneous since ORF farmers believed that general farmers would not convert to an organic system, while conventional farmers even believed that general farmers would do. It seems like organic farmers had distrusted beliefs, and conventional farmers had an optimistic belief. This finding result of belief was in line with previous research that farmers had a positive belief toward organic farming [67].

The P value of the t test between the percentage of ORF and CRF farmers' belief was 0.039, with means of percentages being 75 ± 22.9 in ORF and 51.25 ± 25.4 in CRF.

4 Conclusion and implications

Based on the hypothesis, this study concludes that there were different perceptions between ORF and CRF farmers on production, quality, health and safety, price and

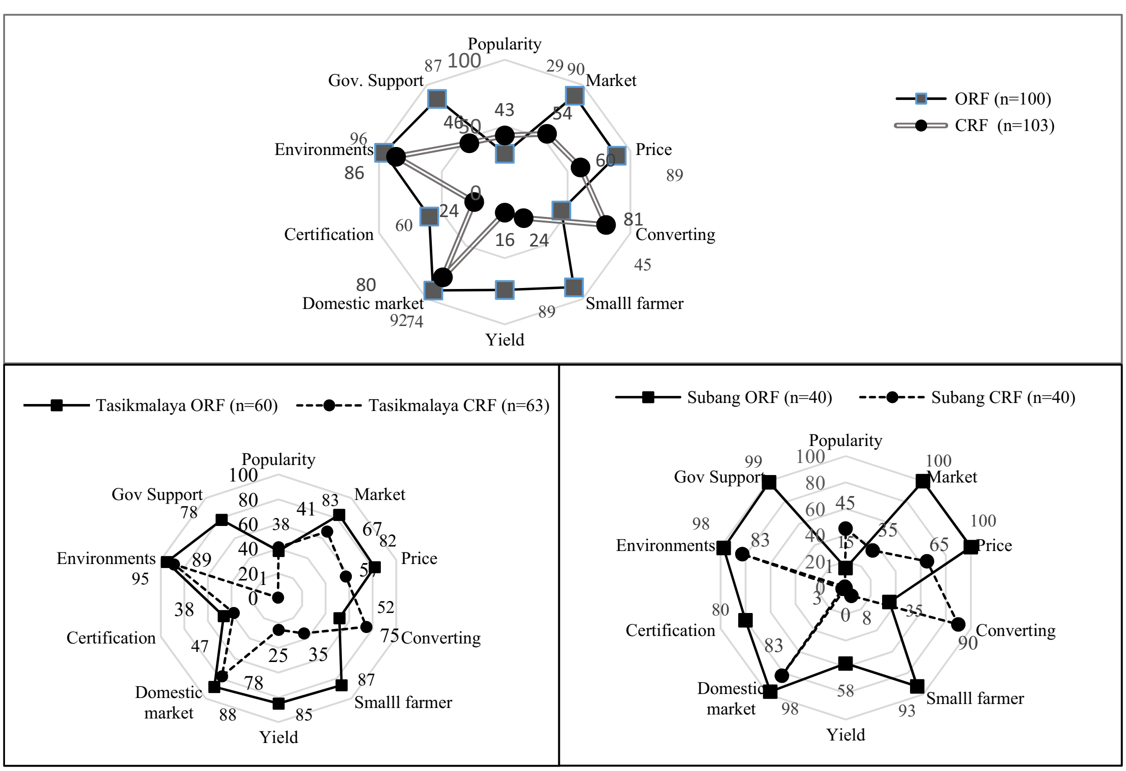

Figure 2: Farmers' beliefs about organic (ORF) and conventional rice farming (CRF) in the future.

market, environmental concern, and certification aspect. Moreover, ORF farmers had more positive perceptions than conventional farmers. The main constraints of ORF farmers were a lower yield (0.63), risk-worries (0.70), and no cash compensation (0.62). From the WAI, ORF farmers have a very strong motivation for a higher price (0.82) and their lifestyle (0.83). Most farmers had a slight and complete understanding and only four variables which still had no understanding, i.e., prohibition of GMO seed, natural fertilizer resource, self-claim certification, and certification providers.

The ORF farmers experienced getting seed difficulty and an unchanged cropping pattern but had a positive experience with institutional issues and environmental concerns. ORF farmers strongly believed in a better future of ORF than conventional farming. Farmers in the research location still had a gap between ORF and CRF about limited understanding of the organic agricultural practice and had many constraints on it.

This study gives some policy recommendations. *First*, farmers' knowledge must be increased by improving infrastructure facilities and empowering the community based on increasing knowledge understanding about organic agricultural practices. Farmers should focus on the awareness of the plant's critical stage and give sufficient nutrients in accordance with plants' growth stages, especially nitrogen deficiency from the natural fertilizer. *Second*, the compensation and incentive strategy could attract farmers' interest due to risk in the shifting period. *Third*, the government should do more intensive socialization and provide assistance and training related to ORF. *Finally*, the government should provide facilitation on the marketing and subsidies on the prices and certification of organic rice to accelerate the adoption of organic farming.

This study was only done in two regencies (i.e., Subang and Tasikmalaya) in West Java Province in Indonesia. Therefore, extending the research area to other regions and outside Indonesia to provide a more global scale conclusion is an excellent opportunity for future research.

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