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The Effect of Organic and Conventional Farming on Land Quality and Farmer Profits in Batur Village, Getasan District, Semarang Regency

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ABSTRACT

The Green Revolution transformed traditional farming systems into conventional farming systems that rely on chemical fertilizers and pesticides, leading to a decline in soil quality. This decline can be addressed by implementing organic farming, which offers benefits such as maintaining and improving soil quality, enhancing product quality, and promoting farmer welfare. In Batur Village, Getasan District, Semarang Regency, there are 35 farmer groups, 5 of which are organic farmer groups managing a total land area of approximately 34.4 hectares. This study aims to evaluate the effects of organic and conventional farming on soil quality and farm profits in Batur Village, with the objective of promoting organic farming practices. The research utilized the composite method for soil sampling and conducted interviews to determine farm profits. Data were analyzed using an independent sample t-test. The results indicate that while soil properties were not significantly different between the two farming systems, organic farming demonstrated higher values for C-organic, N-total, permeability, field capacity, pH, soil consistency, and total soil microbial count compared to conventional farming. Conversely, salinity and porosity values were higher in conventional farming. Additionally, organic farming had lower production costs than conventional farming.

Keywords*: cost, conventional farming, land qualit, organic farming, income*

1. INTRODUCTION

The green revolution in Indonesia and other developing countries has transformed traditional farming systems into conventional farming systems. Conventional farming systems involve synthetic chemicals in the agricultural production process. Synthetic chemicals that are widely used in the agricultural production process are synthetic fertilisers and pesticides (Hadi, 2020). The green revolution led to a change in the perspective of farmers. Farmers thought that increased agricultural production could only be achieved through the use of synthetic chemical fertilisers and pesticides (Fauziah, 2020). Conventional farming systems have increased agricultural production, but also caused some negative impacts. Excessive use of chemicals eventually causes damage to the environment and human health (Andrea et al., 2021).

Chemical fertilisers that are continuously added to the soil degrade the health and quality of the soil, causing soil pollution and disrupting the nutrient balance of the soil (Chandini et al., 2019; Purwanti Pratiwi Purbosari et al., 2021). The quality of the soil will affect the quality of the crop (Lestari et al., 2023), lower soil microbes, and crops are susceptible to disease (Fitriatin et al., 2019; Supriyanto et al., 2021) resulting in lower land production (Sumarji et al., 2023). The use of synthetic fertilisers and pesticides is more desirable because they are practical, easy to obtain, affordable, and the benefits can be immediately felt by farmers (Purbosari et al., 2021). But currently, the availability of fertiliser for horticultural crops is limited and the price is expensive (Wu & Ge, 2019 cit Syamsiyah et al., 2023). The decline in crop productivity and the increasingly expensive price of chemical fertilisers will make farmers' welfare decline. The decline in crop productivity and the increasing cost of chemical fertilisers will result in a decline in food security, farmer welfare and human well-being.

Food security is an issue of concern to all countries in the world. Several countries including Indonesia formed and agreed on the Sustainable Development Goals (SDGs) programme to address the problem, one of whose goals is to end hunger, achieve food security and better nutrition and support sustainable agriculture. Some indicators of achieving SDGs include the proportion of agricultural land area designated as sustainable food agriculture/organic farming and the average income of small-scale agricultural producers, by subsector. One of the efforts to achieve SDGs point 2 is by implementing organic farming systems.

The organic farming is a farming system that does not use synthetic chemicals in the production process (Rachma & Umam, 2020). The organic farming uses organic fertilisers and pesticides. Organic farming has a higher selling price compared to conventional agricultural products and reduces production costs because the inputs used (fertilisers and pesticides) can be made by farmers independently and are based on the diversity of local biological agents (Fitrah et al., 2021) and will be sustainable (F. Y. Ali et al., 2022). It can maintain a healthy environment and improve soil quality (Zendrato et al., 2024). The use of organic fertilisers can improve soil physical, chemical and biological conditions (Dewi & Afrida, 2022; Pahlepi et al., 2023) by increasing organic matter, improving soil structure, increasing biodiversity, and balancing nutrients (Zendrato et al., 2024). The organic farming can improve the quality of agricultural products, productivity, and farmers' welfare (Lestari et al., 2023; Saputro & Hadiyanti, 2023).

In Batur Village, Getasan District, Semarang Regency, there are 35 farmer groups and 5 of them are organic farmer groups with a land area of ± 34.4 ha. Getasan District is an area designated by the Semarang Regency Agriculture Office as an organic horticulture farming area. In Batur Village, the percentage of organic farmer groups is much smaller than conventional farmer groups. Therefore, it is necessary to study the effects of organic and conventional farming on soil quality and the profits obtained by farmers.

In another study entitled “Dampak Pertanian Organik dan Konvensional terhadap Keanekaragaman Hayati dan Sifat Kimia Tanah pada Budidaya Padi” which aims to compare the impact of organic and conventional rice farming on soil chemical and biological properties (Indriyati et al., 2024). This research will compare the impact of organic and conventional farming on soil chemical, physical, and biological properties and compare farming businesses in organic and conventional farming systems. The results of this research are expected to be used as a promotion of organic farming practices so as to increase the number of organic farmer groups.

2. SCOPE

The scope of this research is to compare soil quality and farming in organic farming systems with soil quality and farming in conventional farming systems. The types of crops grown on these farms are horticultural crops (cabbage, mustard greens, tomatoes, beans, lettuce, etc.). The soil quality studied is the physical, chemical, and biological properties of the soil. The farming business studied is the cost of production, income, and profit from farming. This research produces soil quality and farming values that are expected to be used to promote organic farming practices.

3. MATERIALS AND METHODS]

The research was conducted in Batur Village, Getasan District, Semarang Regency. Research tools and materials used include a letter of permission to conduct research, stationery (interview sheet, ballpoint pen, and eraser), recorder (mobile phone), laptop, flashdisk, and camera as well as soil drill, plastic, hoe, permanent marker, and ruler. Permission letters will be submitted to the village office. The method used in this research is a combination method, namely quantitative and qualitative research methods.

3.1 Quantitative Methods

Quantitative methods are used to collect data to analyse the effect of organic and conventional farming on land quality with laboratory analysis. The soil sampling was done in a composite manner to get a general picture of the soil in a place (Rahadi et al., 2020). Parameters used in this study include: soil physical properties (colour, texture, structure, consistency, porosity, field capacity, and permeability), soil chemical properties (pH (H_2O), pH (KCl), N-Total, C-Organic, and DHL), and soil biological properties (total microorganism count). Data were analysed using the independent sample T-test to see the differences in the comparison of land quality. In this part of Figure 1, it explains the stages of research with quantitative methods. Research with this qualitative method has 4 stages, namely: soil sampling, laboratory test, independent sample T-test analysis, and results.

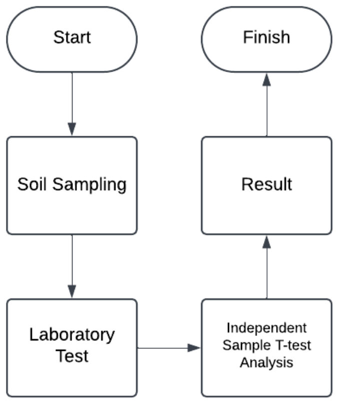

Figure 1. Stages of Quantitative Method Research

3.2 Qualitative Methods

Qualitative methods are used to determine the effect of organic and conventional farming on farm profits with cost and income analysis. Identification of farming costs and income was conducted using semi-structured interview data collection techniques. The technique of determining data sources uses a nonprobability sampling method, namely purposive sampling (Hikmawati, 2019). The Informants are organic farmers and/or conventional farmers in Batur Village, Getasan Sub- district, Semarang Regency, understand the business they are doing, are able to understand the perception of the questions asked by the researcher and have the time to provide the information needed by the researcher. The informants needed were 10 farmers consisting of 5 organic farmers and 5 conventional farmers. The interview data will be analysed using descriptive analysis and then the data will be analysed using independent sample T-test to see the differences in the comparison of production costs, income, and farm profits on organic and conventional farms. In this part of Figure 2, it explains the stages of research with qualitative methods. Research with this qualitative method has 4 stages, namely: data collection, descriptive analysis, Independent sample T-test analysis, and results.

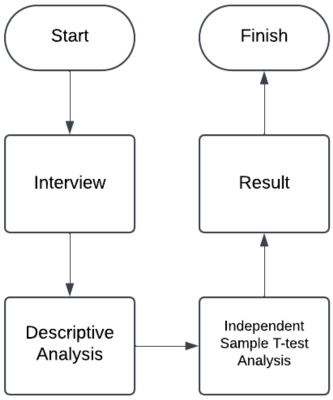

Figure 2. Stages of Qualitative Method Research

The results of the interviews will be analysed by descriptive analysis so that we can obtain production costs and farm income. farm profits will be calculated by the formula:

$$\pi = TR - TC \qquad (1)$$

It is known that π (1) is farm profit (rupiah), TR is farm income (rupiah), and TC is farm production cost (rupiah).

4. DISCUSSION

This research resulted in comparative data on soil quality in organic and conventional farming as well as a comparison of production costs, income, and profit from farming in organic and conventional farming systems in Batur Village, Getasan District, Semarang Regency.

4.1 The effect of organic and conventional farming on soil quality

The results of soil samples from organic farming and conventional farming including soil texture, structure, and colour are shown in Table 1. and C- Organic, N-Total, Salinity, Permeability, Porosity, Field capacity, KCL pH, H2O pH, Soil Consistency (Liquid Limit, Sticky Limit, Roll Limit, and Colour Change Limit), and Total soil microbes are shown in Table 2. While the assessment of soil analysis results is shown in Table 3.

Table 1. Soil Texture, Structure, and Colour

No	Soil Sample		Texture	Structure	Colour	
					Notation	Description
1.	Organic	1	Silty loam	Rounded, medium and strong clumps indry condition	10 YR 7/3	Pole brown
		2	Loam	Rounded, medium and strong clumps indry condition	10 YR 7/3	Pole brown
		3	Sandy loam	Rounded, soft and strong clumps in drycondition	10 YR 5/3	Brown
2.	Conventional	1	Sandy loam	Rounded, medium and strong clumps indry condition	10 YR 5/3	Brown
		2	Silty loam	Rounded, soft and strong clumps in drycondition	10 YR 5/3	Brown
		3	Loam	Rounded, soft and strong clumps in drycondition	10 YR 5/3	Brown

Table 2. The results of soil sample analysis from organic farming and conventional farming

No	Parameter	Satuan	Rata-Rata		T Test
			Organik	Konvensional	
1.	C-Organic	%	2,97	2,71	No significant difference
2.	N-Total	%	0,31	0,27	No significant difference
3.	Salinity	mmhos/cm	0,26	0,32	No significant difference
4.	Permeability	cm/jam	2,26	1,60	No significant difference
5.	Porosity	%	48,77	51,45	No significant difference
6.	Field capacity	%	65,55	62,35	No significant difference
7.	pH KCL	-	6,46	5,75	No significant difference
8.	pH H2O	-	6,93	6,24	No significant difference
9.	BC	%	58,60	53,80	No significant difference
10.	BL	%	49,32	48,17	No significant difference
11.	BG	%	41,44	40,28	No significant difference
12.	BBW	%	21,69	18,86	No significant difference
13.	Total microorganism	cfu's/g	182666,67	86833,33	No significant difference

Tabel 3. The Assessment of Soil Sample Snalysis Results According to The Soil Research Institute (Eviati & Sulaeman, 2009)

No	Parameter	Satuan	Organik		Konvensional	
			Nilai	Harkat	Nilai	Harkat*
1.	C-Organic	%	2,97	Medium	2,71	Medium
2.	N-Total	%	0,31	Medium	0,27	Medium
3.	Salinity	mmhos/cm	0,26	Very low	0,32	Very low
4.	pH H2O	-	6,93	Neutral	6,24	slightly acidic

1. Soil Texture

From the results of the study it can be seen that on organic farmland location 1 soil texture is dusty loam, on location 2 soil texture is loam, and on location 3 soil texture is sandy loam, while on conventional farmland it can be seen that the soil texture on location 1 is sandy loam, location 2 is dusty loam, and location 3 is loam. The average content of sand, dust, and clay fractions is shown in Figure 3.

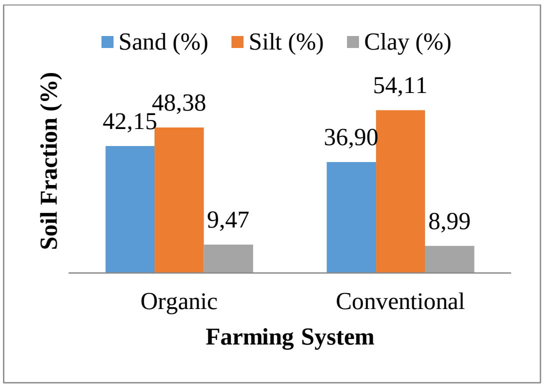

Figure 3. The Bar Chart of Average Soil Texture Analysis(%) in Organic and Conventional Farming.

From Figure 1, it can be seen that organic land and conventional land have low clay content, medium sand content and high dust content. Low clay content causes low soil strength in holding water so that the soil becomes unstable or loose. High sand content makes it difficult for the soil to retain water and nutrients and low organic matter content (Sefiana, 2022). From the analysis results, although the clay content of the soil is low, the C- Organic and N-Total contents of the soil at the research site are in the medium category. This is likely due to the use of chicken manure fertiliser. Organic farmers use chicken manure fertiliser that has been processed by the farmers themselves, while conventional farmers in Batur Village have mostly used raw chicken manure fertiliser for base fertiliser. According to Mathias et al. (2019), ertiliser from chicken manure can increase soil total N and soil C-Organic.

2. C-Organic and N-Total

From the results of soil analysis in the laboratory and field surveys, the quality of organic and conventional soils is not significantly different, although on average the results of organic farming soil analysis are slightly higher than conventional farming soils. The physical, chemical and biological properties of soil in organic and conventional farms are almost the same because although farmers in Batur Village carry out conventional agricultural cultivation, most farmers have begun to reduce the use of chemical fertilisers and for basic fertilisers use chicken manure (rabuk ayam). Some conventional farmers have also started to learn to make liquid fertiliser for additional fertiliser. In Table 2, it can be seen that the C-Organic and Total N values of organic farming soil are slightly higher than conventional farming. This can be caused by the pH value of organic farmland being slightly higher than conventional farmland. The level of soil acidity (pH) affects the process of decomposition of soil minerals and the absorption of nutrients by plants, thus affecting the biological and chemical properties of soil (Teul et al., 2024).

3. Soil pH and Soil Salinity

From the results of the study, it appears that soil pH on organic and conventional farms is not significantly different, but the pH value of organic land is higher than conventional. Based on the assessment according to the Soil Research Centre, the pH of organic land is included in the neutral category while conventional land is included in the slightly acidic category. This is due to the use of conventional fertilisers which can reduce the pH value of the soil. According to Nopriani et al. (2023), One of the causes of the decrease in soil pH is the use of conventional fertilisers, while the application of compost that has been decomposed properly will release its minerals in the form of wet cations so that it can increase the pH towards neutral (Yunanda et al., 2023). The use of manure/compost can act as a buffer by chelating elements that cause salinity by binding Na and Cl elements to reduce soil salinity (Ndua, 2023). This causes the soil salinity value on organic farmland to be smaller than conventional farmland even though the independent sample T test results show no significant difference

4. Field Capacity

From the results of the study, the field capacity of organic and conventional agricultural land is not significantly different, but the value of field capacity of organic land is higher than conventional agricultural land. This can be caused by the content of soil organic matter. Soil organic matter on organic land is higher than soil organic matter on conventional land, although not significantly different. This causes the field capacity of organic land to also be higher than the field capacity of conventional land. This is consistent with the opinion of Maliku et al. (2024), that higher field capacity is caused by higher organic matter, and the reverse is also true.

5. Soil Total Microbes

From the results of laboratory analysis, the number of microbes on organic land and conventional land is not significantly different, but the number of microbes on organic land is higher than the number of microbes on conventional land. This is due to the provision of microbes on organic land, the provision of organic fertiliser, and is influenced by soil pH. neutral soil pH will be more favourable for soil microbial development than acidic soil pH. pH on organic land is neutral while pH on conventional land is slightly acidic so that microbial development on organic land is better than conventional land. This is in accordance with the opinion of Kalay et al. (2019), that the addition of organic matter such as organic fertiliser can spur the development of bacterial populations. The development of bacterial populations is also influenced by soil pH, acidic pH can inhibit microbial populations.

6. Porocity

From the results of soil analysis in the laboratory, it is known that the porosity on organic farmland and porosity on conventional farmland are not significantly different. Although not significantly different, the porosity value of organic land is lower than conventional land and the soil consistency value in organic land is higher than conventional land. Low soil porosity indicates that the soil has a small pore space so that it has the ability to fill and retain higher water as indicated by the results of soil liquid limit analysis on organic land which is higher. High soil porosity indicates that the soil has large pore spaces so that the ability to fill and retain water is lower, indicated by lower soil liquid limit analysis values (Sefiana, 2022). In organic farming and conventional farming in Batur Village, soil porosity is almost the same, indicating that the number of small pores and large pores is also almost the same.

7. Permeability

From the results of the study, soil permeability on organic farmland and conventional farmland is not significantly different. Soil permeability and porosity are also influenced by soil texture. soil texture affects soil pores. soils dominated by sand will have large pores, demu-dominated soils will have medium pores, and clay-dominated soils will have many small pores (Bahar et al., 2020). Soil texture on organic and conventional farmland is similar, dominated by dust, then sand and very little clay. Therefore, organic and conventional farmlands are dominated by medium soil pores, and some large soil pores, and few small soil pores. Soils with small pores cause slow permeability rates while soils with macro pores cause fast permeability rates. Porosity and permeability have a directly proportional relationship, where empty pore space and not filled with mineral materials or others, can increase the permeability rate (Ali et al., 2022). However, in the results of soil sample analysis, porosity and permeability are not directly proportional, this can be caused by errors in sampling or other factors such as tillage, content weight, and total pore volume (Minangkabau et al., 2020).

Table 4. Standard Criteria for Soil Damage in Drylands

No	Parameters	The Critical Threshold
1.	Permeability	< 0,7 cm/h; > 8,0 cm/h
2.	pH (H2O) 1:25	< 4,5; >8,5
3.	Porosity	< 30%; >70%
4.	Electrical Conductivity (DHL)	> 4,0 mS/cm
5.	Number of microbes	< 102 cfu/g

Source: Government Regulation No. 150 Year 2000.

The results of soil analysis in the laboratory include Permeability, pH (H_2O), Porosity, Electrical Conductivity (DHL), and the number of microbes is still above the critical threshold of soil damage quality standard criteria shown in Table 4. This indicates that the agricultural land in Batur Village, Getasan District, Semarang Regency has good quality for agricultural activities.

4.2 Methods The effect of organic and conventional farming on farm profits

The identification of inputs (production costs) and outputs (income) in organic and conventional farming systems from an economic point of view was carried out using the interview method and the resulting data are shown in Table 5.

Table 5. Production Costs and Income of Organic and Conventional Farming per Hectare

No	Types of Vegetables	Production Cost (Rp)		Income (Rp)	
		Organic	Conventional	Organic	Conventional
1	Green Lettuce	8.556.584	12.413.889	80.000.000	72.000.000
2	Pak Choi/ Bok Choy	5.069.444	10.805.556	26.666.667	25.000.000
3	Coriander Leaf	6.583.333	21.277.778	177.777.778	200.000.000
4	Chickpeas	5.054.222	10.459.667	30.000.000	22.500.000
5	Cabbage	5.812.500	22.012.500	40.000.000	54.000.000
6	Kale Curly	12.079.861	19.763.889	500.000.000	500.000.000
7	Tomatoes	24.590.278	21.192.083	82.500.000	55.000.000
8	Chinese Cabbage	7.430.556	5.737.222	56.250.000	60.000.000
Average		**9.397.097**	**15.457.823**	**124.149.306**	**124.149.306**
T Test Results		**Significantly Different**		**No significant difference**	

Production costs were obtained from interviews with organic and conventional farmers. Production costs are obtained from the sum of variable costs and fixed costs, namely the cost of seeds, bollards, mulch, raffia, fertilisers, and pesticides. Table 5 shows that organic farming production costs are significantly different from conventional farming production costs. Organic farming production costs are lower than conventional farming production costs. The production costs of organic farming in lettuce, pakcoy, coriander leaves, beans, cabbage, curly kale, and tomatoes are less than the production costs of conventional farming while the production costs of organic farming in chicory crops are greater than conventional farming. The cost of seeds and fertilisers of organic chicory is greater than conventional chicory. This is influenced by different farming methods that require different seeds and fertilisers. According to the research results Iwe et al. (2022), The organic farming production costs are higher than conventional farming. This is due to the cost of purchasing expensive fertiliser, while in organic farming in Batur Village, Getasan Subdistrict, Semarang Regency, the organic fertiliser used is made independently and sold at Rp1,000/kg according to the decision of farmers and the agricultural office. However, according to the research results Anggita & Suprehatin (2020), organic farming production costs are lower than conventional farming.

Income is obtained from the results of interviews with organic farmers and conventional farmers. Revenue is calculated from the number of crops multiplied by the average price offered by traditional market collectors so that in this study there is no price difference between organic and conventional agricultural products. From Table 5, it can be seen that the income from organic farming in lettuce, pakcoy, beans, and tomatoes is greater than conventional farming, while the income from organic farming in cilantro, cabbage, and chicory is smaller than conventional farming. Organic and conventional farming incomes in curly kale crops are equal. Organic farming income in cilantro, cabbage and mustard greens is less influenced by organic farmers' yields which tend to be less due to consumer demand in supermarkets that prefer medium-sized vegetables. According to the research results Anggita & Suprehatin (2020), Income from organic and conventional farming is not different because organic and conventional farmers get the same sale.

Table 6. Profits from Organic and Conventional Farming per Hectare

No	Types of Vegetables	Profit (Rp)	
		Organic Farming	Conventional Farming
1	Green Lettuce	71.443.416	59.586.111
2	Pak Choi/ Bok Choy	21.597.222	14.194.444
3	Coriander Leaf	171.194.444	178.722.222
4	Chickpeas	24.945.778	12.040.333
5	Cabbage	34.187.500	31.987.500
6	Kale Curly	487.920.139	480.236.111
7	Tomatoes	57.909.722	33.807.917
8	Chinese Cabbage	48.819.444	54.262.778
Average		**114.752.208**	**108.104.677**

The profitability of organic and conventional farming was tested using an independent sample T test with the results shown in Table 7.

Table 7. The Results of The Analysis of The Profit Value of Cultivation with The Independent Sample Mann-Whitney U Test

Independent-Samples Mann-Whitney U Test Summary	
Profit Value of Cultivation	16
Mann-Whitney U	27.000
Wilcoxon W	63.000
Test Statistic	27.000
Standard Error	9.522
Standardized Test Statistic	-.525
Asymptotic Sig.(2-sided test)	.600
Exact Sig.(2-sided test)	.645

From Table 7, it is known that the asymptotic sig. 2 sided is 0.600. Asymptotic sig. 2 is greater than 0.05 so it can be concluded that there is no significant difference between the profit of organic farming and conventional farming. However, it can be seen in Table 6 that the profit from organic farming is slightly greater than conventional farming. The productivity of organic and conventional farming is not different. This can be seen from the soil C-Organic and N-Total contents which are almost the same between organic farming and conventional farming. Income from organic farming and conventional farming is calculated at the selling price of conventional agricultural products (local market price), so if organic farming yields are calculated at the price of organic products, income from organic farming is much higher. This is in accordance with the research results of Anggita & Suprehatin (2020), that the benefits obtained from organic farming are greater than conventional farming. This is due to the total cost of organic farming is lower than conventional farming.

5. CONCLUSION

In Batur Village, Getasan Subdistrict, Semarang Regency, organic and conventional agricultural land did not have significant differences in soil physical, chemical and biological properties, but soil physical, chemical and biological properties were slightly better on organic land. This is because the addition of chemical fertilisers and pesticides in conventional farming can reduce soil quality. The production cost of organic farming is significantly different from the production cost of conventional farming. Organic farming production costs are lower than conventional farming. Revenues and profits of organic and conventional farming are not significantly different. This is because in this study the price used is the price of traditional market middlemen. Organic farmers will get more profit if they sell their crops at the price of organic vegetables in the modern market. The results of this study can be used to promote organic farming practices by favouring low production costs and better soil quality and can increase income if they find the right market share.

6. SUGGESTION

From the results of the study, it can be seen that conventional farming, which combines the use of organic fertilisers and chemical fertilisers, causes soil quality, especially soil pH, to be slightly lower than organic farming. The continued application of conventional farming can lead to a decrease in land quality which has an impact on reducing productivity and the quality of crops. Some suggestions for farmers to be interested in implementing organic farming are: The government is more active in promoting organic farming, providing education to farmers related to organic farming, and providing facilities to farmers so that they can support horticultural farmers to switch to organic farming such as training in making organic agricultural inputs (fertilisers, pesticides, local microorganisms, etc.) and providing free organic certification, expanding the market share of organic agricultural products, educating consumers about the importance of organic vegetables, and government subsidies in the form of organic fertilisers and pesticides for farmers so that the price of organic fertilisers and pesticides will be cheaper.

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