Financial feasibility of developing early-stage organic rice farming: A case study in Tasikmalaya of Indonesia

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Abstract. Intensive rice farming using inorganic fertilisers creates the problem of soil fertility degradation and further impacts decreasing rice productivity. Alternative technologies are needed to increase production while maintaining the sustainability of agricultural resources through organic rice farming. This study aims to 1) analyse the financial feasibility of organic rice farming, 2) identify the constraints in developing organic rice farming, and 3) formulate an alternative policy to develop organic rice farming in Tasikmalaya, Indonesia. The primary data were collected from 30 organic rice farmers. Traditional rice farmer's groups were also interviewed for comparison. The financial feasibility was analysed using cost and benefit analysis. The results showed that organic rice in Tasikmalaya is financially profitable, with the R/C ratios ranging from 1.14 to 1.45. However, the profit is still much lower than traditional rice farming. The main constraint to increasing organic rice profit is that the price of organic rice grain is not different from traditional rice since marketing institutions have not yet been established. To increase the profit of organic rice farming, the government should encourage farmers to keep growing organic rice, accompanied by technical guidance and establishment of organic rice processing and marketing institutions.

1 Introduction

Consumers increasingly accept organic rice as a healthy food, so the demand and production of organic rice are increasing [1,2]. Of all other organic products, organic rice ranks second in consumer demand after organic vegetables [3]. The area of organic rice increased substantively from 144 hectares in 2007 to 2971 hectares in 2010. The 2010 Go Organic

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program launched by the government significantly increased organic rice farming. However, the growth of organic rice has not been steady. Organic rice area fluctuated and decreased until 2016 but increased very sharply in 2017, reaching 53,974 hectares in 2018, or about 21.45% of the total area of organic agriculture in Indonesia [3]. Organic rice shows positive development and contributes to national organic agriculture in Indonesia. Consuming safe foods to ensure health is an increasing necessity and has become a new trend [4].

Tasikmalaya is famous as the centre of organic rice production in West Java, Indonesia. Organic rice farming has been developed since 2004. With market support and local government policies, the development of the organic rice farming system has become more massive [5]. Organic rice from Tasikmalaya has been marketed inter-island and exported to several countries [6]. The development of organic rice in Tasikmalaya continues to be expanded to several regions [7]. Organic rice development is a response to the intensive use of chemical fertilisers in traditional rice farming that causes land degradation [8,9].

Several studies stated that organic farming provides more significant benefits than traditional rice farming [10-12]. Organic agriculture will reduce input costs, especially inorganic fertilisers and pesticides, and naturally improve soil health and fertility. From the consumer side, organic products will be healthier, so consumers are willing to pay higher prices [13-16]. Thus, two benefits organic farmers obtain are higher productivity and the price of products.

However, the cultivation performance of organic rice in the early stages is different from traditional rice farming, including the product market. The early stage of organic rice farming means the initial stage of developing organic cultivation in new areas. In such conditions, farmers still do not understand the GAP of organic rice cultivation. They are not accustomed to producing organic fertiliser for their farming. At the same time, the government has not been able to support all the needed organic inputs and infrastructure [17]. This condition differs from traditional rice farming, where chemical fertilisers are more available in the villages. Shifting from conventional to organic rice requires strenuous efforts [18]. At the beginning stage of organic production, productivity decreases compared to traditional rice [19-22].

Consequently, during the transitional period, small-scale farmers typically employ organic rice products only for subsistence. This condition led to the debate that low productivity in organic rice cultivation will exacerbate food security challenges [23,24]. With all its benefits, the transition process to the established organic farming stage is long-term and gradual. It requires more time to achieve a new balance, namely a purely organic farming system [25]. Therefore, developing organic rice at an early stage requires a model that combines various factors and scenarios, such as technology for efficient resource use, resistance to climate change, and waste reduction [26]. There is also a need for a support system that has not been created, so organic farmers in the early stages of development still face various obstacles [27−30].

Many studies on organic rice farming have been conducted in established organic rice farming [11,12,31−33]. However, research examining the performance of early stages of organic rice farming, especially about financial feasibility and challenges, has not been widely done. To encourage farmers to adopt organic rice farming, they need information on whether the technology will provide economic benefits. Information related to the cost-benefit structure of organic rice production has important implications for developing organic rice farming [4]. Comparing the financial feasibility of organic rice farming in the early stages of development with traditional rice farming can produce useful information for future organic rice development strategies. This research will answer this issue.

The study's objectives are 1) to analyse the financial feasibility of early-stage organic rice farming, 2) to identify the constraints of early-stage organic rice farming, and 3) to formulate alternative strategies to enhance organic rice farming development in Tasikmalaya, Indonesia.

2 Methodology

The research was conducted in the Cipatujah Sub-district of Tasikmalaya District, the new organic rice farming development area, as part of the Upland Agricultural Development program by the Ministry of Agriculture. The organic rice development program in the region began in 2021. The study was conducted from October to December 2022. Primary data was collected through a focus group discussion with 30 farmers who practised organic rice farming. In-depth interviews were also conducted with traditional rice farmers groups, traders, organic rice millers, and key informants from relevant regional and provincial agencies.

The data were analysed descriptively and quantitatively. This study used the Cost Benefit Analysis approach to calculate the cost, revenue, and financial feasibility of organic rice farming in the early stages of development compared to existing traditional rice farming in the research area. The same method was also used by Dat et al. [4] to analyse the benefits and costs of organic and traditional rice production in the Mekong River Delta, [34] in Buthan, and [35] for rice production and rice seeds in Thailand.

The total cost, revenue, and feasibility are described and formulated as follows [36,37]. Total revenue (TR) is farmers' total benefit from rice sales per season. The formula determines it:

$$TR_T = P_T.Q_T \quad (1)$$

where TR_T is total gross revenue (IDR/ha/season) represents the benefit of rice produced by technology T (T = 0 for traditional rice farming; T = 1 for organic rice farming); P_T is price at farmer level with technology (IDR/kg); Q_T is productivity with technology T (kg/ha/season).

The formula determines the total cost of rice production (TCT):`

$$TC_T = TVC_T + TFC \quad (2)$$

where TC_T is the total cost to produce rice (IDR/ha/season)

$$TVC_T = \sum_n^i P_{Xi} X_{iT} \quad (3)$$

where TVC_T: total variable cost (IDR/ha/season) for rice grown by technology T; P_{Xi}: price of input i^{th} (IDR/unit); X_{iT}: quantity of input i^{th} (unit/ha/season) using technology T.

Fixed costs (TFC) are costs that must be incurred by farmers, not depending on the amount of production. The net profit (NP_T) of rice production is calculated as follows:

$$NP_T = TR_T - TC_T \quad (4)$$

The revenue cost ratio (R/C) is the ratio of total revenue TR_T to total cost TC_T and shows the financial feasibility of farming, formulated as follows.

$$R/C = TR_T/TC_T \quad (5)$$

Farming cost was calculated based on the total cost by considering unpaid inputs, including family worker.

3 Results and discussion

3.1 Brief picture of early-stage organic rice farming development in Cipatujah Sub-district of Tasikmalaya District

The Cipatujah Sub-district includes four villages, Bantarkalong, Darawati, Padawaras, and Kertasari, with a total rice field estimated at 840 ha. The organic rice development program is 500 hectares. Of the 500 ha of paddy fields developed by organic rice, only 124 ha (24.80%) have received an organic certificate from PT Sucofindo in 2021, while the remaining 376 ha (75.20%) have not received an organic certificate.

In organic rice cultivation, the availability of organic fertiliser is a factor that significantly determines productivity [43]. However, the availability of organic fertilisers is still inadequate, and it isn't easy to find shops that sell organic fertilisers, both solid and liquid. Few farmers have the skills or desire to make their organic fertiliser using local ingredients. Their understanding of organic rice cultivation is still limited. There is an organic fertiliser processing unit, a compost house to store organic fertiliser, straw choppers, livestock, and sheds. All of them are government assistance for developing organic fertilisers in the region. With this assistance, farmers are expected to understand how to make their organic fertiliser by utilising local raw materials (straw and manure) so that they will no longer depend on organic fertiliser assistance from the government. In addition, farmers are also trained to make organic pesticides using local plant materials. The government provides a mini-laboratory to evaluate the efficacy of farmers' organic fertilisers and insecticides. However, farmers' organic fertilisers cannot be marketed since they have not obtained organic certification, so their use is still limited.

Almost all organic farmers interviewed are subsistence rice farmers, not market-oriented. Despite the price of organic rice being no different from traditional rice, they are committed to growing it with consideration of (a) low-cost production since chemical fertilisers and pesticides are increasingly expensive and (b) organic rice is tastier and healthier.

3.2 Financial feasibility of organic rice farming and traditional rice farming

The result of the financial analysis showed that organic rice farming in the study area is financially profitable. This analysis does not consider land rent since there is no land renting in the study area. Productivity and net income from organic rice farming in the dry season of 2022 are lower than in the rainy season of 2021/2022 due to the very significant impact of climate change. It continued to rain excessively in the dry season, and several irrigation canals were damaged. Crops are damaged, decreasing productivity from an average of 5,236 kg/ha in the rainy season to an average of 2,756 kg/ha in the dry season (Table 1).

Organic rice farming earned a net income of around IDR 5.7 million/hectare in the rainy season and IDR 1.7 million/hectare in the dry season, with R/C ratios of 1.45 and 1.14, respectively. For every IDR 1.00 million/hectare spent by farmers for organic rice farming, they get a return of IDR 1.45 million in the rainy season and IDR 1,14 million in the dry season. In other words, farmers' profits are 45% and 14% of the costs incurred each season, respectively. Thus, organic rice farming in the study area is feasible.

The breakeven point of production, another indicator of farming feasibility, shows that organic rice farming is also feasible. The results showed that the breakeven point of production was 3.62 tons/ha in the rainy season and 2.43 tons/ha in the 2022 dry season, respectively. Meanwhile, the actual yield achieved by farmers averaged 5.24 tons/ha in the rainy season and 2.76 tons/ha in the dry season. Productivity in the rainy season was significantly higher, with its production breakeven point at 44.8%. Meanwhile, productivity in the dry season was only 13.4% above its breakeven point.

The price breakeven point of organic rice was IDR 2,418/kg in the rainy season and IDR 4,594/kg in the dry season. The average prices farmers receive were IDR 3,500/kg in the rainy season and IDR 5,217 in the dry season. Thus, the actual price received by organic rice farmers is 44.7% above its breakeven point in the rainy season and 13.6% above its breakeven point in the dry season. In light of this, the production and price breakeven points support the financial feasibility of organic rice farming. The cost and income structure of rice farming, excluding land lease costs, are presented in Table 1.

Table 1. Cost structure and income of rice farming in Tasikmalaya, 2021-2022.

Indicator	Organic rice farming		Traditional rice farming	
	Rainy season 2021/2022	Dry season 2022	Rainy season 2021/2022	Dry season 2022
Yield (kg/ha)	5.236	2.756	6.375	3.145
Sale price (IDR/kg)	3,500	5,217	4,500	5,500
Total revenue (IDR/ha)	18,326,000	14,378,524	28,687,500	17,297,500
Total cost (IDR/ha)	12,661,406	12,661,406	13,491,456	13,491,456
Net profit (IDR/ha)	5,664,594	1,717,118	15,196,044	3,806,044
R/C ratio	1.45	1.14	2.13	1.28
BEP of production (kg/ha)	3,618	2,427	2,998	2,453
BEP of price (IDR/kg)	2,418	4,594	2,116	4,290

Comparing organic and traditional rice farming shows that the income of organic rice farming is lower than that of conventional rice, both in the 2021/2022 rainy season and the 2022 dry season. This result aligns with previous research [11,20]. The productivity of organic rice is around 81-87% of the conventional rice. Organic rice's material inputs (fertilisers, pesticides, etc.) are lower than that of traditional rice farming, but the labour cost is higher. The lower cost of fertilisers and pesticides could not compensate for the decrease in productivity of organic rice compared to traditional rice. The difference in productivity significantly affects the lower net income of organic rice farming.

In organic rice farming, maintenance and other activities are more intensive, while in traditional rice farming, chemical fertilisers and pesticides lead to higher productivity [5]. In the early stages, organic rice productivity is lower than traditional rice farming [21,22,44,45]. Land productivity will decrease without chemical fertilisers, while the positive impact of organic fertilisers (as a substitute for chemical fertilisers) is slow. However, in the long term, the accumulation of organic content will sustainably increase soil fertility. This impact differs from chemical fertilisers, which cause soil degradation and pollute the environment [2,43]. Organic fertilisers provide relatively low macroelements but contain many micronutrients essential for plants. Therefore, organic farming is one of the ecological-conservative farms that are environmentally friendly, can sustainably maintain soil fertility, and improve the natural health of the environment [43,46,47].

The price of organic rice, which is usually higher than traditional rice, will incentivise farmers to continue cultivating organic rice. However, the organic rice market at the study site has not been developed, so organic rice prices were the same as traditional rice. At the early stage, the lower organic rice yield causes lower net income than traditional rice. The net income of traditional rice farming is IDR 15.20 million/ha in the rainy season and IDR 3.81 million/ha in the dry season, which are much higher than that of organic rice.

Climate change also causes the lower income of both traditional and organic rice farmers in the 2022 dry season. Although organic farming provides lower profits than traditional rice, it is still feasible. The feasibility of organic rice farming at the research location aligns with several previous research results [48,49].

The lower net income of organic rice compared to traditional rice farming in this study differs from the results of several previous studies. Some studies stated that organic rice farming is more profitable than traditional rice. The differentiating factors are mainly in the productivity, price, and cost of farming. Crowder and Reganold [50] revealed that the premium price at the farmer level is the main factor for increasing profitability.

Organic rice costs production less than traditional rice, resulting in more considerable earnings. Another study by Sibarani and Somboonsuke [51] revealed that organic rice productivity is higher while organic rice production costs are lower than traditional rice. The difference in the benefits of organic rice compared to traditional rice is more on productivity and higher prices.

Higher productivity in organic rice cultivation will be achieved on established organic systems. At that stage, there has been an accumulation of organic matter in the soil, so the land is more fertile, but it takes a long time to get land conditions stable. While in the early stages of organic rice development, organic matter accumulation in the soil has not been sufficiently created. Without chemical fertilisers, crop productivity will decrease.

Financial factors are the primary consideration for farmers adopting new technologies. Farmers will cultivate organic rice if the technology is economically more profitable than conventional rice. However, even though economically feasible, the net income of organic rice farming in Cipatujah is far below the net income of traditional rice, farmers still cultivate organic rice. This condition can occur because most farmers participating in the organic rice development program are smallholders (land area<0.25 hectares). So, organic rice cultivation is more of a subsistence system than a market-oriented system. Therefore, productivity, rice prices, and net income, which do not meet their expectations, have not been their main considerations. In addition, farmers still use most of their family labour, which is not their consideration.

3.3 Challenges of accelerating organic rice farming development

Various challenges for organic rice farming development in Cipatujah include the following problems.

1. Most farmers want to practice pure organic rice farming technology, but environmental conditions constrain them. There are still many traditional rice farms that use chemical fertilisers and pesticides. Overflow irrigation water carries chemical residues into organic farming areas. This condition is one of the inhibiting factors in obtaining organic certification.
2. Pure organic rice farming requires substantial organic fertiliser, about 3-5 tons per ha per season. However, the availability of organic fertilisers is still inadequate. Farmers still have obstacles to making organic fertiliser by themselves: (a) limited labour; (b) requires labour and cost to transport straw and animal manure to houses for fermentation; and (c) the availability of organic fertiliser processing units is still minimal.
3. The availability of irrigation water is still inadequate in some areas, especially those far from tertiary irrigation canals, causing the cropping intensity to be less than 200.
4. Most organic rice have not obtained organic product certificates, even though they have received organic certificates for their land and cultivation. As a result, rice prices from certified organic cultivation are the same as those with no certification and even the same as traditional rice prices.

5. The organic market has not been developed. Most of the organic rice harvest is only for the family's consumption.

3.4 Alternatives strategies to coping with challenges

Considering that the development of organic rice farming in the study area is a transition stage from traditional to organic rice farming, policies, programs, and facilitation are needed to overcome various obstacles to accelerate the growth and development of organic rice farming in the region.

1. The government should provide more intensive assistance with organic farming technology to change the farmers' mindset from traditional to organic rice farming. Technical assistance is focused on the organic certification application, which includes the standards of technical organic rice farming.
2. It is necessary to consistently develop organic rice in one homogenous large-scale organic area so that there is no opportunity for farmers to grow traditional rice to prevent farmers implementing organic rice farming from returning to traditional rice farming.
3. The availability of sufficient organic fertilisers and pesticides is necessary for implementing organic rice farming. Therefore, a priority program should facilitate organic fertiliser processing units and their technical guidance by the government under the specifications required by local farmers in sufficient quantities.
4. Since most farmers are smallholders, the government should provide certification funding support for smallholders' organic rice. Internal Control System (ICS) training for farmer groups needs to be expanded. The ICS will guarantee farmers' every improvement in organic rice cultivation, which is acceptable to third-party certification schemes; certification costs to certification bodies can be reduced.
5. For the future development of organic rice farming on a larger scale, it is necessary to develop farmer corporate institutions to strengthen the farmer groups' position in procuring organic inputs, processing, product marketing, and comprehensive business management from upstream to downstream.
6. Direct sales channels might be used to expand the organic rice market inside and outside the region. This strategy establishes direct consumer interaction through farmers' markets, community-supported agriculture programs, and online platforms.

4 Conclusions and policy recommendations

At the early stage, organic rice farming in Tasikmalaya District is feasible to develop, as shown by its R/C ratios greater than 1.00 and production and price breakeven points, which are lower than the actual productivity and actual price. However, the income from organic rice farming is lower than that of traditional rice.

The productivity of organic rice is around 81-87% compared to traditional rice. The cost of fertiliser and pesticides for organic rice is lower than traditional rice farming, but the labour cost of farming is slightly higher. The organic rice market has not yet been developed, so its price is the same as traditional rice. The further development of the early stage of organic rice farming in the Tasikmalaya District faces several challenges related to environmental conditions that are not entirely under organic rice farming practices. The availability of organic fertilisers and pesticides is still limited, and organic certification for land and cultivation is also limited.

To develop sustainable organic rice farming, there is a need for sufficient support in terms of organic fertilisers and pesticides, land and organic product certification, significant price differences between organic and traditional rice, strengthening farmer institutions and partnerships between private companies and farmers groups to strengthen organic rice business.

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