A comparative feasibility study of organic and conventional vegetable farming in Central Java, Indonesia

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Abstract. The objective of this study is to compare the feasibility of organic and conventional vegetable farming. The research was conducted from February to August 2018 in Getasan Regency, Central Java, Indonesia. The survey involved 120 vegetable farmers; 60 organic farmers, and 60 conventional farmers. The data were analyzed by financial analysis. The t-test was used to determine the difference between the feasibility of organic and conventional vegetable farming. The results showed that organic vegetable farmers receive higher revenues, incomes, and benefit than conventional farmers. Organic vegetable farming also more feasible than conventional vegetable farming.

1. Introduction
Based on the Indonesian National Standard (SNI) 6729: 2016, organic is a labeling term which stating that a product has been produced in accordance with organic agriculture standards. Organic agriculture is the production of agricultural products using minimal external inputs and does not use synthetic fertilizers and pesticides [1]. Organic farming emphasizes the use of management practices which use input from within, with the consideration that local conditions require locally adapted systems [2,3]. The objective of organic agriculture is to optimize the productivity of organisms in soil, plants, animals, and humans, which depend on one another [1].

The development of organic agriculture in Indonesia is due to changes in the lifestyle of the people who are starting to pay attention to the importance of health. People have started to change their consumption of food with organic products [4]. Business and organic farming also experience growth every year. The number of producers of organic products, one of which is vegetables, is increasing and increasingly diverse. Based on data from Aliansi Organis Indonesia (the Indonesian Organic Alliance), the land area for organic vegetables in Indonesia in 2018 reached 122.01 ha [5].

Organic farming is considered to increase farmers’ income. Several studies stated that organic farming is profitable [6,7] and feasible to cultivate [7–9]. Organic farming has a higher feasibility rate than farming which does not apply organic principles [4,10]. Farming feasibility studies that compare organic vegetable farming and those that do not apply the principles of organic farming (conventional
farming) are still limited. Research related to the feasibility of organic farming is important as reference material for the development of organic agriculture. The objective of this study is to compare the financial feasibility of organic vegetable farming and conventional vegetable farming.

2. Methods

2.1. Study area
The research location was chosen purposively, which was in Getasan District, Semarang Regency, Central Java, Indonesia. Two villages were selected, which were Kopeng village and Batur village (figure. 1), with the consideration that these two locations were locations for organic farming development.

![Study area map](image)

Figure 1. Study area.

2.2. Survey
The survey was conducted from February to August 2018. The survey involved 120 vegetable farmers as respondents consisting of 60 organic vegetable farmers and 60 conventional vegetable farmers. Respondents were selected randomly. The survey was conducted with a questionnaire guide. The questionnaire was filled out regarding 1) farmer and farm characteristics, 2) farming revenues, and 3) farming costs. This study calculates revenues and costs for all types of vegetables cultivated by farmers during the past year.

2.3. Data Analysis
Data were analyzed using financial analysis and t-test. Farming feasibility analyzes used by several researchers included revenue cost ratio (RCR) and benefit-cost ratio (BCR) [7,11–15]. Farming can be feasible if 1) farming revenues > break-even point (BEP) of farm revenue; 2) value of revenue/total cost (R/C ratio) > 1; and 3) value of benefit/total cost (π/C ratio) > prevailing interest rates [16,17]. Based on this, the feasibility level used in this study is formulated as follows:

1. Break-even point of farm revenue (BEP$_R$)

$$\text{BEP}_R = \frac{\text{FC}}{1 - \frac{\text{VC}}{\text{R}}}$$  (1)
2. R/C ratio

\[ \frac{R}{C} \text{ ratio} = \frac{R}{C} = \frac{P \times Q}{VC + FC} \]  \hspace{1cm} (2)

3. \(\pi/C\) ratio

\[ \frac{\pi}{C} \text{ ratio} = \frac{\pi}{C} = \frac{\pi}{VC + FC} = \frac{I-UD}{VC + FC} = \frac{R-TC-UD}{VC + FC} \]  \hspace{1cm} (3)

Where:

- BEPR = break even point of farm revenue
- R = total revenue (IDR)
- P = price of vegetable (IDR)
- Q = quantity of vegetable (kg)
- C = total cost (IDR)
- VC = total variable cost (IDR)
- FC = total fixed cost (IDR)
- \(\pi\) = benefit (IDR)
- I = income (IDR)
- UD = family labor cost (IDR)

The t-test was used to determine the feasibility of organic and conventional vegetable farming. The t-test was used with the SPSS program. The hypothesis used is as follows:

Ho; means that the average feasibility level of organic vegetable farming is smaller or equal to the average feasibility level of conventional vegetables.

Ha; means that the average feasibility level of organic vegetable farming is higher than the average feasibility level of conventional vegetable farming.

Hypothesis testing criterion is we would reject Ho if t-statistic > t-table.

3. Results and discussion

3.1. Characteristics of organic and conventional vegetable farmers

Table 1 shows the characteristics of organic and conventional vegetable farmers including age and education. The majority of organic and conventional vegetable farmers are in productive age, meaning that organic vegetable farmers have the physical ability to cultivate vegetables for a living. The education side shows that organic vegetable farmers have a higher education than conventional vegetable farmers. The knowledge possessed by farmers is influenced by the level of education taken [18]. Farmers will be able to absorb and apply various new technologies in farming which can increase farmers’ income.

| Characteristics         | Organic     | Conventional | Difference | t-test |
|-------------------------|-------------|--------------|------------|--------|
| Age (years)             | 44.82       | 45.87        | -1.05      | -0.59  |
| Education (years)       | 7.90        | 6.42         | 1.48 *     | 1.78   |
| Farming experience (years) | 21.75      | 24.65        | -2.90 *    | 2.10   |
| Area (ha)               | 2085.00     | 2188.92      | 103.92     | -0.54  |

* Significant at level 1%, t-table (\(\alpha = 10\%), df = 108) = 1.29
Conventional vegetable farmers have much longer experience farming vegetables than organic vegetable farmers. Farmers who are more experienced in cultivating vegetables will have better abilities in cultivating vegetables such as knowing pests and diseases that attack vegetable crops and how to control these pests and diseases. Meanwhile, less experienced farmers will easily receive information related to vegetable technology [19]. Table 1 also shows the characteristics of organic and conventional vegetable farming. The average land ownership is 0.20 - 0.22 ha, meaning that vegetable farming is performed by small scale farmers.

### 3.2. Revenues and costs of organic and conventional vegetable farming

Organic and conventional vegetable farmers produce vegetables sustainably in one year. The commodity of vegetables planted varies and differs between farmers. The revenue structure and costs of organic and conventional vegetable farming are presented in table 2. The revenue of organic vegetable farmers is higher than and significant compared to conventional vegetable farmers. The difference between organic and conventional vegetable farmers' revenue is IDR13 million per 2500 m² per year. Organic vegetable farmers receive a higher revenue than conventional vegetable farmers due to higher product prices and some products which have a high selling value, such as cherry tomatoes and asparagus. This result is in line with some research which states that organic vegetable farmers receive a higher revenue than farmers who do not apply organic because the amount of production and prices received are higher than conventional vegetable farmers [7,20].

### Table 2. Revenue and cost of organic and conventional vegetable farming (in IDR.000 per 2500 m²/year).

|                | Organic   | Conventional | Difference a | t-count |
|----------------|-----------|--------------|--------------|---------|
| Revenue        | 36768.58  | 23703.18     | 13065.40     | 5.097   |
| Total cost     | 10837.03  | 7362.41      | 3474.62      | 2.690   |
| Variable cost: |           |              |              |         |
| Seed           | 1780.37   | 1500.53      | 279.84       | 1.620   |
| Organic fertilizers | 3923.46 | 1157.93      | 2765.52      | 3.029   |
| Chemical fertilizers | 0.00     | 1377.07      | -1377.07     | -9.316  |
| Organic pesticides | 401.55 | 0.00         | 401.55       | 12.645  |
| Chemical pesticides | 0.00     | 831.27       | -831.27      | -5.993  |
| Hired labor    | 1884.93   | 1232.36      | 652.57       | 1.628   |
| Fixed cost     | 2846.72   | 1263.25      | 1583.48      | 7.854   |
| Income         | 25931.54  | 16340.77     | 9590.78      | 4.276   |
| Benefit:       |           |              |              |         |
| Family labor   | 4707.63   | 4601.25      | 106.38       | -0.134  |
| Benefit        | 21223.92  | 11739.52     | 9484.40      | 4.270   |

*a t-test for differences in the mean of two group
*** Significant at level 1%, t-table (α = 1%, df = 108) = 2.36
** Significant at level 5%, t-table (α = 5%, df = 108) = 1.66
* Significant at level 10%, t-table (α = 10%, df = 108) = 1.29

The cash variable costs incurred by vegetable farmers consist of seeds, fertilizers, pesticides and labor costs outside the family (table 2). Table 2 shows that the highest cash variable cost incurred by organic vegetable farmers is the cost of fertilizer. Organic vegetable farmers spend quite a lot on the
purchase of organic fertilizers. Organic vegetable farmers claim that they provide organic fertilizers to increase soil fertility and organic fertilizers which can also maintain soil moisture. The smallest proportion of variable costs is pesticides, because farmers mix their biological pesticides, for instance from empon-empon, to control pests and diseases that attack vegetable crops. Furthermore, if the attack by pests and diseases is still below the threshold of attack, it is enough for farmers to control mechanically.

The two biggest cash variable costs incurred by conventional vegetable farmers, respectively, are seeds and chemical fertilizers. Conventional vegetable farmers spend money to buy seeds which are relatively more expensive because they have higher productivity. Conventional vegetable farmers also use more chemical fertilizers, such as NPK, Urea, KCL, compared to the use of organic fertilizers. Based on interviews with farmers, if the vegetables are not given sufficient chemical fertilizers, the production results are not optimal.

The fixed cash costs incurred by conventional and organic vegetable farmers include depreciation of shade, irrigation and equipment used for growing vegetables. The results of the analysis in Table 2 show that the fixed cash costs incurred by organic farmers are significantly higher than conventional vegetable farmers. Organic vegetable farmers are bound by cooperation contracts, so they must maintain the production of the vegetables they produce. Based on the results of interviews with organic farmers, they built shelters or screen houses to protect vegetable crops due to frequent extreme rains and made irrigation in the form of irrigation systems for watering and water reservoirs as provisions. Farmers consider this screen house and irrigation to reduce the risk of crop failure due to frequent extreme weather.

Table 2 also shows the differences in income and benefits from conventional and organic vegetable farming. Organic farmers have a higher expenditure, but the revenue they get is greater than conventional vegetable farmers, so they have a higher benefit than conventional vegetable farmers. The results of this study are in line with some research which states that organic farmers have higher benefit than conventional vegetable farmers [10,20,21,22]. He further stated that the difference in farming benefits is influenced by land area, seed price, product selling price, and labor wages [22].

### 3.3. Feasibility of organic and conventional vegetable farming

The feasibility of farming used in this study was assessed based on BEP of farm revenue, R/C ratio and π/C ratio. The results of the feasibility analysis of organic and conventional farming are presented in Table 3 showing that 1) farm revenue is greater than the BEP of farm revenue, 2) R/C ratio> 1, and 3) The value of π/C ratio)> 11.2% (interest rate applies), which means that organic and conventional vegetable farming is feasible to be cultivated. The results of this study are in line with some research which states that organic and conventional vegetable farming is feasible [7,9,10,21,23].

| Feasibility | Organic | Conventional | Difference | t-test |
|-------------|---------|--------------|------------|--------|
| BEPr b | 2846725 | 1237165 | 1263725 | 855850 | 158347 | *** | 7.854 |
| R/C ratio | 3.62 | 1.68 | 3.54 | 0.84 | 0.08 | 0.04 | 0.404 |
| π/C ratio | 237 | 156 | 217 | 91 | 20 | 1.119 |

a t-test for differences in the mean of two groups
b in IDR. 000 per 2500 m²/year
*** Significant at level 1%, t-table (α = 1%, df = 108) = 2.36

Table 3 also shows a comparison of the feasibility analysis between organic and conventional farming. This study state that organic farming is more feasible than conventional farming, although it is not statistically significant.
4. Conclusion
Organic vegetable farmers receive higher revenues, incomes, and benefit than conventional farmers. Organic vegetable farming also more feasible than conventional vegetable farming.

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