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Research Article

A Comparative Analysis of Economic Viability of Organic and Conventional Rice Farming in Malang Regency, Indonesia

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Abstract

Background and Objective: Economic viability often becomes a critical parameter for agricultural management with the intention to accept or reject a proposed agricultural system. This study was carried out to conduct a comparative analysis of the economic viability of both organic and conventional rice farming. **Materials and Methods:** Eighty farmers from the area of Malang Regency were randomly selected for this study. The capital budgeting methods were used to analyze the economic viability of the farms. The multiple linear regression was analyzed by SPSS version 20 for determining capital budgeting factors. **Results:** The economic viability result showed that the organic rice farming was 5439.04 USD more profitable, 28% more reliable, 1.78 higher and 0.78 years earlier than the conventional system for net present value, Internal Rate of Return, Benefit-Cost Ratio and Payback Period, respectively. The regression result revealed that revenue and cost were significant in all capital budgeting methods on both farming systems. **Conclusion:** The organic rice farm had given better financial performance and economic viability than conventional rice farm. The return of investment can be enhanced fast by increasing the revenue parameter of rice farming.

Key words: Comparative analysis, benefit-cost ratio, economic viability, rice farming, capital budgeting, internal rate of return

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Data Availability: All relevant data are within the paper and its supporting information files.

INTRODUCTION

Conventional agriculture is a common type of rice production in Indonesia. Such a conventional system refers to any agricultural system in which chemical inputs of chemical fertilizers and chemical pesticides are used[1]. During cultivation, intensification usually occurred to increase profits and quantities of rice production. Since intensification increases food security and profits for some farmers, it also results in various environmental impacts including groundwater depletion, soil degradation and increased pesticide concentration in food products[2]. Environmental degradation adversely affects individual happiness[3].

As the solution, organic farming has previously been proposed as a sustainable strategic option for conventional farming, enhancing benefits to the environment, human health and product quality[4]. Organic farming has been considered to be a sustainable alternative to the predominant agricultural model. Its conception regarding nature, social inclusion and economic viability are supported by societies. Moreover, trend towards this type of farming has increased recently across the globe[5]. Organic farmers reported higher levels of life satisfaction in comparison to conventional farmers. Subjective well-being of these farmers is positively associated with income, profitability, satisfaction at work, social recognition and good health[6]. Moreover, organic farming is input-economizing production method[7] has a premium price[8] and reduces the cost of rice production[9]. Among the advantages of organic farming, the financial reason is accepted by the farmers easily. Financial reasons include attempts to solve existing problems as well as the desire to secure the long-term existence of the farm[10]. One technique to evaluate the long-term existence of the farm is using the economic viability analysis. An economic viability calculation is essential to reflect the farmer's return on investment. Increased income profitability is associated with life satisfaction which indicating that financial viability is vital for farmers to experience increased satisfaction[6]. In the investment context, the economic viability can help the farmers to understand the implications of their decision whether to take action or no action on investment appraisal. Moreover, it also helps in choosing the best approach[8].

Malang Regency, which is one of big rice producer in Indonesia, has organic and conventional rice farming system inside. The economic viability estimation provides information to the farmers in the investment of long-term farming system. Hence, this study was carried out with the objective to evaluate the economic viability of organic rice farming in comparison to conventional rice farm using capital budgeting for 5 years (2017-2022). This study also analyzed the determining factors of each capital budgeting methods.

MATERIALS AND METHODS

Data location and collection: This study focused on a rice farm in Sumber Ngepoh area, Lawang district, Malang Regency, East Java province, Indonesia. Most of the farmers in the study planted rice use chemical pesticides and fertilizer, while the other farmer's group have developed the organic farming system[11]. This study was carried out from March, 2017-February, 2018. The survey was based on 80 respondents, composed of 40 organic farmers and 40 conventional farmers.

Capital budgeting analysis: Capital budgeting techniques are often used to evaluate economic viability. Most commonly used techniques in capital budgeting are Net Present Value, Internal Rate of Return, Payback Period and Benefit-Cost Ratio[12-14]. First, Net Present Value (NPV) is a summation of the present value of a series of present and future cash flows. The investment is acceptable if the NPV has a positive value. The NPV calculation was expressed as follows[15]:

$$NPV = \sum_{k=0}^{n} \frac{C_k}{(1+r)^k} - C_o \quad (1)$$

where, C_o was an initial investment or capital, C_k was cash flow in the year, r was a discount rate (the interest rate on May, 2017 was 4.75% based on Bank of Indonesia) and k was period in years (in this case was 5 years). The cash flow was calculated from revenue minus cost. Revenue was from the multiplication of rice price and production. Price per kg of organic rice was USD 0.45 and conventional rice was USD 0.32. Second, Internal Rate of Return (IRR) measures an investment's rate of return. The IRR must be higher than the opportunity cost of the capital expressed by the discount rate (r) to make the investment convenient[16]. The IRR was obtained by solving r in the Eq. 1 when NPV was equal to zero[17]. Third, Payback Period (PP) assesses an investment by the length of time it would take to repay. The PP was calculated using the following Eq.[13]:

$$PP = \frac{C_o}{C_k} \quad (2)$$

Fourth, Benefit-Cost Ratio (BCR) indicated how much benefit is obtained for each unit of cost. The BCR was higher

than one indicated that the financial benefits outweighed the cost. The calculation of BCR is profit divided by cost[18].

Multiple linear regression: Regression is a statistical assessment technique that is used to establish the line of best fit for the set of data[19]. The regression used a model as follows:

$$y = a + b_1x_1 + b_2x_2 + b_3x_3 + b_4x_4 \quad (3)$$

where, x_1, x_2, x_3 and x_4 were denoted as capital, farm size, cost and revenue, respectively. The constant b_1, b_2, b_3 and b_4 corresponded to the coefficient of each input variables. The output y was related to the value of the capital budgeting method (NPV, IRR, PP and BCR). The multiple regression was estimated using SPSS version 2.0.

RESULTS

General description: The survey data of total respondents are shown in Table 1 which consists of averaged data and normalized data to the area. The average data of organic farm gave 1119.38 USD profit which was higher than the conventional farm. The high number of profit was reasonable because the area of organic rice farming (0.8 ha) was more spacious than the area of conventional rice farming (0.45 ha). In order to make an equal comparison among both of the farm, the average data was normalized to the land size. Based on Table 1, the normalized data to the area of organic rice farm gave 1403.62 USD profit ha^{-1} which was still higher than the profit of conventional rice farm. The total cost of normalized data to the area of conventional rice farming was 837.87 USD which was higher than the total cost of normalized data to the area of organic rice farming.

Economic viability: The results in Fig. 1 and 2 show the capital budgeting of each farm. The sequential number of farmers had been sorted based on the amount of profit they obtained. In Fig. 1, NPV was represented in the bar graph. The NPV of most of the organic rice farming was higher than conventional rice farming. In Fig. 1, IRR was represented in the diamond and triangle icon. Most of organic system IRR was also higher than the conventional system. Based on Fig. 2, most of the PP of organic rice farming was shorter than the conventional one. Most of the organic rice farming gave higher BCR than the conventional system.

The average of capital budgeting analysis and some parameters of organic and conventional rice farms are shown in Table 2. Based on Table 2, the mean NPV of organic rice farms were 7828.31 USD which was more profitable than conventional rice farming. The mean IRR of organic rice farm was 0.61 compared to the IRR of the conventional farm which was only 0.33. The mean payback period of organic rice farm was 1.63 years and the payback period of conventional rice farm was 2.41 years.

Determining factors of capital budgeting: Findings in Table 3 showed the regression result of each capital budgeting (NPV, IRR, PB and BCR) to the input variables (capital, farm size, cost and revenue) based on Eq. 3. Data in Table 3 indicates that the capital variable correlated significantly for all capital budgeting methods on both farming except on the BCR of organic farming. The R^2 was one on NPV models for both farmings indicated that the input model could explain the output correctly. The farm size variable had a positive significance to IRR and BCR on organic farming. However, farms size variable was not significant on all capital budgeting of conventional farming. The cost variable had a positive significance to PP and negative significant to NPV, IRR and BCR in both farmings. The revenue variable had a positive significance to NPV, IRR and BCR in both farmings with significantly 0.001. The revenue had significant positive effects on NPV which was 10.172 for organic and 8.719 for

Table 1: Averaged data and normalized data to the area

	Averaged data		Normalized data to the area	
Descriptions	Organic	Conventional	Organic (ha^{-1})	Conventional (ha^{-1})
Land area (ha)	0.80	0.45	1.00	1.00
Profits (USD)	1119.38	569.58	1403.62	1276.36
Capital (USD)	416.23	257.69	521.92	577.46
Total cost (USD)	415.58	373.90	521.09	837.87
• Seed cost (USD)	20.20	9.77	25.32	21.90
• Fertilizer cost (USD)	62.55	31.15	78.43	69.81
• Pesticide cost (USD)	31.69	19.61	39.73	43.94
• Tractor cost (USD)	61.62	57.33	77.27	128.46
• Thresher cost (USD)	127.91	99.34	160.39	222.62
• Labor cost (USD)	111.61	156.70	139.95	351.14
Production (kg)	3425.00	2937.50	4294.67	6582.63

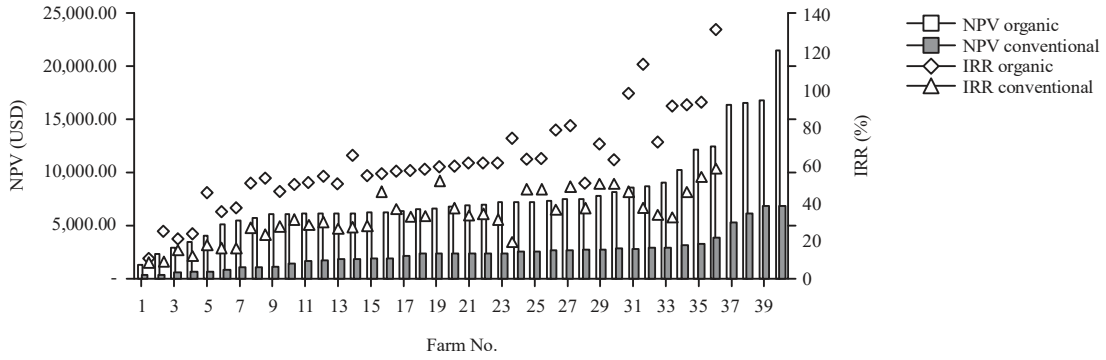

Fig. 1: NPV and IRR of organic and conventional rice farming for 5 years

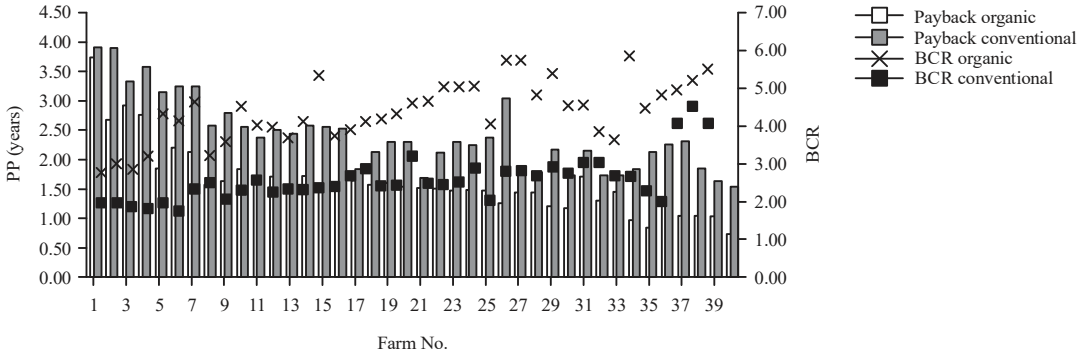

Fig. 2: Payback period and BCR of organic and conventional rice farming for 5 years

Table 2: Capital budgeting analysis of organic and conventional rice farms

Rice farming	Descriptions	Minimum	Maximum	Mean	Std. Deviation
Organic	NPV (USD)	1274.49	21625.59	7828.31	4082.09
	IRR	0.11	1.32	0.61	0.24
	PP (years)	0.75	3.72	1.63	0.58
	BCR	2.77	5.85	4.37	0.80
	Capital (USD)	298.78	746.94	416.23	100.64
	Farm size (ha)	0.25	2.00	0.80	0.46
	Cost (USD)	242.12	665.75	415.57	115.76
	Revenue (USD)	896.33	3137.14	1534.96	488.18
Conventional	NPV (USD)	212.79	6825.56	2389.27	1574.39
	IRR	0.09	0.58	0.33	0.13
	PP (years)	1.54	3.91	2.41	0.61
	BCR	1.76	4.52	2.59	0.59
	Capital (USD)	149.39	597.55	257.69	107.25
	Farm size (ha)	0.25	1.50	0.45	0.23
	Cost (USD)	192.15	1277.86	373.90	196.44
	Revenue (USD)	481.77	2569.47	943.48	428.28

Table 3: Regression results based on four linear models

Rice farming	y	a	b_1	b_2	b_3	b_4	R^2
Organic	NPV	0.003	10.000[a]	0.020	-8.719[a]	10.172[a]	1.000
	IRR	0.677[a]	-0.002[a]	0.107[c]	-0.001[a]	0.001[a]	0.954
	PP	0.920[a]	0.004[a]	-0.134	0.002[b]	-0.001[a]	0.929
	BCR	4.991[a]	0.000	0.335[c]	-0.012[a]	0.003[a]	0.952
Conventional	NPV	0.017	-10.000[a]	0.068	-8.719[a]	8.719[a]	1.000
	IRR	0.331[a]	-0.002[a]	-0.147	-0.001[a]	0.001[a]	0.865
	PP	2.450[a]	0.011[a]	0.486	0.002[b]	-0.004[a]	0.774
	BCR	2.263[a]	-0.002[b]	-0.023	-0.005[a]	0.003[a]	0.961

b_1, b_2, b_3 and b_4 are coefficient of capital variable, farm size variable, cost variable and revenue variable, respectively, [a,b,c]Significance at the level 0.1, 1 and 5%, respectively

conventional farming. Furthermore, the revenue variable had a negative significance to PP in both farmings.

DISCUSSION

The average and normalized survey data showed that organic rice farming gave more profit than conventional farming. The result of this study was in line with Patil *et al.*[2] which declared the high profit of organic farming due to lower cost or premiums price. Cavigelli *et al.*[20] concluded that at the premium price level, the net return of organic farming was 2.4 times higher than that of conventional farms. The contradictive research, Argiles and Brown[21] compared the amount of production, costs and profits gained from organic farming and conventional farming systems in Catalan Farms, Spain. The result showed that the application of organic farming did not significantly lead to changes in output, cost and profit. Froehlich *et al.*[5] reported that the organic producer's a profits were 7-10% lower than the conventional ones based on a survey in Brazil. Kerselaers *et al.*[22] and Kuminoff and Wossink[23] declared that organic farming cost usually was more expensive than the conventional system.

The economic viability result of this study showed that the organic rice farming was 5439.04 USD more profitable, 28% more reliable, 1.78 higher and 0.78 years earlier than the conventional system for Net Present Value, Internal Rate of Return, Benefit-Cost Ratio and Payback Period, respectively. Sgroi *et al.*[17] supported that the organic growth would allow better profitability with respect to conventional one in NPV, BCR and IRR. The high economic viability indicated the sustainable farming system in the future. Patil *et al.*[2] showed that the result of organic farming could be a sustainable farming practice depending on the regional conditions and the crops cultivated. Policies stimulating organic farming should consider the differences in regions and farmer's preferences. Lohr and Salomonsson[24] and Kallas *et al.*[25] showed that profitability could be achieved when the government subsidized the conversion costs.

This study gave the direction that organic rice is suitable for a farmer in Lawang, Indonesia. This study suggested that the rice farmer should cultivate organic rice because organic rice farming offers high return value, higher price and sustainable farming. The high price of organic rice farming would increase the revenue which was the most significant input variable in capital budgeting. The alternative way to gain profit was reducing cost through efficient farming, increasing capital and enlarging the field respectively based on the regression result.

CONCLUSION

The organic rice farm is superior in NPV, IRR, PP and BCR than a conventional farm. It was concluded that organic rice had given better economic viability than a conventional farm. The determining factors showed that the enhancement of both farming profit could be accelerated more by increasing the revenue followed by reducing cost, increasing the capital and by enlarging the field.

SIGNIFICANCE STATEMENT

This study discovered the economic viability of organic rice farming which was superior to conventional rice farming. The information can be beneficial for a farmer to make the best decision regarding organic or conventional rice farming system that provides the most economical return in investment. The determining factors of capital budgeting provide a better way for the farmers to increase their investment return and to amplify their wealth level. This study gave direction to uncover the financial performance of farmer based on a projection that many researchers were not able to explore. Thus a new theory on optimization of return investment of the rice farming may arrive in the future.

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