

Correspondent Author

1. Proofread document received (13-03-2024)
Document from proofreading service
2. Submitted to the journal "SAINS TANAH-Journal of Soil Science and Agroclimatology" (10-06-2024)
3. First revision: Round 1 (10-06-2024)
 - a. Review Version : 87956-252926-1-RV.docx (10-06-2024)
 - b. Uploaded file : Reviewer A 87956-253172-1-RV.docx (12-06-2024)
 - c. Author Version : 87956-254745-1-ED.docx (23-06-2024)
: 87956-254745-2-ED.docx (23-06-2024)
4. Second revision: Round 2 (23-06-2024)
 - a. Review Version : 87956-252926-2-RV.docx (23-06-2024)
 - b. Uploaded file : Reviewer A 87956-255328-1-RV.docx (26-06-2024)
 - c. Editor Version : 87956-261981-1-ED.docx (03-08-2024)
 - d. Author Version : 87956-254745-3-ED.docx (31-07-2024)
: 87956-254745-4-ED.docx (31-07-2024)
5. Third revision: Round 3 (03-08-2024)
 - a. Review Version : 87956-252926-3-RV.docx (03-08-2024)
 - b. Uploaded file : Reviewer A 87956-262933-1-RV.docx (09-08-2024)
 - c. Editor Version : 87956-261981-2-ED.docx (03-08-2024)
 - d. Author Version : 87956-254745-5-ED.docx (24-08-2024)
: 87956-254745-6-ED.docx (24-08-2024)
6. Fourth revision: Round 4 (07-10-2024)
 - a. Review Version : 87956-252926-5-RV.docx (07-10-2024)
 - b. Initiated : 10-09-2024
 - c. Last modified : 20-11-2024
 - d. Uploaded file : Reviewer B 87956-270425-1-RV.docx (22-10-2024)
7. Editor Decision
 - a. Decision : Accept Submission 10-12-2024)
 - b. Editor Version : 87956-261981-3-ED.docx (10-09-2024)
: 87956-261981-4-ED.docx (07-10-2024)
 - c. Author Version : 87956-254745-7-ED.docx (08-12-2024)
: 87956-254745-8-ED.docx (08-12-2024)
8. Copyediting (10-12-2024)
9. Paper published (08-01-2025)

1. Proofread document received (13-03-2024)

Document from proofreading service

COMPARISON ~~OF~~ CONVENTIONAL AND ORGANIC PADDY CROPTING SYSTEMS IN SOUTH SULAWESI

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Abstract

Rice is the food source for the community, including in the South Sulawesi area, ~~consequently, there needs to be.~~ ~~Consequently,~~ proper management ~~is needed~~ to support optimal production results. ~~Currently, several~~ Several farmers are ~~currently~~ starting to develop organic farming systems. ~~This is because due to the shortcomings of the~~ the conventional farming system ~~has many shortcomings, including the usingsuch as the use of~~ chemical inputs, land degradation, and decreased production. This ~~researchstudy~~ aims to compare the organic farming developed by farmers with conventional farming systems in terms of land ownership, input, soil quality, and productivity. In general, in ~~South~~ South Sulawesi, organic farming system is better than conventional farming systems. The inputs in the conventional are certified seeds, chemical fertilizers, and pesticides, which ~~of course~~ will affect costs and have an effect in the long term. Meanwhile, in an organic farming system, seed needs are met independently by farmers, using organic materials (manure, compost, bokashi) and biopesticides. Productivity also shows that the organic farming system ~~is able to increaseincreases~~ production ~~compared tothan~~ conventional farming. In the future, farmers can start to develop an organic farming system by adding various organic ingredients to support their field performance.

Keywords: chemical input, grain productivity, rice, soil fertility.

INTRODUCTION

The use and management of land for economic growth purposes and food availability often seem to be in conflict with efforts to preserve natural resources, especially rice fields. In fact, land management for that purpose should be carried out without damaging the environment, or at least efforts must be made to balance these two components can approach ideal conditions. ~~As a result~~ ~~Consequently,~~ the ideal field management application is economically feasible and ecologically sustainable [1]. One effort that can be made is to support organic farming carried out by farmers on a massive scale. Organic farming systems have experienced rapid development in European and American countries. The rate of organic food sales in these countries has ranged ~~betweenfrom~~ 20%- to 25% per year over the last decade [2].

~~According to~~ Sukristiyonubowo, ~~reported that~~ in Indonesia, various practices of paddy farming ~~are currently still~~ ~~remain~~ closely related to green revolution technology, such as the

combination of high external inputs (fertilizers and pesticides) and high-yielding varieties ~~which that~~ are unsustainable, production costs ~~that~~ are high, and production ~~that~~ tends to decline. ~~So this is~~ Thus, these are the ~~basis for~~ reasons why the farmers ~~switching started~~ to ~~developing~~ develop organic and semi-organic farming systems [3]. ~~A~~ The holistic organic agricultural production system ~~that~~ considers long-term environmental sustainability and primarily aims to produce food in an environmentally friendly way (Seufert et al., 2012). ~~Important~~ The important benefits of organics for the environment include biodiversity conservation, better soil quality, reduced evaporation and air intake, compaction strategies, adaptation and reduction of greenhouse gas emissions, and energy efficiency [4, 5]. Organic farming also increases social capital such as higher bargaining power, better access to credit and markets, opportunities to exchange knowledge and experience, reduced certification costs, and attractive contributions to policy institutions, increases employment opportunities in rural areas, and allows farmers to earn better education and health services due to higher incomes [6, 7]. Farmers who develop organic farming systems gain various economic benefits such as saving money by reducing input costs, selling by-products by entering the organic market with certified products, and selling at higher prices.

The appeal of organic farming, both to farmers and to the general public, is also fueled by awareness of the dangers posed by excessive residues; ~~Most~~ most consumers will choose food that is safe for one's health. South Sulawesi is a province with an organic land area of 150 thousand hectares spread across all districts. The Ministry of Agriculture declared full support in 2019 for South Sulawesi as the largest producer or producer of organic rice in Indonesia. In South Sulawesi, conventional rice fields are larger than organic ~~rice fields. Even though~~ ~~various ones.~~ Various studies have shown the benefits of organic farming compared to conventional paddy fields. Therefore, it is necessary to provide evidence related to cultivation using organic and conventional farming systems to attract the interest of farmers in South Sulawesi so that they can switch to developing organic farming. This ~~research study~~ aims to provide justification for ~~how the comparison of~~ the development of organic ~~systems compares~~ ~~te and~~ conventional ~~ones farming systems~~ in the South Sulawesi area. ~~There are several~~ Several points are studied, namely, the use of inputs used for cultivation, soil fertility, and the rice yields produced.

RESEARCH METHODS

Place and ~~time~~ Time of ~~research~~ Research

~~The research~~ This study was ~~carried out~~ conducted from October 2022 to March 2023 in two rice production centers in South Sulawesi, namely, Bulukumba Regency (conventional rice farming) and Pucak Village, Maros Regency (organic rice development).

Methods

The research used a simple random method using land and production data from 130 farmers, ~~consisting of:~~ 90 farmers (~~using~~ conventional farming system) and 40 ~~farmers (using~~ organic farming system). Organic farmers implemented an organic farming system starting in 2017. Comparing farming systems used by farmers, various criteria ~~were explored~~, such as

land area, inputs used, land ~~quality, and land productivity~~quality, and land productivity, was explored. Information on land area and inputs used was obtained from interviews and discussions with farmers directly.

The ~~land~~land quality evaluation uses the land boundary approach method ~~which that~~ divides land boundary levels and land suitability classes into five groups [8]. The calculation of the land quality index uses the square index road method ~~which that~~ is modified according to the criteria for land use requirements for irrigated rice crops [9, 10]. ~~Apart~~Aside from that, in this research, soil fertility characteristics ~~were also checked, including, such as~~ cation exchange capacity, base saturation, pH H₂O, soil organic C content, and availability of nutrients N, P, and K. ~~To measure land productivity, partial, were also checked. Partial~~ productivity values (production per hectare) were used ~~to measure land productivity~~. Furthermore, to compare the differences in quality and productivity of conventional and organic rice fields, the Kruskal-~~Willis~~-Wallis test [11] is used, namely, a one-way analysis of variance using the SPSS 22.0 program.

RESULTS AND DISCUSSION

1. Land ~~area~~Area

The ownership status of conventional paddy fields is as a farmer-tenant with a land holding area in the range of 0.5—1.7 hectares, while organic paddy fields around 0.1—1.0 hectares. ~~Then the~~The result was grouped into three criteria, namely, narrow land criteria (< 0.5 ha), medium criteria (0.5—1.0 ha), and large criteria (>1.0 ha) (Table 1). The average conventional ~~farmer's~~farmer's land ownership is around 1 hectare, which means it is included in the medium category. Meanwhile, farmers with an organic ~~farming~~ system, on average, have a land area of 0.36 hectares, which is included in the narrow category. It ~~is~~ shows that land ownership ~~of~~ conventional ~~systems~~farmers in South Sulawesi is larger than organic farmers. ~~land.~~

Table 1. Distribution land ownership of conventional and ~~organik~~organic farmers

Category land area	Conventional (farmer)	Organic (farmer)
Narrow (<0.5 ha)	2 (2%)	24 (60%)
Medium (0.5—1.0 ha)	66 (73%)	16 (40%)
Area (>1.0 ha))	22 (25%)	0 (~~(~~ 0%)
Total	90 (100%)	40 (100%)

2. Production Inputs

The use of inputs by farmers ~~is~~ based on cultivation needs. There are differences in land management carried out by conventional and organic farmers. In South Sulawesi, both conventional and organic farmers, plant paddy twice a year. However, the planting pattern of conventional farmers is paddy-paddy-green beans, while ~~the planting pattern that~~ of organic farmers is paddy-paddy-fallow. The needs for rice cultivation include land, seeds,

~~fertilizer~~fertilizers, and pesticides. ~~Yet~~However, it will be different if the farmer uses an organic ~~farming~~ system.

Seeds. There are differences in seed requirements between conventional and organic farmers in South Sulawesi (Table 2). The criteria for seeds used in conventional paddy fields include superior varieties with certificate and production potential of 5–8 ~~tonnes~~tons/ha. However, the use of rice seeds in conventional rice fields is 32.88 kg ha⁻¹, while the recommended amount is 25–30 kg ha⁻¹. It is higher than recommended by agricultural extension workers. Meanwhile, the seeds used in organic rice fields come from local rice types developed by applying organic principles for at least one generation or two seasons. The use of rice seeds in organic rice fields is not engineered and not treated with chemicals. ~~Aside~~ Apart from that, the average use of rice seeds in organic rice fields is 20 kg ha⁻¹, which is lower than ~~the recommendation~~recommended (25–30 kg ha⁻¹).

Table 2. Use of rice seeds by farmers in South Sulawesi

Conventional ~~farming~~ system	Organic ~~farming~~ system
~~100%~~ One hundred percent of farmers use varieties according to recommendations (commercial seeds)	The type used is the local type
There are variations in rotation	There is no variety rotation
Just 66% of farmers use certified seeds	Seeds are produced by farmers independently
~~Seeds~~ The number of seeds planted exceeds ~~recommendations~~ the number recommended	~~Seeds~~ The number of seeds planted is lower than recommended

Fertilizer and ~~Pesticide~~. ~~Aside~~ Apart from seeds, fertilizer is also one of the inputs that differentiates conventional and organic farming (Table 3). Conventional farmers used paddy fields twice, using single and compound fertilizers (~~Urea~~urea and NPK). The composition of basic fertilizer given is 50% at plant ~~age~~aged 0–7 days after planting, and 50% supplementary fertilizer was given at plant ~~age~~aged 30–35 days after planting. All respondents did not use SP36 fertilizer, ZA fertilizer, and organic fertilizer/compost. ~~The cause is the availability of fertilizer was because they are~~ often lateunavailable. Conventional farmers were not interested in using organic fertilizer. Due to the market conditions, obtaining fertilizer was difficult and required additional costs to procure. ~~Whereas, the~~The SL-PTT technology component for paddy is the organic fertilizer provision of at least 500 kg/ha and straw return of at least 2 tons/ha [12]. ~~The use of chemical~~Chemical pesticides ~~is~~are also ~~applied~~used in order to prevent pest and disease attacks in the field, although the average dose is lower than ~~the~~recommended dose.

Table 3. Fertilizers and Pesticides Inputs on Conventional Rice Fields

Types of fertilizers and pesticides	Average Usage (kg, ltr ha ⁻¹)	Recommendation (kg, ltr ha ⁻¹)
Urea	194,53	250
SP36	0,00	100
NPK	100,78	150
Organic	0,00	500
Pesticide	1,38	2

In contrast, farmers who have organic rice fields tend to use manure, compost, bokashi, and liquid organic fertilizer (Table 4). Apart from that, biopesticides are also applied in order to prevent pest and disease attacks. The input needs of the organic rice farmers should be met independently compared to the conventional farmers. Consequently, the implementation of rice cultivation does not depend much on other parties in the future.

Table 4. Fertilizers and Pesticides Inputs on Organic Rice Fields

Types of Fertilizers and Pesticides	Usage Interval (kg, ltr ha ^{0.36})	Average Usage (kg, ltr ha ^{0.36})	Average Usage (kg, ltr ha ⁻¹)
Manure	600—4.500	1.495,0	4.176,0
Compost	0—400	65,0	181,6
Bokashi	200—2.000	615,0	1.717,8
Liquid Fertilizer	1—8	3,3	9,1
Biopesticides	1—6	2,2	6,0

3. Land Quality

Table 5 shows the evaluation of various soil fertility variables between conventional rice fields in South Sulawesi and organic rice fields. The values of all parameters, Cation exchange capacity (CEC), EC, KB, pH, C, N, P, and K in organic fields are higher compared to the conventional fields. Cation exchange capacity (CEC) in cmol kg units⁻¹ is in the land suitability category S₁ (>16 cmol kg⁻¹) for paddy. The range of CEC values in paddy fields is considered sufficient to support nutrient adsorption through fertilization. The optimal soil CEC value for irrigated and rainfed rice is in the range (>16 cmol kg⁻¹ for S₁ and =16 cmol kg⁻¹ for S₂) [6], and both fields already have high CEC even though organic has a higher value than conventional. In addition, the base saturation value expressed in units (%) at the research location is in the land suitability category S₁ (>35%) for rice plants. Base saturation conditions based on land suitability criteria for irrigated rice and rainfed rice are in the range (>36% for S₁; 20—35% for S₂; and <20% for S₃) [9]. The same condition also can be seen in pH assessment, and pH of both fields are sufficient to support

plant growth. It is because of the field in neutral condition (pH 5.5—7.0). The optimal pH value for rice plants ranges from 5.5 to 7.5 [10].

Table 5. Conditional of Quality (CBC, KB, pH) Conventional and Organic Rice-organic rice fields
Fields

Category of soil fertility	Conventional	Organic
CEC: S ₁ (>16 cmol kg ⁻¹)	19.24	23.24
KB: S ₁ (>36%)	42.17	56.00
pHH ₂ O (pH 5.5—7.0)	6.5	6.5
<u>Organic C-organic (%)</u>	1.05%	2.51%
S ₁ (>1.5%)		
S ₂ (0.8—1.5%)		
S ₃ (<0.8%)		
<u>Nitrogen (N)</u>	0.20%	0.44%
<u>low</u> (0.1—0.2%)		
<u>medium</u> (0.21—0.5%)		
<u>Phosphor (P₂O₅)</u>	12.06	12.20
<u>very</u> low (<10 ppm P ₂)		
<u>low</u> (10—25 ppm P ₂)		
<u>medium</u> (26—45 ppm P ₂)		
<u>high</u> (46—60 ppm P ₂)		
<u>Potassium (K₂O)</u>	40	42
<u>very</u> low (<10 mg 100 g ⁻¹)		
<u>low</u> (10—20 mg 100 g ⁻¹)		
<u>medium</u> (21—40 mg 100 g ⁻¹)		
<u>high</u> (41—60 mg 100 g ⁻¹)		

Different results were shown by the organic C and nitrogen content. The organic C and nitrogen content of organic field is twice as high as are higher than that of conventional field. Organic C on organic and conventional land is 1.05% and 2.51%, respectively. The soil organic matter content in conventional rice fields is in the low category (<1.5%), including land suitability class S₂ for rice plant growth. This is thought to be probably due to the intensity of cultivation carried out throughout the year by conventional farmers. Meanwhile, organic rice fields are included in the high category (>1.5%) and included in class two (S₂) land suitability. Nitrogen is one of the main needs of plants. The nitrogen value of organic field reaches 0.44% (medium category), while on that of conventional fields it is only reaches around 0.20% (low category). The low nutrient status of N is due to the nature of N₂ which is very mobile, easy to evaporate (volatilize), and leached. Although in general, farmers use urea fertilizer at quite high doses. Low soil nitrogen nutrient content correlated with organic material content. The availability of N in the soil is directly proportional to the availability of soil organic matter and limited water availability [13]. N loss easily occurs in areas with high rainfall and in soils with low organic matter content. This condition shows that the land management system is not good, especially the application of fertilizer technology and not using organic materials. Overcoming the limitations of nitrogen nutrients in rainfed paddy

fields can be ~~done~~overcome by providing organic material sourced from harvest residues, combined with low doses of inorganic fertilizer [14].

Phosphorus (P) availability in conventional and organic rice fields are 12.06 and 12.20 ppm, respectively. Both are in the low interval (10–25 ppm P). The availability of potassium (K) in conventional rice fields is 40 mg, in the medium interval (21–40 mg 100 g⁻¹), and in organic rice fields, 42 mg is in the high category (41–60 mg 100 g⁻¹). These results show that rice fields managed with an organic farming system, using organic fertilizer and pesticides, show better macronutrient ~~content~~contents N, P, and K.

Overall, ~~there are statistically significant differences on~~ the results of the land quality index for conventional ~~rice fields~~ and organic rice fields ~~show significant differences after being tested statistically~~. Numerically, the average index value for conventional rice fields is 28.6, with category S3 (according to marginal). Meanwhile, organic rice fields reached 51.04, including the S2 category (quite suitable). Soil chemical–physical fertility in the organic field is superior to conventional vegetable farming systems, such as soil pH, organic C and N, total P and K, bulk density, particle density, soil porosity, permeability, bulk density, and dehydrogenase enzymes [3, 15]. Similar results were reported in paddy farming ~~in Sambiredjo District, Sragen Regency~~, that the chemical–physical soil fertility in organic land in ~~Sambiredjo~~Sambirejo District, Sragen Regency, was superior to semi-organic and conventional farming systems. Semi-organic was better than conventional farming systems in terms of soil pH, organic C and N, total P and K, bulk density, particle density, soil porosity, and permeability. Similar findings were observed in paddy biomass production.

4. Land Productivity

~~The~~There is a statistically significant difference on the productivity of conventional and organic rice fields in South Sulawesi ~~is significantly different after being tested statistically~~. The average productivity of conventional rice fields is lower than organic ~~rice fields, respectively ones~~ (5,536 kg ha⁻¹ and 6,285 kg ha⁻¹ (Figure, respectively) (Fig. 1). The superiority of production in organic farming systems is also supported by research results [16] ~~which that~~ state that organic farming systems ~~are able to~~can increase yields by 12% per hectare. Even organic farming systems can increase crop yields by 50–60% [17]. The productivity of organic farming in the beginning stages will decrease, but ~~it~~ will increase over time. Meanwhile, conventional farming productivity systems will tend to decrease in the long term due to the nutrient poverty caused by low organic matter content [19]. This is influenced by soil fertility conditions ~~which that~~ are increasingly stable because the inputs used are without chemicals.

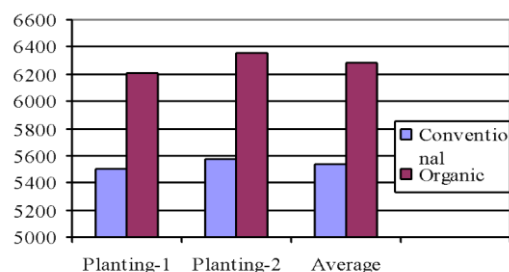


Figure 1. Grain Productivity in Conventional and Organic Rice Fields

CONCLUSIONS

The organic farming system implemented by farmers in South Sulawesi is considered better than conventional farming system based on the inputs used, the quality of the soil tested by looking at fertility parameters, and the grain yield obtained. In the future, the use of chemical inputs can be reduced and replaced with organic materials, consequently, the farmers can slowly improve the field quality and switch to organic farming system, which is more sustainable.

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2. Submitted to the journal “SAINS TANAH-Journal of Soil Science and Agroclimatology” (10-06-2024)

[STJSSA] Submission Acknowledgement

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URL: <http://jurnal.uns.ac.id/tanah>

Scopus ID: <https://www.scopus.com/sourceid/21101016524>

3. First revision: Round 1 (10-06-2024)

- a. Review Version : 87956-252926-1-RV.docx (10-06-2024)
- b. Uploaded file : Reviewer A 87956-253172-1-RV.docx (12-06-2024)
- c. Author Version : 87956-254745-1-ED.docx (23-06-2024)
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Author Version : 87956-254745-1-ED.docx (23-06-2024)

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Author Version : 87956-254745-2-ED.docx (23-06-2024)

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**COMPARISON OF CONVENTIONAL AND ORGANIC PADDY CROPPING
SYSTEMS IN SOUTH SULAWESI**

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VIII. The main findings and why they are important and useful.

Productivity shows that the organic farming system increases production than conventional farming. In the future, farmers can start to develop an organic farming system by adding various organic ingredients to support their field performance.

IX. Why the readers of the journal would be interested in the work.

This study aims to compare the organic farming developed by farmers with conventional farming systems in terms of land ownership, input, soil quality, and productivity. In general, in South Sulawesi, organic farming system is better than conventional farming systems.

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COMPARISON OF CONVENTIONAL AND ORGANIC PADDY CROPPING SYSTEMS IN SOUTH SULAWESI

ABSTRACT

Rice is the food source for the community, including in the South Sulawesi area. Consequently, proper management is needed to support optimal production results. Several farmers are currently starting to develop organic farming systems due to the shortcomings of the conventional farming system such as the use of chemical inputs, land degradation, and decreased production. This study aims to compare the organic farming developed by farmers with conventional farming systems in terms of land ownership, input, soil quality, and productivity. In general, in South Sulawesi, organic farming system is better than conventional farming systems. The inputs in the conventional are certified seeds, chemical fertilizers, and pesticides, which will affect costs and have an effect in the long term. Meanwhile, in an organic farming system, seed needs are met independently by farmers, using organic materials (manure, compost, bokashi) and biopesticides. Productivity also shows that the organic farming system increases production than conventional farming. In the future, farmers can start to develop an organic farming system by adding various organic ingredients to support their field performance.

Keywords: chemical input, grain productivity, rice, soil fertility

INTRODUCTION

The use and management of land for economic growth purposes and food availability often seem to be in conflict with efforts to preserve natural resources, especially rice fields. In fact, land management for that purpose should be carried out without damaging the environment, or at least efforts must be made to balance these two components can approach ideal conditions. Consequently, the ideal field management application is economically feasible and ecologically sustainable (Indahyani & Maga, 2023). One effort that can be made is to support organic farming carried out by farmers on a massive scale. Organic farming systems have experienced rapid development in European and American countries. The rate of organic food sales in these countries has ranged from 20% to 25% per year over the last decade (Zulvera, 2014).

Sukristiyonubowo reported that in Indonesia, various practices of paddy farming remain closely related to green revolution technology, such as the combination of high external inputs (fertilizers and pesticides) and high-yielding varieties that are unsustainable, production costs that are high, and production that tends to decline. Thus, these are the reasons why the farmers started to develop organic and semiorganic farming systems (Sukristiyonubowo et al., 2018). The holistic organic agricultural production system considers long term environmental sustainability and primarily aims to produce food in an environmentally friendly way (Seufert et al., 2012). The important benefits of organics for the environment include biodiversity conservation, better soil quality, reduced evaporation and air intake, compaction strategies, adaptation and reduction of greenhouse gas emissions, and energy efficiency (Reganold & Wachter, 2016; Seufert et al., 2012). Organic farming also increases social capital such as higher bargaining power, better access to credit and markets,

opportunities to exchange knowledge and experience, reduced certification costs, and attractive contributions to policy institutions, increases employment opportunities in rural areas, and allows farmers to earn better education and health services due to higher incomes (UNEP, 2008; van Elzakker & Eyhorn, 2010). Farmers who develop organic farming systems gain various economic benefits such as saving money by reducing input costs, selling by-products by entering the organic market with certified products, and selling at higher prices.

The appeal of organic farming, both to farmers and to the general public, is also fueled by awareness of the dangers posed by excessive residues; most consumers will choose food that is safe for one's health. South Sulawesi is a province with an organic land area of 150 thousand hectares spread across all districts. The Ministry of Agriculture declared full support in 2019 for South Sulawesi as the largest producer or producer of organic rice in Indonesia. In South Sulawesi, conventional rice fields are larger than organic ones. Various studies have shown the benefits of organic farming compared to conventional paddy fields. Therefore, it is necessary to provide evidence related to cultivation using organic and conventional farming systems to attract the interest of farmers in South Sulawesi so that they can switch to developing organic farming. This study aims to provide justification for the comparison of the development of organic and conventional farming systems in the South Sulawesi area. Several points are studied, namely, the use of inputs used for cultivation, soil fertility, and the rice yields produced.

MATERIAL AND METHODS

Place and Time of Research

This study was conducted from October 2022 to March 2023 in two rice production centers in South Sulawesi, namely, Bulukumba Regency (conventional rice farming) and Pucak Village, Maros Regency (organic rice development).

Methods

The research used a simple random method using land and production data from 130 farmers: 90 farmers using conventional farming system and 40 using organic farming system. Organic farmers implemented an organic farming system starting in 2017. Comparing farming systems used by farmers, various criteria, such as land area, inputs used, land quality, and land productivity, was explored. Information on land area and inputs used was obtained from interviews and discussions with farmers directly.

The land quality evaluation uses the land boundary approach method that divides land boundary levels and land suitability classes into five groups (Sys et al., 1991). The calculation of the land quality index uses the square index road method that is modified according to the criteria for land use requirements for irrigated rice crops (Djaenudin et al., 2003; Sys et al., 1993). Aside from that, in this research, soil fertility characteristics, such as cation exchange capacity, base saturation, pH H₂O, soil organic C content, and availability of nutrients N, P, and K, were also checked. Partial productivity values (production per hectare) were used to measure land productivity. Furthermore, to compare the differences in quality and productivity of conventional and organic rice fields, the Kruskal–Wallis test (Kruskal & Wallis, 1952) is used, namely, a one-way analysis of variance using the SPSS 22.0 program.

RESULTS

Land Area

The ownership status of conventional paddy fields is as a farmer-tenant with a land holding area in the range of 0.5–1.7 hectares, while organic paddy fields around 0.1–1.0 hectares. The result was grouped into three criteria, namely, narrow land criteria (< 0.5 ha), medium criteria (0.5–1.0 ha), and large criteria (>1.0 ha) (Table 1). The average conventional farmer's land ownership is around 1 hectare, which means it is included in the medium category. Meanwhile, farmers with an organic farming system, on average, have a land area of 0.36 hectares, which is included in the narrow category. It shows that land ownership of conventional farmers in South Sulawesi is larger than organic farmers.

[Table 1 here]

Production Inputs

The use of inputs by farmers is based on cultivation needs. There are differences in land management carried out by conventional and organic farmers. In South Sulawesi, both conventional and organic farmers plant paddy twice a year. However, the planting pattern of conventional farmers is paddy-paddy-green beans, while that of organic farmers is paddy-paddy-fallow. The needs for rice cultivation include land, seeds, fertilizers, and pesticides. However, it will be different if the farmer uses an organic farming system.

Seeds

There are differences in seed requirements between conventional and organic farmers in South Sulawesi (Table 2). The criteria for seeds used in conventional paddy fields include superior varieties with certificate and production potential of 5–8 tons/ha. However, the use of rice seeds in conventional rice fields is 32.88 kg ha⁻¹, while the recommended amount is 25–30 kg ha⁻¹. It is higher than recommended by agricultural extension workers. Meanwhile, the seeds used in organic rice fields come from local rice types developed by applying organic principles for at least one generation or two seasons. The use of rice seeds in organic rice fields is not engineered and not treated with chemicals. Aside from that, the average use of rice seeds in organic rice fields is 20 kg ha⁻¹, which is lower than recommended (25–30 kg ha⁻¹).

[Table 2 here]

Fertilizer and pesticide

Aside from seeds, fertilizer is also one of the inputs that differentiates conventional and organic farming (Table 3). Conventional farmers used paddy fields twice, using single and compound fertilizers (urea and NPK). The composition of basic fertilizer given is 50% at plant aged 0–7 days after planting, and 50% supplementary fertilizer was given at plant aged 30–35 days after planting. All respondents did not use SP36 fertilizer, ZA fertilizer, and organic fertilizer/compost because they are often unavailable.

[Table 3 here]

In contrast, farmers who have organic rice fields tend to use manure, compost, bokashi, and liquid organic fertilizer (Table 4). Aside from that, biopesticides are also used in order to prevent pest and disease attacks. The input needs of the organic rice farmers should be met independently than those

of the conventional farmers. Consequently, the implementation of rice cultivation does not depend much on other parties in the future.

[Table 4 here]

Land Quality

Table 5 shows the evaluation of various soil fertility variables between conventional rice fields in South Sulawesi. The values of all parameters, Cation exchange capacity (CEC), KB, pH, organic C, N, P, and K in organic fields are higher than those of conventional fields. Cation exchange capacity (CEC) in $\text{cmol kg units}^{-1}$ is in the land suitability category S_1 ($>16 \text{ cmol kg}^{-1}$) for paddy.

[Table 5 here]

Land Productivity

There is a statistically significant difference on the productivity of conventional and organic rice fields in South Sulawesi. The average productivity of conventional rice fields is lower than organic ones ($5,536 \text{ kg ha}^{-1}$ and $6,285 \text{ kg ha}^{-1}$, respectively) (Fig. 1).

[Figure 1 here]

DISCUSSION

Conventional farmers were not interested in using organic fertilizer. Due to the market conditions, obtaining fertilizer was difficult and required additional costs to procure. The SL-PTT technology component for paddy is the organic fertilizer provision of at least 500 kg/ha and straw return of at least 2 tons/ha (Supriadi et al., 2016). Chemical pesticides are also used in order to prevent pest and disease attacks in the field, although the average dose is lower than recommended.

The range of Cation exchange capacity (CEC) values in paddy fields is enough to support nutrient adsorption through fertilization. The optimal soil CEC value for irrigated and rainfed rice is in the range ($>16 \text{ cmol kg}^{-1}$ for S_1 and $=16 \text{ cmol kg}^{-1}$ for S_2) [6], and both fields already have high CEC even though organic has a higher value than conventional. In addition, the base saturation value expressed in units (%) at the research location is in the land suitability category S_1 ($>35\%$) for rice plants. Base saturation conditions based on land suitability criteria for irrigated rice and rainfed rice are in the range ($>36\%$ for S_1 ; $20\text{--}35\%$ for S_2 ; and $<20\%$ for S_3) [9]. The same condition also can be seen in pH assessment, and pH of both fields are sufficient to support plant growth because of the field in neutral condition (pH $5.5\text{--}7.0$). The optimal pH value for rice plants ranges from 5.5 to 7.5 (Djaenudin et al., 2003).

Different results were shown by the organic C and nitrogen content. The organic C and nitrogen content of organic field are higher than that of conventional field. Organic C on organic and conventional land is 1.05% and 2.51% , respectively. The soil organic matter content in conventional rice fields is in the low category ($<1.5\%$), including land suitability class S_2 for rice plant growth. This is probably due to the intensity of cultivation carried out throughout the year by conventional farmers. Meanwhile, organic rice fields are included in the high category ($>1.5\%$) and included in class two (S_2) land suitability. Nitrogen is one of the main needs of plants. The nitrogen value of organic field reaches 0.44% (medium category), while that of conventional fields reaches around 0.20% (low category). The low nutrient status of N is due to the nature of N, which is very mobile, easy to evaporate (volatilize), and leached. In general, farmers use urea fertilizer at quite high doses. Low soil nitrogen nutrient content correlated with organic material content. The availability of N in the soil is directly proportional to the availability of soil organic matter and limited water availability (Peku Jawang, 2021). N loss easily

occurs in areas with high rainfall and in soils with low organic matter content. This condition shows that the land management system is not good, especially the application of fertilizer technology and not using organic materials. The limitations of nitrogen nutrients in rainfed paddy fields can be overcome by providing organic material sourced from harvest residues, combined with low doses of inorganic fertilizer (Benauli, 2021).

Phosphorus (P) availability in conventional and organic rice fields are 12.06 and 12.20 ppm, respectively. Both are in the low interval (10–25 ppm P). The availability of potassium (K) in conventional rice fields is 40 mg in the medium interval (21–40 mg 100 g⁻¹), and in organic rice fields, 42 mg is in the high category (41–60 mg 100 g⁻¹). These results show that rice fields managed with an organic farming system, using organic fertilizer and pesticides, show better macronutrient contents N, P, and K.

Overall, there are statistically significant differences on the results of the land quality index for conventional and organic rice fields. Numerically, the average index value for conventional rice fields is 28.6, with category S3 (according to marginal). Meanwhile, organic rice fields reached 51.04, including the S2 category (quite suitable). Soil chemical–physical fertility in the organic field is superior to conventional vegetable farming systems, such as soil pH, organic C and N, total P and K, bulk density, particle density, soil porosity, permeability, bulk density, and dehydrogenase enzymes (Sukristiyonubowo et al., 2015, 2018). Similar results were reported in paddy farming that the chemical–physical soil fertility in organic land in Sambirejo District, Sragen Regency, was superior to semiorganic and conventional farming systems. Semiorganic was better than conventional farming systems in terms of soil pH, organic C and N, total P and K, bulk density, particle density, soil porosity, and permeability. Similar findings were observed in paddy biomass production.

There is a statistically significant difference on the productivity of conventional and organic rice fields in South Sulawesi. The superiority of production in organic farming systems is also supported by research results Santoso (2012) that state that organic farming systems can increase yields by 12% per hectare. Even organic farming systems can increase crop yields by 50–60% (Surekha, 2013). The productivity of organic farming in the beginning stages will decrease but will increase over time. Meanwhile, conventional farming productivity systems will tend to decrease in the long term due to the nutrient poverty caused by low organic matter content (Heryanto et al., 2016). This is influenced by soil fertility conditions that are increasingly stable because the inputs used are without chemicals.

CONCLUSION

The organic farming system implemented by farmers in South Sulawesi is considered better than conventional farming system based on the inputs used, the quality of the soil tested by looking at fertility parameters, and the grain yield obtained. In the future, the use of chemical inputs can be reduced and replaced with organic materials. Consequently, the farmers can slowly improve the field quality and switch to organic farming system, which is more sustainable.

Figure and Table

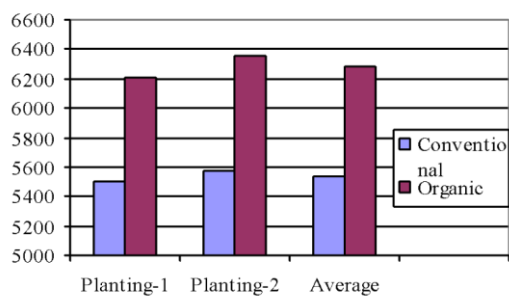


Figure 1. Grain productivity in conventional and organic rice fields.

Table 1. Distribution land ownership of conventional and organic farmers

Category land area	Conventional (farmer)	Organic (farmer)
Narrow (<0.5 ha)	2 (2%)	24 (60%)
Medium (0.5–1.0 ha)	66 (73%)	16 (40%)
Area (>1.0 ha))	22 (25%)	0 (0%)
Total	90 (100%)	40 (100%)

Table 2. Use of rice seeds by farmers in South Sulawesi

Conventional farming system	Organic farming system
One hundred percent of farmers use varieties according to recommendations (commercial seeds)	The type used is the local type
There are variations in rotation	There is no variety rotation
Just 66% of farmers use certified seeds	Seeds are produced by farmers independently
The number of seeds planted exceeds the number recommended	The number of seeds planted is lower than recommended

Table 3. Fertilizers and pesticides inputs on conventional rice fields

Types of fertilizers and pesticides	Average usage (kg, ltr ha ⁻¹)	Recommendation (kg, ltr ha ⁻¹)
Urea	194,53	250
SP36	0,00	100
NPK	100,78	150
Organic	0,00	500
Pesticide	1,38	2

Table 4. Fertilizers and pesticides inputs on organic rice fields

Types of fertilizers and pesticides	Usage interval (kg, ltr ha ^{0.36})	Average usage (kg, ltr ha ^{0.36})	Average usage (kg, ltr ha ⁻¹)
Manure	600–4.500	1.495,0	4.176,0
Compost	0–400	65,0	181,6
Bokashi fertilizer	200–2.000	615,0	1.717,8
Liquid fertilizer	1–8	3,3	9,1
Biopesticides	1–6	2,2	6,0

Table 5. Conditional of quality (CBC, KB, pH) conventional and organic rice fields

Category of soil fertility	Conventional	Organic
CEC: S ₁ (>16 cmol kg ⁻¹)	19.24	23.24
KB: S ₁ (>36%)	42.17	56.00
pHH ₂ O (pH 5.5–7.0)	6.5	6.5
<u>Organic C (%)</u>	1.05%	2.51%
S ₁ (>1.5%)		
S ₂ (0.8–1.5%)		
S ₃ (<0.8%)		
<u>Nitrogen (N)</u>	0.20%	0.44%
Low (0.1–0.2%)		
Medium (0.21–0.5%)		
<u>Phosphor (P₂O₅)</u>	12.06	12.20
Very low (<10 ppm P)		
Low (10–25 ppm P)		
Medium (26–45 ppm P)		
High (46–60 ppm P)		
<u>Potassium (K₂O)</u>	40	42
Very low (<10 mg 100 g ⁻¹)		
Low (10–20 mg 100 g ⁻¹)		
Medium (21–40 mg 100 g ⁻¹)		
High (41–60 mg 100 g ⁻¹)		

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4.Second revision: Round 2 (3-8-2024)

- a. Review Version : 87956-252926-2-RV.docx (23-06-2024)
- b. Uploaded file : Reviewer A 87956-255328-1-RV.docx (26-06-2024)
- c. Editor Version : 87956-261981-1-ED.docx (03-08-2024)
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Dear Nurliani Nurliani:

We have reached a decision regarding your submission to SAINS TANAH - Journal of Soil Science and Agroclimatology, "COMPARISON OF CONVENTIONAL AND ORGANIC PADDY CROPPING SYSTEMS IN SOUTH SULAWESI".
Our decision is: Resubmit for Review (due date is August 23, 2024)

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POINT-TO-POINT RESPONSES

Comments on manuscript:

No	Comments	Responses
1.	Please add more references in the introduction and discussion. Here some suggestion references : https://dx.doi.org/10.20961/stjssa.v20i2.71431 https://dx.doi.org/10.20961/stjssa.v19i2.58375 https://dx.doi.org/10.20961/stjssa.v18i1.50489 https://dx.doi.org/10.20961/stjssa.v18i2.56330	We have added citations to the introduction as directed.
2.	Please add the method in the abstract (before the result)	As per the instructions, we added the method before the result in the abstract section.
3.	The introduction is not strong enough, please add more citations to explain the urgency of this research	We have added three recent citations (2021–2023) in the introduction that explain the urgency of this research. This research is urgent to provide empirical evidence of the benefits of organic farming over conventional methods in South Sulawesi, addressing high costs, declining yields, and environmental impacts of conventional practices. Demonstrating improvements in soil

		quality, crop yields, and sustainability through organic farming can encourage local farmers to adopt these methods for long-term economic and ecological gains.
4.	Please add the coordinate and land characteristic	We have added the coordinates and land characteristics information as directed in the materials and methods section.
5.	Add the map of sampling or mention how many soil sampling points	We have included information on the coordinates and characteristics of the sampling sites in the materials and methods section as directed. Additionally, we have specified that soil samples were taken from 10 locations to address the reviewer's suggestion.
6.	Add more citations in the discussion. The discussion should be arranged comprehensively by correlating one parameter to others (Not explaining each parameter separately). Start the discussion with the main finding of this research, and explain the reason/mechanism of WHY the results are like that (why the organic system is better than conventional). Explain it with your data and support it with citations. ex: Start with the result : organic cropping is better than conventional (explain why you can conclude that), and show your data. Then, explain the reason.	We have added an explanation regarding comparing our research results with previous research as directed.
7.	Add the exist title and the units	We have updated Figure 1 by adding the title and units as instructed.

COMPARISON OF CONVENTIONAL AND ORGANIC PADDY CROPPING SYSTEMS IN SOUTH SULAWESI

ABSTRACT

Rice is the food source for the community, including in the South Sulawesi area. Consequently, proper management is needed to support optimal production results. Several farmers are currently starting to develop organic farming systems due to the shortcomings of the conventional farming system such as the use of chemical inputs, land degradation, and decreased production. This study aims to compare the organic farming developed by farmers with conventional farming systems in terms of land ownership, input, soil quality, and productivity. In general, in South Sulawesi, organic farming system is better than conventional farming systems. The inputs in the conventional are certified seeds, chemical fertilizers, and pesticides, which will affect costs and have an effect in the long term. Meanwhile, in an organic farming system, seed needs are met independently by farmers, using organic materials (manure, compost, bokashi) and biopesticides. Productivity also shows that the organic farming system increases production than conventional farming. In the future, farmers can start to develop an organic farming system by adding various organic ingredients to support their field performance.

Keywords: chemical input, grain productivity, rice, soil fertility

INTRODUCTION

The use and management of land for economic growth purposes and food availability often seem to be in conflict with efforts to preserve natural resources, especially rice fields. In fact, land management for that purpose should be carried out without damaging the environment, or at least efforts must be made to balance these two components can approach ideal conditions. Consequently, the ideal field management application is economically feasible and ecologically sustainable (Indahyani & Maga, 2023). One effort that can be made is to support organic farming carried out by farmers on a massive scale. Organic farming systems have experienced rapid development in European and American countries. The rate of organic food sales in these countries has ranged from 20% to 25% per year over the last decade (Zulvera, 2014).

Sukristiyonubowo reported that in Indonesia, various practices of paddy farming remain closely related to green revolution technology, such as the combination of high external inputs (fertilizers and pesticides) and high-yielding varieties that are unsustainable, production costs that are high, and production that tends to decline. Thus, these are the reasons why the farmers started to develop organic and semiorganic farming systems (Sukristiyonubowo et al., 2018). The holistic organic agricultural production system considers long term environmental sustainability and primarily aims to produce food in an environmentally friendly way (Seufert et al., 2012). The important benefits of organics for the environment include biodiversity conservation, better soil quality, reduced evaporation and air intake, compaction strategies, adaptation and reduction of greenhouse gas emissions, and energy efficiency (Reganold & Wachter, 2016; Seufert et al., 2012). Organic farming also increases social capital such as higher bargaining power, better access to credit and markets,

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<https://dx.doi.org/10.20961/stissa.v20i2.71431>

<https://dx.doi.org/10.20961/stissa.v19i2.58375>

<https://dx.doi.org/10.20961/stissa.v18i1.50489>

<https://dx.doi.org/10.20961/stissa.v18i2.56330>

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opportunities to exchange knowledge and experience, reduced certification costs, and attractive contributions to policy institutions, increases employment opportunities in rural areas, and allows farmers to earn better education and health services due to higher incomes (UNEP, 2008; van Elzakker & Eyhorn, 2010). Farmers who develop organic farming systems gain various economic benefits such as saving money by reducing input costs, selling by-products by entering the organic market with certified products, and selling at higher prices.

The appeal of organic farming, both to farmers and to the general public, is also fueled by awareness of the dangers posed by excessive residues; most consumers will choose food that is safe for one's health. South Sulawesi is a province with an organic land area of 150 thousand hectares spread across all districts. The Ministry of Agriculture declared full support in 2019 for South Sulawesi as the largest producer or producer of organic rice in Indonesia. In South Sulawesi, conventional rice fields are larger than organic ones. Various studies have shown the benefits of organic farming compared to conventional paddy fields. Therefore, it is necessary to provide evidence related to cultivation using organic and conventional farming systems to attract the interest of farmers in South Sulawesi so that they can switch to developing organic farming. This study aims to provide justification for the comparison of the development of organic and conventional farming systems in the South Sulawesi area. Several points are studied, namely, the use of inputs used for cultivation, soil fertility, and the rice yields produced.

MATERIAL AND METHODS

Place and Time of Research

This study was conducted from October 2022 to March 2023 in two rice production centers in South Sulawesi, namely, Bulukumba Regency (conventional rice farming) and Pucak Village, Maros Regency (organic rice development).

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Methods

The research used a simple random method using land and production data from 130 farmers: 90 farmers using conventional farming system and 40 using organic farming system. Organic farmers implemented an organic farming system starting in 2017. Comparing farming systems used by farmers, various criteria, such as land area, inputs used, land quality, and land productivity, was explored. Information on land area and inputs used was obtained from interviews and discussions with farmers directly.

Commented [H5]:

The land quality evaluation uses the land boundary approach method that divides land boundary levels and land suitability classes into five groups (Sys et al., 1991). The calculation of the land quality index uses the square index road method that is modified according to the criteria for land use requirements for irrigated rice crops (Djaenudin et al., 2003; Sys et al., 1993). Aside from that, in this research, soil fertility characteristics, such as cation exchange capacity, base saturation, pH H₂O, soil organic C content, and availability of nutrients N, P, and K, were also checked. Partial productivity values (production per hectare) were used to measure land productivity. Furthermore, to compare the differences in quality and productivity of conventional and organic rice fields, the Kruskal–Wallis test (Kruskal & Wallis, 1952) is used, namely, a one-way analysis of variance using the SPSS 22.0 program.

Commented [H6]: Add the map of sampling or mention how many soil sampling points

RESULTS

Land Area

The ownership status of conventional paddy fields is as a farmer-tenant with a land holding area in the range of 0.5–1.7 hectares, while organic paddy fields around 0.1–1.0 hectares. The result was grouped into three criteria, namely, narrow land criteria (< 0.5 ha), medium criteria (0.5–1.0 ha), and large criteria (>1.0 ha) (Table 1). The average conventional farmer's land ownership is around 1 hectare, which means it is included in the medium category. Meanwhile, farmers with an organic farming system, on average, have a land area of 0.36 hectares, which is included in the narrow category. It shows that land ownership of conventional farmers in South Sulawesi is larger than organic farmers.

[Table 1 here]

Production Inputs

The use of inputs by farmers is based on cultivation needs. There are differences in land management carried out by conventional and organic farmers. In South Sulawesi, both conventional and organic farmers plant paddy twice a year. However, the planting pattern of conventional farmers is paddy-paddy-green beans, while that of organic farmers is paddy-paddy-fallow. The needs for rice cultivation include land, seeds, fertilizers, and pesticides. However, it will be different if the farmer uses an organic farming system.

Seeds

There are differences in seed requirements between conventional and organic farmers in South Sulawesi (Table 2). The criteria for seeds used in conventional paddy fields include superior varieties with certificate and production potential of 5–8 tons/ha. However, the use of rice seeds in conventional rice fields is 32.88 kg ha⁻¹, while the recommended amount is 25–30 kg ha⁻¹. It is higher than recommended by agricultural extension workers. Meanwhile, the seeds used in organic rice fields come from local rice types developed by applying organic principles for at least one generation or two seasons. The use of rice seeds in organic rice fields is not engineered and not treated with chemicals. Aside from that, the average use of rice seeds in organic rice fields is 20 kg ha⁻¹, which is lower than recommended (25–30 kg ha⁻¹).

[Table 2 here]

Fertilizer and pesticide

Aside from seeds, fertilizer is also one of the inputs that differentiates conventional and organic farming (Table 3). Conventional farmers used paddy fields twice, using single and compound fertilizers (urea and NPK). The composition of basic fertilizer given is 50% at plant aged 0–7 days after planting, and 50% supplementary fertilizer was given at plant aged 30–35 days after planting. All respondents did not use SP36 fertilizer, ZA fertilizer, and organic fertilizer/compost because they are often unavailable.

[Table 3 here]

In contrast, farmers who have organic rice fields tend to use manure, compost, bokashi, and liquid organic fertilizer (Table 4). Aside from that, biopesticides are also used in order to prevent pest and disease attacks. The input needs of the organic rice farmers should be met independently than those

of the conventional farmers. Consequently, the implementation of rice cultivation does not depend much on other parties in the future.

[Table 4 here]

Land Quality

Table 5 shows the evaluation of various soil fertility variables between conventional rice fields in South Sulawesi. The values of all parameters, Cation exchange capacity (CEC), KB, pH, organic C, N, P, and K in organic fields are higher than those of conventional fields. Cation exchange capacity (CEC) in cmol kg^{-1} is in the land suitability category S_1 ($>16 \text{ cmol kg}^{-1}$) for paddy.

[Table 5 here]

Land Productivity

There is a statistically significant difference on the productivity of conventional and organic rice fields in South Sulawesi. The average productivity of conventional rice fields is lower than organic ones ($5,536 \text{ kg ha}^{-1}$ and $6,285 \text{ kg ha}^{-1}$, respectively) (Fig. 1).

[Figure 1 here]

DISCUSSION

Conventional farmers were not interested in using organic fertilizer. Due to the market conditions, obtaining fertilizer was difficult and required additional costs to procure. The SL-PTT technology component for paddy is the organic fertilizer provision of at least 500 kg/ha and straw return of at least 2 tons/ha (Supriadi et al., 2016). Chemical pesticides are also used in order to prevent pest and disease attacks in the field, although the average dose is lower than recommended.

The range of Cation exchange capacity (CEC) values in paddy fields is enough to support nutrient adsorption through fertilization. The optimal soil CEC value for irrigated and rainfed rice is in the range ($>16 \text{ cmol kg}^{-1}$ for S_1 and $=16 \text{ cmol kg}^{-1}$ for S_2) [6], and both fields already have high CEC even though organic has a higher value than conventional. In addition, the base saturation value expressed in units (%) at the research location is in the land suitability category S_1 ($>35\%$) for rice plants. Base saturation conditions based on land suitability criteria for irrigated rice and rainfed rice are in the range ($>36\%$ for S_1 ; $20\text{--}35\%$ for S_2 ; and $<20\%$ for S_3) [9]. The same condition also can be seen in pH assessment, and pH of both fields are sufficient to support plant growth because of the field in neutral condition (pH $5.5\text{--}7.0$). The optimal pH value for rice plants ranges from 5.5 to 7.5 (Djaenudin et al., 2003).

Different results were shown by the organic C and nitrogen content. The organic C and nitrogen content of organic field are higher than that of conventional field. Organic C on organic and conventional land is 1.05% and 2.51% , respectively. The soil organic matter content in conventional rice fields is in the low category ($<1.5\%$), including land suitability class S_2 for rice plant growth. This is probably due to the intensity of cultivation carried out throughout the year by conventional farmers. Meanwhile, organic rice fields are included in the high category ($>1.5\%$) and included in class two (S_2) land suitability. Nitrogen is one of the main needs of plants. The nitrogen value of organic field reaches 0.44% (medium category), while that of conventional fields reaches around 0.20% (low category). The low nutrient status of N is due to the nature of N, which is very mobile, easy to evaporate (volatilize), and leached. In general, farmers use urea fertilizer at quite high doses. Low soil nitrogen nutrient content correlated with organic material content. The availability of N in the soil is directly proportional to the availability of soil organic matter and limited water availability (Peku Jawang, 2021). N loss easily

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The discussion should be arranged comprehensively by correlating one parameter to others (Not explaining each parameter separately). Start the discussion with the main finding of this research, and explain the reason/mechanism of WHY the results are like that (why the organic system is better than conventional). Explain it with your data and support it with citations.

ex: Start with the result : organic cropping is better than conventional (explain why you can conclude that), and show your data.
Then, explain the reason.

occurs in areas with high rainfall and in soils with low organic matter content. This condition shows that the land management system is not good, especially the application of fertilizer technology and not using organic materials. The limitations of nitrogen nutrients in rainfed paddy fields can be overcome by providing organic material sourced from harvest residues, combined with low doses of inorganic fertilizer (Benauli, 2021).

Phosphorus (P) availability in conventional and organic rice fields are 12.06 and 12.20 ppm, respectively. Both are in the low interval (10–25 ppm P). The availability of potassium (K) in conventional rice fields is 40 mg in the medium interval (21–40 mg 100 g⁻¹), and in organic rice fields, 42 mg is in the high category (41–60 mg 100 g⁻¹). These results show that rice fields managed with an organic farming system, using organic fertilizer and pesticides, show better macronutrient contents N, P, and K.

Overall, there are statistically significant differences on the results of the land quality index for conventional and organic rice fields. Numerically, the average index value for conventional rice fields is 28.6, with category S3 (according to marginal). Meanwhile, organic rice fields reached 51.04, including the S2 category (quite suitable). Soil chemical–physical fertility in the organic field is superior to conventional vegetable farming systems, such as soil pH, organic C and N, total P and K, bulk density, particle density, soil porosity, permeability, bulk density, and dehydrogenase enzymes (Sukristiyonubowo et al., 2015, 2018). Similar results were reported in paddy farming that the chemical–physical soil fertility in organic land in Sambirejo District, Sragen Regency, was superior to semiorganic and conventional farming systems. Semiorganic was better than conventional farming systems in terms of soil pH, organic C and N, total P and K, bulk density, particle density, soil porosity, and permeability. Similar findings were observed in paddy biomass production.

There is a statistically significant difference on the productivity of conventional and organic rice fields in South Sulawesi. The superiority of production in organic farming systems is also supported by research results Santoso (2012) that state that organic farming systems can increase yields by 12% per hectare. Even organic farming systems can increase crop yields by 50–60% (Surekha, 2013). The productivity of organic farming in the beginning stages will decrease but will increase over time. Meanwhile, conventional farming productivity systems will tend to decrease in the long term due to the nutrient poverty caused by low organic matter content (Heryanto et al., 2016). This is influenced by soil fertility conditions that are increasingly stable because the inputs used are without chemicals.

CONCLUSION

The organic farming system implemented by farmers in South Sulawesi is considered better than conventional farming system based on the inputs used, the quality of the soil tested by looking at fertility parameters, and the grain yield obtained. In the future, the use of chemical inputs can be reduced and replaced with organic materials. Consequently, the farmers can slowly improve the field quality and switch to organic farming system, which is more sustainable.

Figure and Table

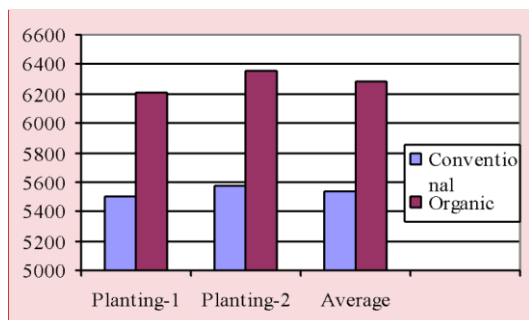


Figure 1. Grain productivity in conventional and organic rice fields.

Table 1. Distribution land ownership of conventional and organic farmers

Category land area	Conventional (farmer)	Organic (farmer)
Narrow (<0.5 ha)	2 (2%)	24 (60%)
Medium (0.5–1.0 ha)	66 (73%)	16 (40%)
Area (>1.0 ha))	22 (25%)	0 (0%)
Total	90 (100%)	40 (100%)

Table 2. Use of rice seeds by farmers in South Sulawesi

Conventional farming system	Organic farming system
One hundred percent of farmers use varieties according to recommendations (commercial seeds)	The type used is the local type
There are variations in rotation	There is no variety rotation
Just 66% of farmers use certified seeds	Seeds are produced by farmers independently
The number of seeds planted exceeds the number recommended	The number of seeds planted is lower than recommended

Table 3. Fertilizers and pesticides inputs on conventional rice fields

Types of fertilizers and pesticides	Average usage (kg, ltr ha ⁻¹)	Recommendation (kg, ltr ha ⁻¹)
Urea	194,53	250
SP36	0,00	100
NPK	100,78	150
Organic	0,00	500
Pesticide	1,38	2

Table 4. Fertilizers and pesticides inputs on organic rice fields

Types of fertilizers and pesticides	Usage interval (kg, ltr ha ^{0.36})	Average usage (kg, ltr ha ^{0.36})	Average usage (kg, ltr ha ⁻¹)
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Manure	600–4.500	1.495,0	4.176,0
Compost	0–400	65,0	181,6
Bokashi fertilizer	200–2.000	615,0	1.717,8
Liquid fertilizer	1–8	3,3	9,1
Biopesticides	1–6	2,2	6,0

Table 5. Conditional of quality (CBC, KB, pH) conventional and organic rice fields

Category of soil fertility	Conventional	Organic
CEC: S_1 (>16 cmol kg^{-1})	19.24	23.24
KB: S_1 ($>36\%$)	42.17	56.00
pHH ₂ O (pH 5.5–7.0)	6.5	6.5
<u>Organic C (%)</u>	1.05%	2.51%
S_1 ($>1.5\%$)		
S_2 (0.8–1.5%)		
S_3 ($<0.8\%$)		
<u>Nitrogen (N)</u>	0.20%	0.44%
Low (0.1–0.2%)		
Medium (0.21–0.5%)		
<u>Phosphor (P_2O_5)</u>	12.06	12.20
Very low (<10 ppm P)		
Low (10–25 ppm P)		
Medium (26–45 ppm P)		
High (46–60 ppm P)		
<u>Potassium (K_2O)</u>	40	42
Very low (<10 mg 100 g^{-1})		
Low (10–20 mg 100 g^{-1})		
Medium (21–40 mg 100 g^{-1})		
High (41–60 mg 100 g^{-1})		

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Author Version : 87956-254745-3-ED.docx (31-07-2024)

COVER PAGE

XI. Manuscript Title

**COMPARISON OF CONVENTIONAL AND ORGANIC PADDY CROPPING SYSTEMS
IN SOUTH SULAWESI**

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XVIII. The main findings and why they are important and useful.

Productivity shows that the organic farming system increases production than conventional farming. In the future, farmers can start to develop an organic farming system by adding various organic ingredients to support their field performance.

XIX. Why the readers of the journal would be interested in the work.

This study aims to compare the organic farming developed by farmers with conventional farming systems in terms of land ownership, input, soil quality, and productivity. In general, in South Sulawesi, organic farming system is better than conventional farming systems.

XX. Suggested Reviewers : (2 reviewers from different country with authors, and Scopus H-index minimum 2)

No	Name	Affiliation	Review Interests	E-mail address And Phone contact number (if any)	ORCID ID/ Scopus ID/ Linkedin ID/ Google Scholar Profile Address
1	Pietro Barbieri	INRA, UMR 1391 ISPA, CS 20032, 33882 Villenave d'Ornon, France	Crop rotations, farming system	Pietro.barbieri@inra.fr	0000-0003-3248-4487
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COMPARISON OF CONVENTIONAL AND ORGANIC PADDY CROPPING SYSTEMS IN SOUTH SULAWESI

ABSTRACT

Rice is the food source for the community, including in the South Sulawesi area. Consequently, proper management is needed to support optimal production results. Several farmers are currently starting to develop organic farming systems due to the shortcomings of the conventional farming system such as the use of chemical inputs, land degradation, and decreased production. This study aims to compare the organic farming developed by farmers with conventional farming systems in terms of land ownership, input, soil quality, and productivity. **This research used a simple random sampling method to collect land and production data from 130 farmers (90 conventional, 40 organic).** In general, in South Sulawesi, organic farming system is better than conventional farming systems. The inputs in the conventional are certified seeds, chemical fertilizers, and pesticides, which will affect costs and have an effect in the long term. Meanwhile, in an organic farming system, seed needs are met independently by farmers, using organic materials (manure, compost, bokashi) and biopesticides. Productivity also shows that the organic farming system increases production than conventional farming. In the future, farmers can start to develop an organic farming system by adding various organic ingredients to support their field performance.

Keywords: chemical input, grain productivity, rice, soil fertility

INTRODUCTION

The use and management of land for economic growth purposes and food availability often seem to be in conflict with efforts to preserve natural resources, especially rice fields. In fact, land management for that purpose should be carried out without damaging the environment, or at least efforts must be made to balance these two components can approach ideal conditions. Consequently, the ideal field management application is economically feasible and ecologically sustainable (Indahyani & Maga, 2023). One effort that can be made is to support organic farming carried out by farmers on a massive scale. Organic farming systems have experienced rapid development in European and American countries. The rate of organic food sales in these countries has ranged from 20% to 25% per year over the last decade (Zulvera, 2014).

Sukristiyonubowo reported that in Indonesia, various practices of paddy farming remain closely related to green revolution technology, such as the combination of high external inputs (fertilizers and pesticides) and high-yielding varieties that are unsustainable, production costs that are high, and production that tends to decline. Thus, these are the reasons why the farmers started to develop organic and semiorganic farming systems (Sukristiyonubowo et al., 2018). The holistic organic agricultural production system considers long term environmental sustainability and primarily aims to produce food in an environmentally friendly way (Seufert et al., 2012). **Recent studies have shown that organic farming significantly improves soil properties and rice yields over time. For instance, research conducted in Central Java, Indonesia, found that soil organic carbon increased by 51.63% within ten years, leading to improved physical, chemical, and biological soil properties. This improvement is largely driven by increased soil total nitrogen, which directly contributes to higher rice yields**

(Syamsiyah et al., 2023). Additionally, research on Hazton's paddy farming method in Banyumas Regency revealed that soil quality deteriorates despite the application of organic fertilizers, indicating that intensive paddy farming practices can significantly affect land sustainability and soil health (Supriyadi et al., 2022). Furthermore, studies on biochar, such as rice-husk biochar (RHB), have shown its potential in improving soil quality indices like soil organic carbon, aggregate stability, and nitrogen fertility in tropical soils, which in turn enhances crop growth and soil sustainability (Ebido et al., 2021). The important benefits of organics for the environment include biodiversity conservation, better soil quality, reduced evaporation and air intake, compaction strategies, adaptation and reduction of greenhouse gas emissions, and energy efficiency (Reganold & Wachter, 2016; Seufert et al., 2012). Organic farming also increases social capital such as higher bargaining power, better access to credit and markets, opportunities to exchange knowledge and experience, reduced certification costs, and attractive contributions to policy institutions, increases employment opportunities in rural areas, and allows farmers to earn better education and health services due to higher incomes (UNEP, 2008; van Elzakker & Eyhorn, 2010). Farmers who develop organic farming systems gain various economic benefits such as saving money by reducing input costs, selling by-products by entering the organic market with certified products, and selling at higher prices.

The urgency of this research lies in the need to provide empirical evidence supporting the benefits of organic farming systems over conventional methods in South Sulawesi. Given the high costs, declining yields, and environmental impact associated with conventional paddy farming practices, transitioning to organic farming offers a sustainable alternative. This study aims to demonstrate the improvements in soil quality, crop yields, and overall environmental sustainability achievable through organic farming, thereby encouraging farmers in South Sulawesi to adopt these methods for long-term economic and ecological benefits.

The appeal of organic farming, both to farmers and to the general public, is also fueled by awareness of the dangers posed by excessive residues; most consumers will choose food that is safe for one's health. South Sulawesi is a province with an organic land area of 150 thousand hectares spread across all districts. The Ministry of Agriculture declared full support in 2019 for South Sulawesi as the largest producer or producer of organic rice in Indonesia. In South Sulawesi, conventional rice fields are larger than organic ones. Various studies have shown the benefits of organic farming compared to conventional paddy fields. Therefore, it is necessary to provide evidence related to cultivation using organic and conventional farming systems to attract the interest of farmers in South Sulawesi so that they can switch to developing organic farming. This study aims to provide justification for the comparison of the development of organic and conventional farming systems in the South Sulawesi area. Several points are studied, namely, the use of inputs used for cultivation, soil fertility, and the rice yields produced.

MATERIAL AND METHODS

Place and Time of Research

This study was conducted from October 2022 to March 2023 in two rice production centers in South Sulawesi, namely, Bulukumba Regency (conventional rice farming) and Pucak Village, Maros Regency (organic rice development).

Coordinates and Land Characteristics

Manjalling Village, Ujungloe District, Bulukumba Regency (Conventional Paddy)

Latitude: -5.51633

Longitude: 120.28011

Timpuseng Village (Pucak), Camba District, Maros Regency (Organic Paddy)

Latitude: -4.93728

Longitude: 119.80339

Methods

The research used a simple random method using land and production data from 130 farmers: 90 farmers using conventional farming system and 40 using organic farming system. Organic farmers implemented an organic farming system starting in 2017. Comparing farming systems used by farmers, various criteria, such as land area, inputs used, land quality, and land productivity, was explored. Information on land area and inputs used was obtained from interviews and discussions with farmers directly.

The research was conducted in three stages: (1) field research, (2) laboratory research, and (3) data analysis. In the field research stage, two steps were carried out:

- Soil samples were collected from 10 locations in organic paddy fields, spread across predetermined soil map units. At each location, composite soil samples were taken from 5 points, totaling approximately 1 kg, at a depth of 0–20 cm for physical and chemical soil property analysis. Soil sampling was conducted after the harvest season when the soil was dry or not waterlogged.
- Primary data collection involved interviewing respondent farmers and agricultural extension workers (PPL) to gather socioeconomic data, such as farmer characteristics (age, education, family size, farming experience, land size), use of production inputs (seeds, organic fertilizers, and pesticides), rice production data, production costs, and income.

The land quality evaluation uses the land boundary approach method that divides land boundary levels and land suitability classes into five groups (Sys et al., 1991). The calculation of the land quality index uses the square index road method that is modified according to the criteria for land use requirements for irrigated rice crops (Djaenudin et al., 2003; Sys et al., 1993). Aside from that, in this research, soil fertility characteristics, such as cation exchange capacity, base saturation, pH H₂O, soil organic C content, and availability of nutrients N, P, and K, were also checked. Partial productivity values (production per hectare) were used to measure land productivity. Furthermore, to compare the differences in quality and productivity of conventional and organic rice fields, the Kruskal–Wallis test (Kruskal & Wallis, 1952) is used, namely, a one-way analysis of variance using the SPSS 22.0 program.

RESULTS

Land Area

The ownership status of conventional paddy fields is as a farmer-tenant with a land holding area in the range of 0.5–1.7 hectares, while organic paddy fields around 0.1–1.0 hectares. The result was grouped into three criteria, namely, narrow land criteria (< 0.5 ha), medium criteria (0.5–1.0 ha), and large criteria (>1.0 ha) (Table 1). The average conventional farmer's land ownership is around 1 hectare, which means it is included in the medium category. Meanwhile, farmers with an organic farming

system, on average, have a land area of 0.36 hectares, which is included in the narrow category. It shows that land ownership of conventional farmers in South Sulawesi is larger than organic farmers.

[Table 1 here]

Production Inputs

The use of inputs by farmers is based on cultivation needs. There are differences in land management carried out by conventional and organic farmers. In South Sulawesi, both conventional and organic farmers plant paddy twice a year. However, the planting pattern of conventional farmers is paddy-paddy-green beans, while that of organic farmers is paddy-paddy-fallow. The needs for rice cultivation include land, seeds, fertilizers, and pesticides. However, it will be different if the farmer uses an organic farming system.

Seeds

There are differences in seed requirements between conventional and organic farmers in South Sulawesi (Table 2). The criteria for seeds used in conventional paddy fields include superior varieties with certificate and production potential of 5–8 tons/ha. However, the use of rice seeds in conventional rice fields is 32.88 kg ha⁻¹, while the recommended amount is 25–30 kg ha⁻¹. It is higher than recommended by agricultural extension workers. Meanwhile, the seeds used in organic rice fields come from local rice types developed by applying organic principles for at least one generation or two seasons. The use of rice seeds in organic rice fields is not engineered and not treated with chemicals. Aside from that, the average use of rice seeds in organic rice fields is 20 kg ha⁻¹, which is lower than recommended (25–30 kg ha⁻¹).

[Table 2 here]

Fertilizer and pesticide

Aside from seeds, fertilizer is also one of the inputs that differentiates conventional and organic farming (Table 3). Conventional farmers used paddy fields twice, using single and compound fertilizers (urea and NPK). The composition of basic fertilizer given is 50% at plant aged 0–7 days after planting, and 50% supplementary fertilizer was given at plant aged 30–35 days after planting. All respondents did not use SP36 fertilizer, ZA fertilizer, and organic fertilizer/compost because they are often unavailable.

[Table 3 here]

In contrast, farmers who have organic rice fields tend to use manure, compost, bokashi, and liquid organic fertilizer (Table 4). Aside from that, biopesticides are also used in order to prevent pest and disease attacks. The input needs of the organic rice farmers should be met independently than those of the conventional farmers. Consequently, the implementation of rice cultivation does not depend much on other parties in the future.

[Table 4 here]

Land Quality

Table 5 shows the evaluation of various soil fertility variables between conventional rice fields in South Sulawesi. The values of all parameters, Cation exchange capacity (CEC), KB, pH, organic C, N, P, and K

in organic fields are higher than those of conventional fields. Cation exchange capacity (CEC) in $\text{cmol kg units}^{-1}$ is in the land suitability category S_1 ($>16 \text{ cmol kg}^{-1}$) for paddy.

[Table 5 here]

Land Productivity

There is a statistically significant difference on the productivity of conventional and organic rice fields in South Sulawesi. The average productivity of conventional rice fields is lower than organic ones ($5,536 \text{ kg ha}^{-1}$ and $6,285 \text{ kg ha}^{-1}$, respectively) (Fig. 1).

[Figure 1 here]

DISCUSSION

Conventional farmers were not interested in using organic fertilizer. Due to the market conditions, obtaining fertilizer was difficult and required additional costs to procure. The SL-PTT technology component for paddy is the organic fertilizer provision of at least 500 kg/ha and straw return of at least 2 tons/ha (Supriadi et al., 2016). Chemical pesticides are also used in order to prevent pest and disease attacks in the field, although the average dose is lower than recommended.

The range of Cation exchange capacity (CEC) values in paddy fields is enough to support nutrient adsorption through fertilization. The optimal soil CEC value for irrigated and rainfed rice is in the range ($>16 \text{ cmol kg}^{-1}$ for S_1 and $=16 \text{ cmol kg}^{-1}$ for S_2) [6], and both fields already have high CEC even though organic has a higher value than conventional. In addition, the base saturation value expressed in units (%) at the research location is in the land suitability category S_1 ($>35\%$) for rice plants. Base saturation conditions based on land suitability criteria for irrigated rice and rainfed rice are in the range ($>36\%$ for S_1 ; $20\text{--}35\%$ for S_2 ; and $<20\%$ for S_3) [9]. The same condition also can be seen in pH assessment, and pH of both fields are sufficient to support plant growth because of the field in neutral condition (pH $5.5\text{--}7.0$). The optimal pH value for rice plants ranges from 5.5 to 7.5 (Djaenudin et al., 2003).

Different results were shown by the organic C and nitrogen content. The organic C and nitrogen content of organic field are higher than that of conventional field. Organic C on organic and conventional land is 1.05% and 2.51% , respectively. The soil organic matter content in conventional rice fields is in the low category ($<1.5\%$), including land suitability class S_2 for rice plant growth. This is probably due to the intensity of cultivation carried out throughout the year by conventional farmers. Meanwhile, organic rice fields are included in the high category ($>1.5\%$) and included in class two (S_2) land suitability. Nitrogen is one of the main needs of plants. The nitrogen value of organic field reaches 0.44% (medium category), while that of conventional fields reaches around 0.20% (low category). The low nutrient status of N is due to the nature of N, which is very mobile, easy to evaporate (volatilize), and leached. In general, farmers use urea fertilizer at quite high doses. Low soil nitrogen nutrient content correlated with organic material content. The availability of N in the soil is directly proportional to the availability of soil organic matter and limited water availability (Peku Jawang, 2021). N loss easily occurs in areas with high rainfall and in soils with low organic matter content. This condition shows that the land management system is not good, especially the application of fertilizer technology and not using organic materials. The limitations of nitrogen nutrients in rainfed paddy fields can be overcome by providing organic material sourced from harvest residues, combined with low doses of inorganic fertilizer (Benauli, 2021).

Phosphorus (P) availability in conventional and organic rice fields are 12.06 and 12.20 ppm , respectively. Both are in the low interval ($10\text{--}25 \text{ ppm P}$). The availability of potassium (K) in

conventional rice fields is 40 mg in the medium interval (21–40 mg 100 g⁻¹), and in organic rice fields, 42 mg is in the high category (41–60 mg 100 g⁻¹). These results show that rice fields managed with an organic farming system, using organic fertilizer and pesticides, show better macronutrient contents N, P, and K.

Overall, there are statistically significant differences on the results of the land quality index for conventional and organic rice fields. Numerically, the average index value for conventional rice fields is 28.6, with category S3 (according to marginal). Meanwhile, organic rice fields reached 51.04, including the S2 category (quite suitable). Soil chemical–physical fertility in the organic field is superior to conventional vegetable farming systems, such as soil pH, organic C and N, total P and K, bulk density, particle density, soil porosity, permeability, bulk density, and dehydrogenase enzymes (Sukristiyonubowo et al., 2015, 2018). Similar results were reported in paddy farming that the chemical–physical soil fertility in organic land in Sambirejo District, Sragen Regency, was superior to semiorganic and conventional farming systems. Semiorganic was better than conventional farming systems in terms of soil pH, organic C and N, total P and K, bulk density, particle density, soil porosity, and permeability. Similar findings were observed in paddy biomass production.

There is a statistically significant difference on the productivity of conventional and organic rice fields in South Sulawesi. The superiority of production in organic farming systems is also supported by research results Santoso (2012) that state that organic farming systems can increase yields by 12% per hectare. Even organic farming systems can increase crop yields by 50–60% (Surekha, 2013). The productivity of organic farming in the beginning stages will decrease but will increase over time. Meanwhile, conventional farming productivity systems will tend to decrease in the long term due to the nutrient poverty caused by low organic matter content (Heryanto et al., 2016). This is influenced by soil fertility conditions that are increasingly stable because the inputs used are without chemicals.

The results of this study align with recent findings by Syamsiyah et al. (2023), who observed significant improvements in soil organic carbon and nitrogen levels in organic farming systems, leading to enhanced soil properties and higher rice yields. In contrast, Supriyadi et al. (2022) highlighted that intensive conventional practices, even with organic inputs, often deteriorate soil quality. Furthermore, the use of rice-husk biochar (RHB) has been shown by Ebido et al. (2021) to improve critical soil quality indices such as soil organic carbon and aggregate stability, which correlate with better crop growth and soil sustainability. These findings collectively emphasize the superior soil quality and productivity benefits of organic farming systems over conventional methods.

CONCLUSION

The organic farming system implemented by farmers in South Sulawesi is considered better than conventional farming system based on the inputs used, the quality of the soil tested by looking at fertility parameters, and the grain yield obtained. In the future, the use of chemical inputs can be reduced and replaced with organic materials. Consequently, the farmers can slowly improve the field quality and switch to organic farming system, which is more sustainable.

Figure and Table

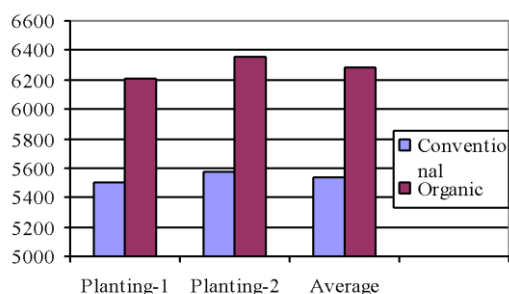


Figure 1. Grain productivity in conventional and organic rice fields.

Table 1. Distribution land ownership of conventional and organic farmers

Category land area	Conventional (farmer)	Organic (farmer)
Narrow (<0.5 ha)	2 (2%)	24 (60%)
Medium (0.5–1.0 ha)	66 (73%)	16 (40%)
Area (>1.0 ha))	22 (25%)	0 (0%)
Total	90 (100%)	40 (100%)

Table 2. Use of rice seeds by farmers in South Sulawesi

Conventional farming system	Organic farming system
One hundred percent of farmers use varieties according to recommendations (commercial seeds)	The type used is the local type
There are variations in rotation	There is no variety rotation
Just 66% of farmers use certified seeds	Seeds are produced by farmers independently
The number of seeds planted exceeds the number recommended	The number of seeds planted is lower than recommended

Table 3. Fertilizers and pesticides inputs on conventional rice fields

Types of fertilizers and pesticides	Average usage (kg, ltr ha ⁻¹)	Recommendation (kg, ltr ha ⁻¹)
Urea	194,53	250
SP36	0,00	100
NPK	100,78	150
Organic	0,00	500
Pesticide	1,38	2

Table 4. Fertilizers and pesticides inputs on organic rice fields

Types of fertilizers and pesticides	Usage interval	Average usage	Average usage
-------------------------------------	----------------	---------------	---------------

	(kg, ltr ha ^{0.36})	(kg, ltr ha ^{0.36})	(kg, ltr ha ⁻¹)
Manure	600–4.500	1.495,0	4.176,0
Compost	0–400	65,0	181,6
Bokashi fertilizer	200–2.000	615,0	1.717,8
Liquid fertilizer	1–8	3,3	9,1
Biopesticides	1–6	2,2	6,0

Table 5. Conditional of quality (CBC, KB, pH) conventional and organic rice fields

Category of soil fertility	Conventional	Organic
CEC: S ₁ (>16 cmol kg ⁻¹)	19.24	23.24
KB: S ₁ (>36%)	42.17	56.00
pHH ₂ O (pH 5.5–7.0)	6.5	6.5
<u>Organic C (%)</u>	1.05%	2.51%
S ₁ (>1.5%)		
S ₂ (0.8–1.5%)		
S ₃ (<0.8%)		
<u>Nitrogen (N)</u>	0.20%	0.44%
Low (0.1–0.2%)		
Medium (0.21–0.5%)		
<u>Phosphor (P₂O₅)</u>	12.06	12.20
Very low (<10 ppm P)		
Low (10–25 ppm P)		
Medium (26–45 ppm P)		
High (46–60 ppm P)		
<u>Potassium (K₂O)</u>	40	42
Very low (<10 mg 100 g ⁻¹)		
Low (10–20 mg 100 g ⁻¹)		
Medium (21–40 mg 100 g ⁻¹)		
High (41–60 mg 100 g ⁻¹)		

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1. Third revision : Round 3 (03-08-2024)

- a. Review Version : 87956-252926-3-RV.docx (03-08-2024)
- b. Uploaded file : Reviewer A 87956-262933-1-RV.docx (09-08-2024)
- c. Editor Version : 87956-261981-2-ED.docx (03-08-2024)
- d. Author Version : 87956-254745-5-ED.docx (24-08-2024)
: 87956-254745-6-ED.docx (24-08-2024)

[STJSSA] Editor Decision (RESUBMIT FOR REVIEW)

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to me, Ida, Sitti, Abdel, Abdel

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We have reached a decision regarding your submission to SAINS TANAH - Journal of Soil Science and Agroclimatology, "COMPARISON OF CONVENTIONAL AND ORGANIC PADDY CROPPING SYSTEMS IN SOUTH SULAWESI".

Our decision is: Resubmit for Review (due date is August 23, 2024)

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COVER PAGE

XXI. Manuscript Title

COMPARISON OF CONVENTIONAL AND ORGANIC PADDY CROPPING SYSTEMS IN SOUTH SULAWESI

Commented [H9]: Add the country, Indonesia

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XXVIII. The main findings and why they are important and useful.

Productivity shows that the organic farming system increases production than conventional farming. In the future, farmers can start to develop an organic farming system by adding various organic ingredients to support their field performance.

XXIX. Why the readers of the journal would be interested in the work.

This study aims to compare the organic farming developed by farmers with conventional farming systems in terms of land ownership, input, soil quality, and productivity. In general, in South Sulawesi, organic farming system is better than conventional farming systems.

XXX.Suggested Reviewers : (2 reviewers from different country with authors, and Scopus H-index minimum 2)

No	Name	Affiliation	Review Interests	E-mail address And Phone contact number (if any)	ORCID ID/ Scopus ID/ Linkedin ID/ Google Scholar Profile Address
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COMPARISON OF CONVENTIONAL AND ORGANIC PADDY CROPPING SYSTEMS IN SOUTH SULAWESI

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ABSTRACT

Rice is the food source for the community, including in the South Sulawesi area. Consequently, proper management is needed to support optimal production results. Several farmers are currently starting to develop organic farming systems due to the shortcomings of the conventional farming system such as the use of chemical inputs, land degradation, and decreased production. This study aims to compare the organic farming developed by farmers with conventional farming systems in terms of land ownership, input, soil quality, and productivity. **This research used a simple random sampling method to collect land and production data from 130 farmers (90 conventional, 40 organic).** In general, in South Sulawesi, organic farming system is better than conventional farming systems. The inputs in the conventional are certified seeds, chemical fertilizers, and pesticides, which will affect costs and have an effect in the long term. Meanwhile, in an organic farming system, seed needs are met independently by farmers, using organic materials (manure, compost, bokashi) and biopesticides. Productivity also shows that the organic farming system increases production than conventional farming. In the future, farmers can start to develop an organic farming system by adding various organic ingredients to support their field performance.

Keywords: chemical input, grain productivity, rice, soil fertility

INTRODUCTION

The use and management of land for economic growth purposes and food availability often seem to be in conflict with efforts to preserve natural resources, especially rice fields. In fact, land management for that purpose should be carried out without damaging the environment, or at least efforts must be made to balance these two components can approach ideal conditions. Consequently, the ideal field management application is economically feasible and ecologically sustainable (Indahyani & Maga, 2023). One effort that can be made is to support organic farming carried out by farmers on a massive scale. Organic farming systems have experienced rapid development in European and American countries. The rate of organic food sales in these countries has ranged from 20% to 25% per year over the last decade (Zulvera, 2014).

Sukristiyonubowo reported that in Indonesia, various practices of paddy farming remain closely related to green revolution technology, such as the combination of high external inputs (fertilizers and pesticides) and high-yielding varieties that are unsustainable, production costs that are high, and production that tends to decline. Thus, these are the reasons why the farmers started to develop organic and semiorganic farming systems (Sukristiyonubowo et al., 2018). The holistic organic agricultural production system considers long term environmental sustainability and primarily aims to produce food in an environmentally friendly way (Seufert et al., 2012). **Recent studies have shown that organic farming significantly improves soil properties and rice yields over time. For instance, research conducted in Central Java, Indonesia, found that soil organic carbon increased by 51.63% within ten years, leading to improved physical, chemical, and biological soil properties. This improvement is**

largely driven by increased soil total nitrogen, which directly contributes to higher rice yields (Syamsiyah et al., 2023). Additionally, research on Hazton's paddy farming method in Banyumas Regency revealed that soil quality deteriorates despite the application of organic fertilizers, indicating that intensive paddy farming practices can significantly affect land sustainability and soil health (Supriyadi et al., 2022). Furthermore, studies on biochar, such as rice-husk biochar (RHB), have shown its potential in improving soil quality indices like soil organic carbon, aggregate stability, and nitrogen fertility in tropical soils, which in turn enhances crop growth and soil sustainability (Ebido et al., 2021). The important benefits of organics for the environment include biodiversity conservation, better soil quality, reduced evaporation and air intake, compaction strategies, adaptation and reduction of greenhouse gas emissions, and energy efficiency (Reganold & Wachter, 2016; Seufert et al., 2012). Organic farming also increases social capital such as higher bargaining power, better access to credit and markets, opportunities to exchange knowledge and experience, reduced certification costs, and attractive contributions to policy institutions, increases employment opportunities in rural areas, and allows farmers to earn better education and health services due to higher incomes (UNEP, 2008; van Elzakker & Eyhorn, 2010). Farmers who develop organic farming systems gain various economic benefits such as saving money by reducing input costs, selling by-products by entering the organic market with certified products, and selling at higher prices.

The urgency of this research lies in the need to provide empirical evidence supporting the benefits of organic farming systems over conventional methods in South Sulawesi. Given the high costs, declining yields, and environmental impact associated with conventional paddy farming practices, transitioning to organic farming offers a sustainable alternative. This study aims to demonstrate the improvements in soil quality, crop yields, and overall environmental sustainability achievable through organic farming, thereby encouraging farmers in South Sulawesi to adopt these methods for long-term economic and ecological benefits.

The appeal of organic farming, both to farmers and to the general public, is also fueled by awareness of the dangers posed by excessive residues; most consumers will choose food that is safe for one's health. South Sulawesi is a province with an organic land area of 150 thousand hectares spread across all districts. The Ministry of Agriculture declared full support in 2019 for South Sulawesi as the largest producer or producer of organic rice in Indonesia. In South Sulawesi, conventional rice fields are larger than organic ones. Various studies have shown the benefits of organic farming compared to conventional paddy fields. Therefore, it is necessary to provide evidence related to cultivation using organic and conventional farming systems to attract the interest of farmers in South Sulawesi so that they can switch to developing organic farming. This study aims to provide justification for the comparison of the development of organic and conventional farming systems in the South Sulawesi area. Several points are studied, namely, the use of inputs used for cultivation, soil fertility, and the rice yields produced.

MATERIAL AND METHODS

Place and Time of Research

This study was conducted from October 2022 to March 2023 in two rice production centers in South Sulawesi, namely, Bulukumba Regency (conventional rice farming) and Pucak Village, Maros Regency (organic rice development).

Coordinates and Land Characteristics

The position of Manjalling Village, Ujungloe District, Bulukumba Regency (Conventional Paddy) is located at coordinates 120°28'011"E and -5°51'633"S. The soil type is podsolic. The soil profile has a clay texture, with 58% clay, 18% silt, and 24% sand. Additionally, the position of Timpuseng Village (Pucak), Camba District, Maros Regency (Organic Paddy) is located at coordinates 119°80'339"E and -4°93'728"S. The soil type is regosol. The soil profile has a silty clay loam texture, with 65% clay, 21% silt, and 14% sand.

Methods

The research used a simple random method using land and production data from 130 farmers: 90 farmers using conventional farming system and 40 using organic farming system. Organic farmers implemented an organic farming system starting in 2017. Comparing farming systems used by farmers, various criteria, such as land area, inputs used, land quality, and land productivity, was explored. Information on land area and inputs used was obtained from interviews and discussions with farmers directly.

The research was conducted in three stages: (1) field research, (2) laboratory research, and (3) data analysis. In the field research stage, two steps were carried out:

- Soil samples were collected from 10 locations in organic paddy fields, spread across predetermined soil map units. At each location, composite soil samples were taken from 5 points, totaling approximately 1 kg, at a depth of 0–20 cm for physical and chemical soil property analysis. Soil sampling was conducted after the harvest season when the soil was dry or not waterlogged.
- Primary data collection involved interviewing respondent farmers and agricultural extension workers (PPL) to gather socioeconomic data, such as farmer characteristics (age, education, family size, farming experience, land size), use of production inputs (seeds, organic fertilizers, and pesticides), rice production data, production costs, and income.

The land quality evaluation uses the land boundary approach method that divides land boundary levels and land suitability classes into five groups (Sys et al., 1991). The calculation of the land quality index uses the square index road method that is modified according to the criteria for land use requirements for irrigated rice crops (Djaenudin et al., 2003; Sys et al., 1993). Aside from that, in this research, soil fertility characteristics, such as cation exchange capacity, base saturation, pH H₂O, soil organic C content, and availability of nutrients N, P, and K, were also checked. Partial productivity values (production per hectare) were used to measure land productivity. Furthermore, to compare the differences in quality and productivity of conventional and organic rice fields, the Kruskal–Wallis test (Kruskal & Wallis, 1952) is used, namely, a one-way analysis of variance using the SPSS 22.0 program.

RESULTS

Land Area

The ownership status of conventional paddy fields is as a farmer-tenant with a land holding area in the range of 0.5–1.7 hectares, while organic paddy fields around 0.1–1.0 hectares. The result was grouped into three criteria, namely, narrow land criteria (< 0.5 ha), medium criteria (0.5–1.0 ha), and large criteria (>1.0 ha) (Table 1). The average conventional farmer's land ownership is around 1 hectare, which means it is included in the medium category. Meanwhile, farmers with an organic farming system, on average, have a land area of 0.36 hectares, which is included in the narrow category. It

shows that land ownership of conventional farmers in South Sulawesi is larger than organic farmers.

[Table 1 here]

Production Inputs

The use of inputs by farmers is based on cultivation needs. There are differences in land management carried out by conventional and organic farmers. In South Sulawesi, both conventional and organic farmers plant paddy twice a year. However, the planting pattern of conventional farmers is paddy-paddy-green beans, while that of organic farmers is paddy-paddy-fallow. The needs for rice cultivation include land, seeds, fertilizers, and pesticides. However, it will be different if the farmer uses an organic farming system.

Seeds

There are differences in seed requirements between conventional and organic farmers in South Sulawesi (Table 2). The criteria for seeds used in conventional paddy fields include superior varieties with certificate and production potential of 5–8 tons/ha. However, the use of rice seeds in conventional rice fields is 32.88 kg ha⁻¹, while the recommended amount is 25–30 kg ha⁻¹. It is higher than recommended by agricultural extension workers. Meanwhile, the seeds used in organic rice fields come from local rice types developed by applying organic principles for at least one generation or two seasons. The use of rice seeds in organic rice fields is not engineered and not treated with chemicals. Aside from that, the average use of rice seeds in organic rice fields is 20 kg ha⁻¹, which is lower than recommended (25–30 kg ha⁻¹).

[Table 2 here]

Fertilizer and pesticide

Aside from seeds, fertilizer is also one of the inputs that differentiates conventional and organic farming (Table 3). Conventional farmers used paddy fields twice, using single and compound fertilizers (urea and NPK). The composition of basic fertilizer given is 50% at plant aged 0–7 days after planting, and 50% supplementary fertilizer was given at plant aged 30–35 days after planting. All respondents did not use SP36 fertilizer, ZA fertilizer, and organic fertilizer/compost because they are often unavailable.

[Table 3 here]

In contrast, farmers who have organic rice fields tend to use manure, compost, bokashi, and liquid organic fertilizer (Table 4). Aside from that, biopesticides are also used in order to prevent pest and disease attacks. The input needs of the organic rice farmers should be met independently than those of the conventional farmers. Consequently, the implementation of rice cultivation does not depend much on other parties in the future.

[Table 4 here]

Land Quality

Table 5 shows the evaluation of various soil fertility variables between conventional rice fields in South Sulawesi. The values of all parameters, Cation exchange capacity (CEC), KB, pH, organic C, N, P, and K in organic fields are higher than those of conventional fields. Cation exchange capacity (CEC) in cmol

kg units⁻¹ is in the land suitability category S₁ (>16 cmol kg⁻¹) for paddy.

[Table 5 here]

Land Productivity

There is a statistically significant difference on the productivity of conventional and organic rice fields in South Sulawesi. The average productivity of conventional rice fields is lower than organic ones (5,536 kg ha⁻¹ and 6,285 kg ha⁻¹, respectively) (Fig. 1).

[Figure 1 here]

DISCUSSION

Conventional farmers were not interested in using organic fertilizer. Due to the market conditions, obtaining fertilizer was difficult and required additional costs to procure. The SL-PTT technology component for paddy is the organic fertilizer provision of at least 500 kg/ha and straw return of at least 2 tons/ha (Supriadi et al., 2016). Chemical pesticides are also used in order to prevent pest and disease attacks in the field, although the average dose is lower than recommended.

The range of Cation exchange capacity (CEC) values in paddy fields is enough to support nutrient adsorption through fertilization. The optimal soil CEC value for irrigated and rainfed rice is in the range (>16 cmol kg⁻¹ for S₁ and =16 cmol kg⁻¹ for S₂) [6], and both fields already have high CEC even though organic has a higher value than conventional. In addition, the base saturation value expressed in units (%) at the research location is in the land suitability category S₁ (>35%) for rice plants. Base saturation conditions based on land suitability criteria for irrigated rice and rainfed rice are in the range (>36% for S₁; 20–35% for S₂; and <20% for S₃) [9]. The same condition also can be seen in pH assessment, and pH of both fields are sufficient to support plant growth because of the field in neutral condition (pH 5.5–7.0). The optimal pH value for rice plants ranges from 5.5 to 7.5 (Djaenudin et al., 2003).

Different results were shown by the organic C and nitrogen content. The organic C and nitrogen content of organic field are higher than that of conventional field. Organic C on organic and conventional land is 1.05% and 2.51%, respectively. The soil organic matter content in conventional rice fields is in the low category (<1.5%), including land suitability class S₂ for rice plant growth. This is probably due to the intensity of cultivation carried out throughout the year by conventional farmers. Meanwhile, organic rice fields are included in the high category (>1.5%) and included in class two (S₂) land suitability. Nitrogen is one of the main needs of plants. The nitrogen value of organic field reaches 0.44% (medium category), while that of conventional fields reaches around 0.20% (low category). The low nutrient status of N is due to the nature of N, which is very mobile, easy to evaporate (volatilize), and leached. In general, farmers use urea fertilizer at quite high doses. Low soil nitrogen nutrient content correlated with organic material content. The availability of N in the soil is directly proportional to the availability of soil organic matter and limited water availability (Peku Jawang, 2021). N loss easily occurs in areas with high rainfall and in soils with low organic matter content. This condition shows that the land management system is not good, especially the application of fertilizer technology and not using organic materials. The limitations of nitrogen nutrients in rainfed paddy fields can be overcome by providing organic material sourced from harvest residues, combined with low doses of inorganic fertilizer (Benauli, 2021).

Phosphorus (P) availability in conventional and organic rice fields are 12.06 and 12.20 ppm, respectively. Both are in the low interval (10–25 ppm P). The availability of potassium (K) in

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Make sure when the readers read the first paragraph of the discussion, they understand the main finding of this research.

Make the discussion to be a one of story that tells about main finding and explanation the mechanism or the reason WHY organic paddy cropping is better than conventional.

Please start the discussion with the answer to the objectives or conclusion. Then explain WHY.

example: Start with the result that organic cropping is better than conventional (explain why you can conclude that, showing the data, mention the table). Then, explain the reason.

Why the organic cropping, with those conditions better? because of? maybe because of the soil nutrient or others.

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conventional rice fields is 40 mg in the medium interval (21–40 mg 100 g⁻¹), and in organic rice fields, 42 mg is in the high category (41–60 mg 100 g⁻¹). These results show that rice fields managed with an organic farming system, using organic fertilizer and pesticides, show better macronutrient contents N, P, and K.

Overall, there are statistically significant differences on the results of the land quality index for conventional and organic rice fields. Numerically, the average index value for conventional rice fields is 28.6, with category S3 (according to marginal). Meanwhile, organic rice fields reached 51.04, including the S2 category (quite suitable). Soil chemical–physical fertility in the organic field is superior to conventional vegetable farming systems, such as soil pH, organic C and N, total P and K, bulk density, particle density, soil porosity, permeability, bulk density, and dehydrogenase enzymes (Sukristiyonubowo et al., 2015, 2018). Similar results were reported in paddy farming that the chemical–physical soil fertility in organic land in Sambirejo District, Sragen Regency, was superior to semiorganic and conventional farming systems. Semiorganic was better than conventional farming systems in terms of soil pH, organic C and N, total P and K, bulk density, particle density, soil porosity, and permeability. Similar findings were observed in paddy biomass production.

There is a statistically significant difference on the productivity of conventional and organic rice fields in South Sulawesi. The superiority of production in organic farming systems is also supported by research results Santoso (2012) that state that organic farming systems can increase yields by 12% per hectare. Even organic farming systems can increase crop yields by 50–60% (Surekha, 2013). The productivity of organic farming in the beginning stages will decrease but will increase over time. Meanwhile, conventional farming productivity systems will tend to decrease in the long term due to the nutrient poverty caused by low organic matter content (Heryanto et al., 2016). This is influenced by soil fertility conditions that are increasingly stable because the inputs used are without chemicals.

The results of this study align with recent findings by Syamsiyah et al. (2023), who observed significant improvements in soil organic carbon and nitrogen levels in organic farming systems, leading to enhanced soil properties and higher rice yields. In contrast, Supriyadi et al. (2022) highlighted that intensive conventional practices, even with organic inputs, often deteriorate soil quality. Furthermore, the use of rice-husk biochar (RHB) has been shown by Ebido et al. (2021) to improve critical soil quality indices such as soil organic carbon and aggregate stability, which correlate with better crop growth and soil sustainability. These findings collectively emphasize the superior soil quality and productivity benefits of organic farming systems over conventional methods.

CONCLUSION

The organic farming system implemented by farmers in South Sulawesi is considered better than conventional farming system based on the inputs used, the quality of the soil tested by looking at fertility parameters, and the grain yield obtained. In the future, the use of chemical inputs can be reduced and replaced with organic materials. Consequently, the farmers can slowly improve the field quality and switch to organic farming system, which is more sustainable.

Figure and Table

Grain Productivity in Conventional and Organic Rice Fields

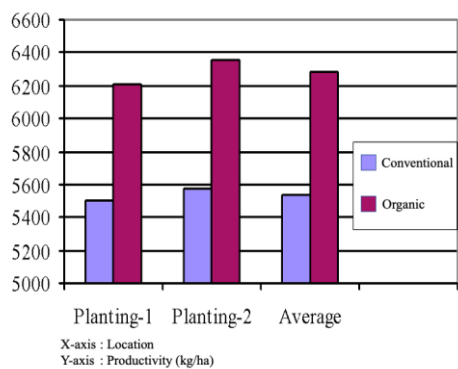


Figure 1. Comparison of Grain Productivity from Conventional and Organic Rice Fields

Table 1. Distribution land ownership of conventional and organic farmers

Category land area	Conventional (farmer)	Organic (farmer)
Narrow (<0.5 ha)	2 (2%)	24 (60%)
Medium (0.5–1.0 ha)	66 (73%)	16 (40%)
Area (>1.0 ha))	22 (25%)	0 (0%)
Total	90 (100%)	40 (100%)

Table 2. Use of rice seeds by farmers in South Sulawesi

Conventional farming system	Organic farming system
One hundred percent of farmers use varieties according to recommendations (commercial seeds)	The type used is the local type
There are variations in rotation	There is no variety rotation
Just 66% of farmers use certified seeds	Seeds are produced by farmers independently
The number of seeds planted exceeds the number recommended	The number of seeds planted is lower than recommended

Table 3. Fertilizers and pesticides inputs on conventional rice fields

Types of fertilizers and pesticides	Average usage (kg, ltr ha ⁻¹)	Recommendation (kg, ltr ha ⁻¹)
Urea	194,53	250
SP36	0,00	100
NPK	100,78	150
Organic	0,00	500
Pesticide	1,38	2

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Table 4. Fertilizers and pesticides inputs on organic rice fields

Types of fertilizers and pesticides	Usage interval (kg, ltr ha ^{0.36})	Average usage (kg, ltr ha ^{0.36})	Average usage (kg, ltr ha ⁻¹)
Manure	600–4.500	1.495,0	4.176,0
Compost	0–400	65,0	181,6
Bokashi fertilizer	200–2.000	615,0	1.717,8
Liquid fertilizer	1–8	3,3	9,1
Biopesticides	1–6	2,2	6,0

Table 5. Conditional of quality (CBC, KB, pH) conventional and organic rice fields

Category of soil fertility	Conventional	Organic
CEC: S ₁ (>16 cmol kg ⁻¹)	19.24	23.24
KB: S ₁ (>36%)	42.17	56.00
pHH ₂ O (pH 5.5–7.0)	6.5	6.5
<u>Organic C (%)</u>	1.05%	2.51%
S ₁ (>1.5%)		
S ₂ (0.8–1.5%)		
S ₃ (<0.8%)		
<u>Nitrogen (N)</u>	0.20%	0.44%
Low (0.1–0.2%)		
Medium (0.21–0.5%)		
<u>Phosphor (P₂O₅)</u>	12.06	12.20
Very low (<10 ppm P)		
Low (10–25 ppm P)		
Medium (26–45 ppm P)		
High (46–60 ppm P)		
<u>Potassium (K₂O)</u>	40	42
Very low (<10 mg 100 g ⁻¹)		
Low (10–20 mg 100 g ⁻¹)		
Medium (21–40 mg 100 g ⁻¹)		
High (41–60 mg 100 g ⁻¹)		

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Reviewer A:

The manuscript has been revised according to the reviewer's comments, the manuscript can proceed to the next steps.

Reviewer B:

The study "COMPARISON OF CONVENTIONAL AND ORGANIC PADDY CROPPING SYSTEMS IN SOUTH SULAWESI, INDONESIA" is a good attempt to compare the two systems (Organic and conventional). However, there are some points on which authors must seriously look upon:

- Introduction: Reference should be cited to support statements. The detail comments and suggestion re mentioned in the attached file. Also I have reworded the sentences kindly go through that and confirm if you are in agreement.
- Materials and Methods: Use of Kruskal-Wallis test was mentioned in materials and methods but significance is not shown in Tables for the parameters. Also how land quality index was calculated is not written.
- Results: Results on land quality index is not presented through it is mentioned in discussion. The average values should also include standard deviation (SD) for organic and conventional rice fields for every quantitative trait if Kruskal-Wallis test is not employed.
- Discussion: Authors need to mention references to support their statement while justifying the findings and should relate their findings with earlier one. Also mention the abbreviation for its first use in each section.
- Conclusion: It could be modified based on the finding.
- I have reworded the sentences and made changes in the tables/figure kindly go through that and confirm if you are in agreement. Further, many suggestions/comments are given in detail in the attached word file in track change mode for improvement of the manuscript.

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COMPARISON OF CONVENTIONAL AND ORGANIC PADDY CROPPING SYSTEMS IN SOUTH SULAWESI, INDONESIA

ABSTRACT

Rice is the food source for the community, including in the South Sulawesi area. Consequently, proper management is needed to support optimal production results. Several farmers are currently starting to develop organic farming systems due to the shortcomings of the conventional farming system such as the use of chemical inputs, land degradation, and decreased production. This study aims to compare the organic farming developed by farmers with conventional farming systems in terms of land ownership, input, soil quality, and productivity. This research used a simple random sampling method to collect land and production data from 130 farmers (90 conventional, 40 organic). In general, in South Sulawesi, organic farming system is better than conventional farming systems. The inputs in the conventional are certified seeds, chemical fertilizers, and pesticides, which will affect costs and have an effect in the long term. Meanwhile, in an organic farming system, seed needs are met independently by farmers, using organic materials (manure, compost, bokashi) and biopesticides. Productivity also shows that the organic farming system increases production than conventional farming. In the future, farmers can start to develop an organic farming system by adding various organic ingredients to support their field performance.

Keywords: chemical input, grain productivity, rice, soil fertility

INTRODUCTION

Rice production in Indonesia is currently aimed at meeting its growing domestic demand. The average rice consumption per capita in Indonesia is notably high, reaching 81.23 kg per capita per year (Badan Pusat Statistik, 2024). To fulfill this demand, various policy programs have been implemented. However, the adoption of technology packages oriented towards synthetic chemical farming systems has led to the degradation of the soil's physical and chemical properties. The lack of organic matter application in the soil has exacerbated the decline in the quality of paddy fields, particularly in terms of soil fertility. Farmers tend to overuse inorganic fertilizers, exceeding recommended doses, which, over time, contributes to the deterioration of soil quality in paddy fields.

The use and management of land for economic growth purposes and food availability often seem to be in conflict with efforts to preserve natural resources, especially rice fields. In fact, land management for that purpose should be carried out without damaging the environment, or at least efforts must be made to balance these two components can approach ideal conditions. Consequently, the ideal field management application is economically feasible and ecologically sustainable (Indahyani & Maga, 2023). One effort that can be made is to support organic farming carried out by farmers on a massive scale. Organic farming systems have experienced rapid development in European and American countries. The rate of organic food sales in these countries has ranged from 20% to 25% per year over

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the last decade (Zulvera, 2014).

Sukristiyonubowo et al. (2018) reported that in Indonesia, various practices of paddy farming remain closely related to green revolution technology, such as the combination of high external inputs (fertilizers and pesticides) and high-yielding varieties that are unsustainable in long run and involves higher production costs. These issues have paved the way for the farmers to adopt for organic and semiorganic farming systems (Sukristiyonubowo et al., 2018). The holistic organic agricultural production system considers long term environmental sustainability and primarily aims to produce food in an environmentally friendly way (Seufert et al., 2012). Recent studies have shown that organic farming significantly improves soil properties and rice yields over time. For instance, research conducted in Central Java, Indonesia, found that soil organic carbon increased by 51.63% within ten years, leading to improved physical, chemical, and biological soil properties. This improvement is largely driven by increased soil total nitrogen, which directly contributes to higher rice yields (Syamsiyah et al., 2023). Additionally, research on Hazton's paddy farming method in Banyumas Regency revealed that soil quality deteriorates despite the application of organic fertilizers, indicating that intensive paddy farming practices can significantly affect land sustainability and soil health (Supriyadi et al., 2022). Furthermore, studies on biochar, such as rice-husk biochar (RHB), have shown its potential in improving soil quality indices like soil organic carbon, aggregate stability, and nitrogen fertility in tropical soils, which in turn enhances crop growth and soil sustainability (Ebido et al., 2021). The important benefits of organics for the environment include biodiversity conservation, better soil quality, reduced evaporation and air intake, compaction strategies, adaptation and reduction of greenhouse gas emissions, and energy efficiency (Reganold & Wachter, 2016; Seufert et al., 2012). Organic farming also increases social capital such as higher bargaining power, better access to credit and markets, opportunities to exchange knowledge and experience, reduced certification costs, and attractive contributions to policy institutions, increases employment opportunities in rural areas, and allows farmers to earn better education and health services due to higher incomes (UNEP, 2008; van Elzakker & Eyhorn, 2010). Farmers who develop organic farming systems gain various economic benefits such as saving money by reducing input costs, selling by-products by entering the organic market with certified products, and selling at higher prices.

The urgency of this research lies in the need to provide empirical evidence supporting the benefits of organic farming systems over conventional methods in South Sulawesi. Given the high costs, declining yields, and environmental impact associated with conventional paddy farming practices, transitioning to organic farming offers a sustainable alternative. This study aims to demonstrate the improvements in soil quality, crop yields, and overall environmental sustainability achievable through organic farming, thereby encouraging farmers in South Sulawesi to adopt these methods for long-term economic and ecological benefits.

The appeal of organic farming, both to farmers and to the general public, is also fueled by awareness of the dangers posed by excessive residues; most consumers will choose food that is safe for one's health. South Sulawesi is a province with an organic land area of 150 thousand hectares spread across all districts. The Ministry of Agriculture declared full support in 2019 for South Sulawesi as the largest producer or producer of organic rice in Indonesia. In South Sulawesi, conventional rice fields are larger than organic ones. Various studies have shown the benefits of organic farming compared to conventional paddy fields. Therefore, it is necessary to provide evidence related to cultivation using organic and conventional farming systems to attract the interest of farmers in South Sulawesi so that they can switch to organic farming. This study aims to provide justification for the comparison of the

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development of organic and conventional farming systems in the South Sulawesi area. Several points are studied, namely, the use of inputs used for cultivation, soil fertility, and the rice yields produced.

MATERIAL AND METHODS

Place and Time of Research

This study was conducted from October 2022 to March 2023 in two rice production centers in South Sulawesi, namely, Bulukumba Regency (conventional rice farming) and Pucak Village, Maros Regency (organic rice development).

Coordinates and Land Characteristics

The position of Manjalling Village, Ujungloe District, Bulukumba Regency (Conventional Paddy) is located at coordinates 120°28'011"E and -5°51'633"S. The soil type is podsolic. The soil profile has a clay texture, with 58% clay, 18% silt, and 24% sand. Additionally, the position of Timpuseng Village (Pucak), Camba District, Maros Regency (Organic Paddy) is located at coordinates 119°80'339"E and -4°93'728"S. The soil type is regosol. The soil profile has a silty clay loam texture, with 65% clay, 21% silt, and 14% sand.

Methods

The research used a simple random method using land and production data from 130 farmers: 90 farmers using conventional farming system and 40 using organic farming system. Organic farmers implemented an organic farming system starting in 2017. Comparing farming systems used by farmers, various criteria, such as land area, inputs used, land quality, and land productivity, was explored. Information on land area and inputs used was obtained from interviews and discussions with farmers directly.

The research was conducted in three stages: (1) field research, (2) laboratory research, and (3) data analysis. In the field research stage, two steps were carried out:

- Soil samples were collected from 10 locations in organic paddy fields, spread across predetermined soil map units. At each location, composite soil samples were taken from 5 points, totaling approximately 1 kg, at a depth of 0–20 cm for physical and chemical soil property analysis. Soil sampling was conducted after the harvest season when the soil was dry or not waterlogged.
- Primary data collection involved interviewing respondent farmers and agricultural extension workers (PPL) to gather socioeconomic data, such as farmer characteristics (age, education, family size, farming experience, land size), use of production inputs (seeds, organic fertilizers, and pesticides), rice production data, production costs, and income.

The land quality evaluation uses the land boundary approach method that divides land boundary levels and land suitability classes into five groups (Sys et al., 1991). The calculation of the land quality index uses the square index road method that is modified according to the criteria for land use requirements for irrigated rice crops (Djaenudin et al., 2003; Sys et al., 1993). Aside from that, in this research, soil fertility characteristics, such as cation exchange capacity, base saturation, pH H₂O, soil organic C content, and availability of nutrients N, P, and K, were also checked. Partial productivity values (production per hectare) were used to measure land productivity. Furthermore, to compare the differences in quality and productivity of conventional and organic rice fields, the Kruskal–Wallis test

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(Kruskal & Wallis, 1952) is used, namely, a one-way analysis of variance using the SPSS 22.0 program.

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RESULTS

Land Area

The ownership status of conventional paddy fields is as a farmer-tenant with a land holding area in the range of 0.5–1.7 hectares, while organic paddy fields around 0.1–1.0 hectares. The result was grouped into three criteria, namely, narrow land criteria (< 0.5 ha), medium criteria (0.5–1.0 ha), and large criteria (>1.0 ha) (Table 1). The average conventional farmer's land ownership is around 1 hectare, which means it is included in the medium category. Meanwhile, farmers with an organic farming system, on average, have a land area of 0.36 hectares, which is included in the narrow category. It shows that land ownership of conventional farmers in South Sulawesi is larger than organic farmers.

[Table 1 here]

Production Inputs

The use of inputs by farmers is based on cultivation needs. There are differences in land management carried out by conventional and organic farmers. In South Sulawesi, both conventional and organic farmers plant paddy twice a year. However, the planting pattern of conventional farmers is paddy-paddy-green beans, while that of organic farmers is paddy-paddy-fallow. The needs for rice cultivation include land, seeds, fertilizers, and pesticides. However, it will be different if the farmer uses an organic farming system.

Seeds

There are differences in seed requirements between conventional and organic farmers in South Sulawesi (Table 2). The criteria for seeds used in conventional paddy fields include superior varieties with certificate and production potential of 5-8 tons ha^{-1} . However, the use of rice seeds in conventional rice fields is 32.88 kg ha^{-1} , while the recommended amount is 25-30 kg ha^{-1} . It is higher than recommended by agricultural extension workers. Meanwhile, the seeds used in organic rice fields come from local rice types developed by applying organic principles for at least one generation or two seasons. The use of rice seeds in organic rice fields is not engineered and not treated with chemicals. Aside from that, the average use of rice seeds in organic rice fields is 20 kg ha^{-1} , which is lower than recommended (25-30 kg ha^{-1}).

[Table 2 here]

Fertilizer and pesticide

Aside from seeds, fertilizer is also one of the inputs that differentiates conventional and organic farming (Table 3). Conventional farmers used paddy fields twice, using single and compound fertilizers (urea and NPK). The composition of basic fertilizer given is 50% at plant aged 0–7 days after planting, and 50% supplementary fertilizer was given at plant aged 30–35 days after planting. All respondents did not use SP36 fertilizer, ZA fertilizer, and organic fertilizer/compost because they are often unavailable.

[Table 3 here]

In contrast, farmers who have organic rice fields tend to use manure, compost, bokashi, and liquid organic fertilizer (Table 4). Aside from that, biopesticides are also used in order to prevent pest and disease attacks. The input needs of the organic rice farmers should be met independently than those of the conventional farmers. Consequently, the implementation of rice cultivation does not depend much on other parties in the future.

[Table 4 here]

Land Quality

Table 5 shows the evaluation of various soil fertility variables between conventional rice fields in South Sulawesi. The values of all parameters, Cation exchange capacity (CEC), KB, pH, organic C, N, P, and K in organic fields are higher than those of conventional fields. Cation exchange capacity (CEC) in $\text{cmol kg units}^{-1}$ is in the land suitability category S_1 ($>16 \text{ cmol kg}^{-1}$) for paddy.

[Table 5 here]

Land Productivity

There is a statistically significant difference on the productivity of conventional and organic rice fields in South Sulawesi. The average productivity of conventional rice fields is lower than organic ones ($5,536 \text{ kg ha}^{-1}$ and $6,285 \text{ kg ha}^{-1}$, respectively) (Fig. 1).

[Figure 1 here]

DISCUSSION

Based on the results of this study, organic paddy cropping systems have proven to be superior to conventional methods, as evidenced by significantly better soil quality and higher productivity in organic fields. The land quality index for organic rice fields reached an average value of 51.04, placing it in the S_2 category (quite suitable), compared to 28.6 for conventional fields, which fell into the S_3 category (marginally suitable). These differences are supported by improved soil chemical and physical properties in organic systems, such as higher organic carbon (C) and nitrogen (N) content, better pH balance, and greater availability of essential nutrients like phosphorus (P) and potassium (K). Additionally, organic farming practices enhance long-term soil fertility and stability, contributing to more sustainable and productive agricultural outcomes. The superiority of organic farming can be attributed to the consistent use of organic inputs, which enrich the soil with nutrients, improve its structure, and support a more balanced ecosystem, ultimately leading to increased rice yields and better overall soil health.

The organic paddy cropping systems in South Sulawesi have proven to be superior to conventional methods, particularly in improving soil quality and productivity. This is especially crucial given the current state of paddy fields in the region, which are characterized by low organic matter content (soil organic carbon levels below 2%), low cation exchange capacity (CEC) ranging from $3\text{--}15 \text{ cmolc kg}^{-1}$, and a soil pH of 6.92. These factors indicate a significant degradation in soil fertility, with limitations in phosphorus availability, organic matter, and CEC. As a result, the soil has become compacted and less responsive to fertilizers, leading to decreased crop productivity and increased farming costs (Budianto et al., 2023).

The application of organic fertilizers addresses these challenges by replenishing soil nutrients,

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enhancing soil structure, and improving the overall fertility of the land. Organic fertilizers provide multiple benefits, including the addition of organic matter to the soil, contributing essential nutrients such as nitrogen, phosphorus, and potassium, and enhancing the soil's physical, chemical, and biological properties. For instance, the combination of poultry manure with 100% N, P, K fertilizers has been shown to yield 7,090 kg ha⁻¹ of dry grain (Yuniarti et al., 2022). Furthermore, a combination of 25% NPK and 75% organic fertilizer has been recommended for achieving rice production of up to 8.05 tons/ha (Murnita & Taher, 2021). Additionally, research by Bachtiar et al. (2020) demonstrated that the application of organic fertilizers at a dose of 20 t/ha, along with 300 kg N ha⁻¹ of urea, significantly increased dry grain weight by 64.75%. The use of organic manure also enhances the availability of nutrients, particularly nitrogen, from the soil, which is crucial for rice growth. These findings underscore the importance of organic inputs in reversing soil degradation and enhancing the productivity of paddy fields in South Sulawesi, ultimately making organic farming systems more sustainable and beneficial than conventional practices.

Conventional farmers were not interested in using organic fertilizer. Due to the market conditions, obtaining fertilizer was difficult and required additional costs to procure. The SL-PTT technology component for paddy is the organic fertilizer provision of at least 500 kg ha⁻¹ and straw return of at least 2 tons ha⁻¹ (Supriadi et al., 2016). Chemical pesticides are also used in order to prevent pest and disease attacks in the field, although the average dose is lower than recommended.

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The range of Cation exchange capacity (CEC) values in paddy fields is enough to support nutrient adsorption through fertilization. The optimal soil CEC value for irrigated and rainfed rice is in the range (>16 cmol kg⁻¹ for S₁ and ≈16 cmol kg⁻¹ for S₂) (Djaenudin et al., 2003), and both fields already have high CEC even though organic has a higher value than conventional. In addition, the base saturation value expressed in units (%) at the research location is in the land suitability category S₁ (>35%) for rice plants. Base saturation conditions based on land suitability criteria for irrigated rice and rainfed rice are in the range (>36% for S₁; 20–35% for S₂; and <20% for S₃). The same condition also can be seen in pH assessment, and pH of both fields are sufficient to support plant growth because of the field in neutral condition (pH 5.5–7.0). The optimal pH value for rice plants ranges from 5.5 to 7.5 (Djaenudin et al., 2003).

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Different results were shown by the organic C and nitrogen content. The organic C and nitrogen content of organic field are higher than that of conventional field. Organic C on organic and conventional land is 1.05% and 2.51%, respectively. The soil organic matter content in conventional rice fields is in the low category (<1.5%), including land suitability class S₂ for rice plant growth. This is probably due to the intensity of cultivation carried out throughout the year by conventional farmers. Meanwhile, organic rice fields are included in the high category (>1.5%) and included in class two (S₂) land suitability. Nitrogen is one of the main needs of plants. The nitrogen value of organic field reaches 0.44% (medium category), while that of conventional fields reaches around 0.20% (low category). The low nutrient status of N is due to the nature of N, which is very mobile, easy to evaporate (volatilize), and leached. In general, farmers use urea fertilizer at quite high doses. Low soil nitrogen nutrient content correlated with organic material content. The availability of N in the soil is directly proportional to the availability of soil organic matter and limited water availability (Peku Jawang, 2021). N loss easily occurs in areas with high rainfall and in soils with low organic matter content. This condition shows that the land management system is not good, especially the application of fertilizer technology and not using organic materials. The limitations of nitrogen nutrients in rainfed paddy fields can be overcome by providing organic material sourced from harvest residues, combined with low doses of

inorganic fertilizer (Benauli, 2021).

Phosphorus (P) availability in conventional and organic rice fields are 12.06 and 12.20 ppm, respectively. Both are in the low interval (10–25 ppm P). The availability of potassium (K) in conventional rice fields is 40 mg in the medium interval (21–40 mg 100 g⁻¹), and in organic rice fields, 42 mg is in the high category (41–60 mg 100 g⁻¹). These results show that rice fields managed with an organic farming system, using organic fertilizer and pesticides, show better macronutrient contents N, P, and K.

Overall, there are statistically significant differences on the results of the land quality index for conventional and organic rice fields. Numerically, the average index value for conventional rice fields is 28.6, with category S3 (according to marginal). Meanwhile, organic rice fields reached 51.04, including the S2 category (quite suitable). Soil chemical–physical fertility in the organic field is superior to conventional vegetable farming systems, such as soil pH, organic C and N, total P and K, bulk density, particle density, soil porosity, permeability, bulk density, and dehydrogenase enzymes (Sukristiyonubowo et al., 2015, 2018). Similar results were reported in paddy farming that the chemical–physical soil fertility in organic land in Sambirejo District, Sragen Regency, was superior to semi-organic and conventional farming systems. Semi-organic was better than conventional farming systems in terms of soil pH, organic C and N, total P and K, bulk density, particle density, soil porosity, and permeability. Similar findings were observed in paddy biomass production.

There is a statistically significant difference on the productivity of conventional and organic rice fields in South Sulawesi. The superiority of production in organic farming systems is also supported by research results of Santoso (2012) that state that organic farming systems can increase yields by 12% per hectare. Even organic farming systems can increase crop yields by 50–60% (Surekha, 2013). The productivity of organic farming in the beginning stages will decrease but will increase over time. Meanwhile, conventional farming productivity systems will tend to decrease in the long term due to the nutrient poverty caused by low organic matter content (Heryanto et al., 2016). This is influenced by soil fertility conditions that are increasingly stable because the inputs used are without chemicals.

The results of this study align with recent findings by Syamsiyah et al. (2023), who observed significant improvements in soil organic carbon and nitrogen levels in organic farming systems, leading to enhanced soil properties and higher rice yields. In contrast, Supriyadi et al. (2022) highlighted that intensive conventional practices, even with organic inputs, often deteriorate soil quality. Furthermore, the use of rice-husk biochar (RHB) has been shown by Ebido et al. (2021) to improve critical soil quality indices such as soil organic carbon and aggregate stability, which correlate with better crop growth and soil sustainability. These findings collectively emphasize the superior soil quality and productivity benefits of organic farming systems over conventional methods.

CONCLUSION

The organic farming system implemented by farmers in South Sulawesi is considered better than conventional farming system based on the inputs used, the quality of the soil tested by looking at fertility parameters, and the grain yield obtained. In the future, the use of chemical inputs can be reduced and replaced with organic materials. Consequently, the farmers can slowly improve the field quality and switch to organic farming system, which is more sustainable.

Figure and Table

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Grain Productivity in Conventional and Organic Rice Fields

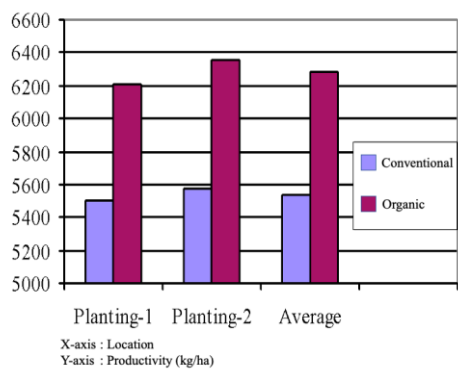


Figure 1. Comparison of Grain Productivity of Conventional and Organic Rice Fields

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Table 1. Distribution land ownership of conventional and organic farmers

Category land area	Conventional (farmer)	Organic (farmer)
Narrow (<0.5 ha)	2 (2%)	24 (60%)
Medium (0.5–1.0 ha)	66 (73%)	16 (40%)
Area (>1.0 ha))	22 (25%)	0 (0%)
Total	90 (100%)	40 (100%)

Table 2. Use of rice seeds by farmers in South Sulawesi

Conventional farming system	Organic farming system
One hundred percent of farmers use varieties according to recommendations (commercial seeds)	The type used is the local type
There are variations in rotation	There is no variety rotation
Just 66% of farmers use certified seeds	Seeds are produced by farmers independently
The number of seeds planted exceeds the number recommended	The number of seeds planted is lower than recommended

Table 3. Fertilizers and pesticides inputs on conventional rice fields

Types of fertilizers and pesticides	Average usage (ha ⁻¹)	Recommendation (ha ⁻¹)
Urea (kg)	194.53	250
SP36 (kg)	0.00	100
NPK (kg)	100.78	150
Organic (kg)	0.00	500
Pesticide (L)	1.38	2

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Table 4. Fertilizers and pesticides inputs on organic rice fields

Types of fertilizers and pesticides	Usage interval (kg, ltr ha ^{0.36})	Average usage (kg, ltr ha ^{0.36})	Average usage (kg, ltr ha ⁻¹)
Manure	600–4,500	1,495.0	4,176.0
Compost	0–400	65.0	181.6
Bokashi fertilizer	200–2,000	615.0	1,717.8
Liquid fertilizer	1–8	3.3	9.1
Biopesticides	1–6	2.2	6.0

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Table 5. Conditional of quality (CBC, KB, pH) conventional and organic rice fields

Category of soil fertility (Balittanah, 1999)	Conventional	Organic
CEC:S ₁ (>16 cmol kg ⁻¹)	19.24	23.24
KB: S ₁ (>36%)	42.17	56.00
pHH ₂ O (pH 5.5–7.0)	6.5	6.5
Organic C (%)	1.05%	2.51%
S ₁ (>1.5%)		
S ₂ (0.8–1.5%)		
S ₃ (<0.8%)		
Nitrogen (N)	0.20%	0.44%
Low (0.1–0.2%)		
Medium (0.21–0.5%)		
Phosphor (P ₂ O ₅)	12.06	12.20
Very low (<10 ppm P)		
Low (10–25 ppm P)		
Medium (26–45 ppm P)		
High (46–60 ppm P)		
Potassium (K ₂ O)	40	42
Very low (<10 mg 100 g ⁻¹)		
Low (10–20 mg 100 g ⁻¹)		

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Medium (21–40 mg 100 g⁻¹)
High (41–60 mg 100 g⁻¹)

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COMPARISON OF CONVENTIONAL AND ORGANIC PADDY CROPPING SYSTEMS IN SOUTH SULAWESI, INDONESIA

ABSTRACT

Rice is the food source for the community, including in the South Sulawesi area. Consequently, proper management is needed to support optimal production results. Several farmers are currently starting to develop organic farming systems due to the shortcomings of the conventional farming system such as the use of chemical inputs, land degradation, and decreased production. This study aims to compare the organic farming developed by farmers with conventional farming systems in terms of land ownership, input, soil quality, and productivity. This research used a simple random sampling method to collect land and production data from 130 farmers (90 conventional, 40 organic). In general, in South Sulawesi, organic farming system is better than conventional farming systems. The inputs in the conventional are certified seeds, chemical fertilizers, and pesticides, which will affect costs and have an effect in the long term. Meanwhile, in an organic farming system, seed needs are met independently by farmers, using organic materials (manure, compost, bokashi) and biopesticides. Productivity also shows that the organic farming system increases production than conventional farming. In the future, farmers can start to develop an organic farming system by adding various organic ingredients to support their field performance.

Keywords: chemical input, grain productivity, rice, soil fertility

INTRODUCTION

Rice production in Indonesia is currently aimed at meeting its growing domestic demand. The average rice consumption per capita in Indonesia is notably high, reaching 81.23 kg per capita per year (Badan Pusat Statistik, 2024). To fulfill this demand, various policy programs have been implemented. However, the adoption of technology packages oriented towards synthetic chemical farming systems has led to the degradation of the soil's physical and chemical properties. The lack of organic matter application in the soil has exacerbated the decline in the quality of paddy fields, particularly in terms of soil fertility. Farmers tend to overuse inorganic fertilizers, exceeding recommended doses, which, over time, contributes to the deterioration of soil quality in paddy fields.

The use and management of land for economic growth purposes and food availability often seem to be in conflict with efforts to preserve natural resources, especially rice fields. In fact, land management for that purpose should be carried out without damaging the environment, or at least efforts must be made to balance these two components can approach ideal conditions. Consequently, the ideal field management application is economically feasible and ecologically sustainable (Indahyani & Maga, 2023). One effort that can be made is to support organic farming carried out by farmers on a massive

scale. Organic farming systems have experienced rapid development in European and American countries. The rate of organic food sales in these countries has ranged from 20% to 25% per year over the last decade (Zulvera, 2014). **Organic farming serves as an economically feasible and ecologically sustainable alternative by promoting cost-effective practices that conserve natural resources and maintain soil health.**

Sukristiyonubowo et al. (2018) reported that in Indonesia, various practices of paddy farming remain closely related to green revolution technology, such as the combination of high external inputs (fertilizers and pesticides) and high-yielding varieties that are unsustainable in long run and involves higher production costs. These issues have paved the way for the farmers to adopt for organic and **semiorganic** farming systems (Sukristiyonubowo et al., 2018). The holistic organic agricultural production system considers long term environmental sustainability and primarily aims to produce food in an environmentally friendly way (Seufert et al., 2012). Recent studies have shown that organic farming significantly improves soil properties and rice yields over time. For instance, research conducted in Central Java, Indonesia, found that soil organic carbon increased by 51.63% within ten years, leading to improved physical, chemical, and biological soil properties. This improvement is largely driven by increased soil total nitrogen, which directly contributes to higher rice yields (Syamsiyah et al., 2023). Additionally, research on Hazton's paddy farming method in Banyumas Regency, **Indonesia**, revealed that soil quality deteriorates despite the application of organic fertilizers, indicating that intensive paddy farming practices can significantly affect land sustainability and soil health (Supriyadi et al., 2022). Furthermore, studies on biochar, such as rice-husk biochar (RHB), have shown its potential in improving soil quality indices like soil organic carbon, aggregate stability, and nitrogen fertility in tropical soils, which in turn enhances crop growth and soil sustainability (Ebido et al., 2021). The important benefits of organics for the environment include biodiversity conservation, better soil quality, reduced evaporation, **improved soil physical properties, enhanced water** and air intake, compaction strategies, adaptation and reduction of greenhouse gas emissions, and **improved energy efficiency** (Reganold & Wachter, 2016; Seufert et al., 2012). Organic farming also increases social capital such as higher bargaining power, better access to credit and markets, opportunities to exchange knowledge and experience, reduced certification costs, and attractive contributions to policy institutions, increases employment opportunities in rural areas, and allows farmers to earn better education and health services due to higher incomes (UNEP, 2008; van Elzakker & Eyhorn, 2010). Farmers who develop organic farming systems gain various economic benefits such as saving money by reducing input costs, selling by-products by entering the organic market with certified products, and selling at higher prices.

The urgency of this research lies in the need to provide empirical evidence supporting the benefits of organic farming systems over conventional methods in South Sulawesi. Given the high costs, declining yields, and environmental impact associated with conventional paddy farming practices, transitioning to organic farming offers a sustainable alternative. This study aims to demonstrate the improvements in soil quality, crop yields, and overall environmental sustainability achievable through organic farming, thereby encouraging farmers in South Sulawesi to adopt these methods for long-term economic and ecological benefits.

The appeal of organic farming, both to farmers and to the general public, is also fueled by awareness of the dangers posed by excessive residues; most consumers will choose food that is safe for one's health. South Sulawesi is a province with an organic land area of 150 thousand hectares spread across all districts. The Ministry of Agriculture declared full support in 2019 for South Sulawesi as the largest

producer or producer of organic rice in **Indonesia**. In South Sulawesi, conventional rice fields are larger than organic ones. Various studies have shown the benefits of organic farming compared to conventional paddy fields. Therefore, it is necessary to provide evidence related to cultivation using organic and conventional farming systems to attract the interest of farmers in South Sulawesi so that they can switch to organic farming. This study aims to provide justification for the comparison of the development of organic and conventional farming systems in the South Sulawesi area. Several points are studied, namely, the use of inputs used for cultivation, soil fertility, and the rice yields produced.

MATERIAL AND METHODS

Place and Time of Research

This study was conducted from October 2022 to March 2023 in two rice production centers in South Sulawesi, namely, Bulukumba Regency (conventional rice farming) and Pucak Village, Maros Regency (organic rice development).

Coordinates and Land Characteristics

The position of Manjalling Village, Ujungloe District, Bulukumba Regency (Conventional Paddy) is located at coordinates 120°28'011"E and -5°51'633"S. The soil type is podsolic. The soil profile has a clay texture, with 58% clay, 18% silt, and 24% sand. Additionally, the position of Timpuseng Village (Pucak), Camba District, Maros Regency (Organic Paddy) is located at coordinates 119°80'339"E and -4°93'728"S. The soil type is regosol. The soil profile has a silty clay loam texture, with 65% clay, 21% silt, and 14% sand.

Methods

The research used a simple random method using land and production data from 130 farmers: 90 farmers using conventional farming system and 40 using organic farming system. Organic farmers implemented an organic farming system starting in 2017. Comparing farming systems used by farmers, various criteria, such as land area, inputs used, land quality, and land productivity, was explored. Information on land area and inputs used was obtained from interviews and discussions with farmers directly.

The research was conducted in three stages: (1) field research, (2) laboratory research, and (3) data analysis. In the field research stage, two steps were carried out:

- Soil samples were collected from 10 locations in organic paddy fields, spread across predetermined soil map units. At each location, composite soil samples were taken from 5 points, totaling approximately 1 kg, at a depth of 0–20 cm for physical and chemical soil property analysis. Soil sampling was conducted after the harvest season when the soil was dry or not waterlogged.
- Primary data collection involved interviewing respondent farmers and agricultural extension workers (PPL) to gather socioeconomic data, such as farmer characteristics (age, education, family size, farming experience, land size), use of production inputs (seeds, organic fertilizers, and pesticides), rice production data, production costs, and income.

The land quality evaluation uses the land boundary approach method that divides land boundary levels and land suitability classes into five groups (Sys et al., 1991). The calculation of the land quality index uses the square index road method that is modified according to the criteria for land use requirements

for irrigated rice crops (Djaenudin et al., 2003; Sys et al., 1993). Aside from that, in this research, soil fertility characteristics, such as cation exchange capacity, base saturation, pH H₂O, soil organic C content, and availability of nutrients N, P, and K, were also checked. Grain productivity values (production per hectare) were used to measure land productivity. Furthermore, to compare the differences in quality and productivity of conventional and organic rice fields, the Kruskal–Wallis test (Kruskal & Wallis, 1952) is used, namely, a one-way analysis of variance using the SPSS 22.0 program.

RESULTS

Land Area

The ownership status of conventional paddy fields is as a farmer-tenant with a land holding area in the range of 0.5–1.7 hectares, while organic paddy fields around 0.1–1.0 hectares. The result was grouped into three criteria, namely, narrow land criteria (< 0.5 ha), medium criteria (0.5–1.0 ha), and large criteria (>1.0 ha) (Table 1). The average conventional farmer's land ownership is around 1 hectare, which means it is included in the medium category. Meanwhile, farmers with an organic farming system, on average, have a land area of 0.36 hectares, which is included in the narrow category. It shows that land ownership of conventional farmers in South Sulawesi is larger than organic farmers.

[Table 1 here]

Production Inputs

The use of inputs by farmers is based on cultivation needs. There are differences in land management carried out by conventional and organic farmers. In South Sulawesi, both conventional and organic farmers plant paddy twice a year. However, the planting pattern of conventional farmers is paddy-paddy-green beans, while that of organic farmers is paddy-paddy-fallow. The needs for rice cultivation include land, seeds, fertilizers, and pesticides. However, it will be different if the farmer uses an organic farming system.

Seeds

There are differences in seed requirements between conventional and organic farmers in South Sulawesi (Table 2). The criteria for seeds used in conventional paddy fields include superior varieties with certificate and production potential of 5–8 tons ha⁻¹. However, the use of rice seeds in conventional rice fields is 32.88 kg ha⁻¹, while the recommended amount is 25–30 kg ha⁻¹. It is higher than recommended by agricultural extension workers. Meanwhile, the seeds used in organic rice fields come from local rice types developed by applying organic principles for at least one generation or two seasons. The use of rice seeds in organic rice fields is not engineered and not treated with chemicals. Aside from that, the average use of rice seeds in organic rice fields is 20 kg ha⁻¹, which is lower than recommended (25–30 kg ha⁻¹).

[Table 2 here]

Fertilizer and pesticide

Aside from seeds, fertilizer is also one of the inputs that differentiates conventional and organic farming (Table 3). Conventional farmers used paddy fields twice, using single and compound fertilizers (urea and NPK). The composition of basic fertilizer given is 50% at plant aged 0–7 days after planting,

and 50% supplementary fertilizer was given at plant aged 30–35 days after planting. All respondents did not use SP36 fertilizer, ZA fertilizer, and organic fertilizer/compost because they are often unavailable.

[Table 3 here]

In contrast, farmers who have organic rice fields tend to use manure, compost, bokashi, and liquid organic fertilizer (Table 4). Aside from that, biopesticides are also used in order to prevent pest and disease attacks. The input needs of the organic rice farmers should be met independently than those of the conventional farmers. Consequently, the implementation of rice cultivation does not depend much on other parties in the future.

[Table 4 here]

Land Quality

Table 5 shows the evaluation of various soil fertility variables between conventional rice fields in South Sulawesi. The values of all parameters, Cation exchange capacity (CEC), KB, pH, organic C, N, P, and K in organic fields are higher than those of conventional fields. Cation exchange capacity (CEC) in $\text{cmol kg units}^{-1}$ is in the land suitability category S_1 ($>16 \text{ cmol kg}^{-1}$) for paddy.

[Table 5 here]

Land Productivity

There is a statistically significant difference on the productivity of conventional and organic rice fields in South Sulawesi. The average productivity of conventional rice fields is lower than organic ones ($5,536 \text{ kg ha}^{-1}$ and $6,285 \text{ kg ha}^{-1}$, respectively) (Fig. 1).

[Figure 1 here]

DISCUSSION

Based on the results of this study, organic paddy cropping systems have proven to be superior to conventional methods, as evidenced by significantly better soil quality and higher productivity in organic fields. The land quality index for organic rice fields reached an average value of 51.04, placing it in the S_2 category (quite suitable), compared to 28.6 for conventional fields, which fell into the S_3 category (marginally suitable). These differences are supported by improved soil chemical and physical properties in organic systems, such as higher organic carbon (C) and nitrogen (N) content, better pH balance, and greater availability of essential nutrients like phosphorus (P) and potassium (K). Additionally, organic farming practices enhance long-term soil fertility and stability, contributing to more sustainable and productive agricultural outcomes. The superiority of organic farming can be attributed to the consistent use of organic inputs, which enrich the soil with nutrients, improve its structure, and support a more balanced ecosystem, ultimately leading to increased rice yields and better overall soil health.

The organic paddy cropping systems in South Sulawesi have proven to be superior to conventional methods, particularly in improving soil quality and productivity. This is especially crucial given the current state of paddy fields in the region, which are characterized by low organic matter content (soil organic carbon levels below 2%), low cation exchange capacity (CEC) ranging from $3\text{--}15 \text{ cmolc kg}^{-1}$, and a soil pH of 6.92. These factors indicate a significant degradation in soil fertility, with limitations in phosphorus availability, organic matter, and CEC. As a result, the soil has become compacted and less

responsive to fertilizers, leading to decreased crop productivity and increased farming costs (Budianto et al., 2023).

The application of organic fertilizers addresses these challenges by replenishing soil nutrients, enhancing soil structure, and improving the overall fertility of the land. Organic fertilizers provide multiple benefits, including the addition of organic matter to the soil, contributing essential nutrients such as nitrogen, phosphorus, and potassium, and enhancing the soil's physical, chemical, and biological properties. For instance, the combination of poultry manure with 100% N, P, K fertilizers has been shown to yield 7,090 kg ha⁻¹ of dry grain (Yuniarti et al., 2022). Furthermore, a combination of 25% NPK and 75% organic fertilizer has been recommended for achieving rice production of up to 8.05 tons/ha (Murnita & Taher, 2021). Additionally, research by Bachtiar et al. (2020) demonstrated that the application of organic fertilizers at a dose of 20 t/ha, along with 300 kg N ha⁻¹ of urea, significantly increased dry grain weight by 64.75%. The use of organic manure also enhances the availability of nutrients, particularly nitrogen, from the soil, which is crucial for rice growth. These findings underscore the importance of organic inputs in reversing soil degradation and enhancing the productivity of paddy fields in South Sulawesi, ultimately making organic farming systems more sustainable and beneficial than conventional practices.

Conventional farmers were not interested in using organic fertilizer. Due to the market conditions, obtaining fertilizer was difficult and required additional costs to procure. The SL-PTT technology component for paddy is the organic fertilizer provision of at least 500 kg ha⁻¹ and straw return of at least 2 tons ha⁻¹ (Supriadi et al., 2016). Chemical pesticides are also used in order to prevent pest and disease attacks in the field, although the average dose is lower than recommended.

The range of Cation exchange capacity (CEC) values in paddy fields is enough to support nutrient adsorption through fertilization. The optimal soil CEC value for irrigated and rainfed rice is in the range (>16 cmol kg⁻¹ for S₁ and =16 cmol kg⁻¹ for S₂) (Djaenudin et al., 2003), and both fields already have high CEC even though organic has a higher value than conventional. In addition, the base saturation value expressed in units (%) at the research location is in the land suitability category S₁ (>35%) for rice plants. Base saturation conditions based on land suitability criteria for irrigated rice and rainfed rice are in the range (>36% for S₁; 20–35% for S₂; and <20% for S₃). The same condition also can be seen in pH assessment, and pH of both fields are sufficient to support plant growth because of the field in neutral condition (pH 5.5–7.0). The optimal pH value for rice plants ranges from 5.5 to 7.5 (Djaenudin et al., 2003).

Different results were shown by the organic C and nitrogen content. The organic C and nitrogen content of organic field are higher than that of conventional field. Organic C on organic and conventional land is 1.05% and 2.51%, respectively. The soil organic matter content in conventional rice fields is in the low category (<1.5%), including land suitability class S₂ for rice plant growth. This is probably due to the intensity of cultivation carried out throughout the year by conventional farmers. Meanwhile, organic rice fields are included in the high category (>1.5%) and included in class two (S₂) land suitability. Nitrogen is one of the main needs of plants. The nitrogen value of organic field reaches 0.44% (medium category), while that of conventional fields reaches around 0.20% (low category). The low nutrient status of N is due to the nature of N, which is very mobile, easy to evaporate (volatilize), and leached. In general, farmers use urea fertilizer at quite high doses. Low soil nitrogen nutrient content correlated with organic material content. The availability of N in the soil is directly proportional

to the availability of soil organic matter and limited water availability (Peku Jawang, 2021). N loss easily occurs in areas with high rainfall and in soils with low organic matter content. This condition shows that the land management system is not good, especially the application of fertilizer technology and not using organic materials. The limitations of nitrogen nutrients in rainfed paddy fields can be overcome by providing organic material sourced from harvest residues, combined with low doses of inorganic fertilizer (Benauli, 2021).

Phosphorus (P) availability in conventional and organic rice fields are 12.06 and 12.20 ppm, respectively. Both are in the low interval (10–25 ppm P). The availability of potassium (K) in conventional rice fields is 40 mg in the medium interval (21–40 mg 100 g⁻¹), and in organic rice fields, 42 mg is in the high category (41–60 mg 100 g⁻¹). These results show that rice fields managed with an organic farming system, using organic fertilizer and pesticides, show better macronutrient contents N, P, and K.

Overall, there are statistically significant differences on the results of the land quality index for conventional and organic rice fields. Numerically, the average index value for conventional rice fields is 28.6, with category S3 (according to marginal). Meanwhile, organic rice fields reached 51.04, including the S2 category (quite suitable). Soil chemical–physical fertility in the organic field is superior to conventional vegetable farming systems, such as soil pH, organic C and N, total P and K, bulk density, particle density, soil porosity, permeability, bulk density, and dehydrogenase enzymes (Sukristiyonubowo et al., 2015, 2018). Similar results were reported in paddy farming that the chemical–physical soil fertility in organic land in Sambirejo District, Sragen Regency, was superior to semi-organic and conventional farming systems. Semi-organic was better than conventional farming systems in terms of soil pH, organic C and N, total P and K, bulk density, particle density, soil porosity, and permeability. Similar findings were observed in paddy biomass production.

There is a statistically significant difference on the productivity of conventional and organic rice fields in South Sulawesi. The superiority of production in organic farming systems is also supported by research results of Santoso (2012) that state that organic farming systems can increase yields by 12% per hectare. Even organic farming systems can increase crop yields by 50–60% (Surekha, 2013). The productivity of organic farming in the beginning stages will decrease but will increase over time. Meanwhile, conventional farming productivity systems will tend to decrease in the long term due to the nutrient poverty caused by low organic matter content (Heryanto et al., 2016). This is influenced by soil fertility conditions that are increasingly stable because the inputs used are without chemicals.

The results of this study align with recent findings by Syamsiyah et al. (2023), who observed significant improvements in soil organic carbon and nitrogen levels in organic farming systems, leading to enhanced soil properties and higher rice yields. In contrast, Supriyadi et al. (2022) highlighted that intensive conventional practices, even with organic inputs, often deteriorate soil quality. Furthermore, the use of rice-husk biochar (RHB) has been shown by Ebido et al. (2021) to improve critical soil quality indices such as soil organic carbon and aggregate stability, which correlate with better crop growth and soil sustainability. These findings collectively emphasize the superior soil quality and productivity benefits of organic farming systems over conventional methods.

CONCLUSION

The organic farming system implemented by farmers in South Sulawesi is considered better than

conventional farming system based on the inputs used, the quality of the soil tested by looking at fertility parameters, and the grain yield obtained. In the future, the use of chemical inputs can be reduced and replaced with organic materials. Consequently, the farmers can slowly improve the field quality and switch to organic farming system, which is more sustainable.

Figure and Table

Grain Productivity in Conventional and Organic Rice Fields

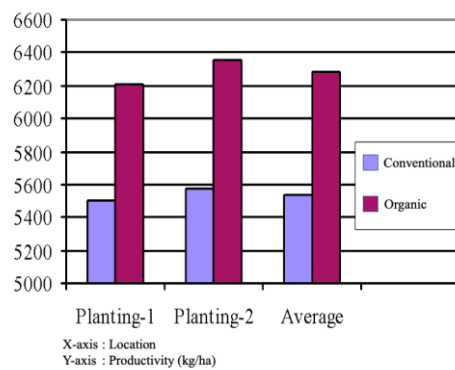


Figure 1. Comparison of Grain Productivity of Conventional and Organic Rice Fields

Table 1. Distribution land ownership of conventional and organic farmers

Category land area	Conventional (farmer)	Organic (farmer)
Narrow (<0.5 ha)	2 (2%)	24 (60%)
Medium (0.5–1.0 ha)	66 (73%)	16 (40%)
Area (>1.0 ha))	22 (25%)	0 (0%)
Total	90 (100%)	40 (100%)

Table 2. Use of rice seeds by farmers in South Sulawesi

Conventional farming system	Organic farming system
One hundred percent of farmers use varieties according to recommendations (commercial seeds)	The type used is the local type
There are variations in rotation	There is no variety rotation
Just 66% of farmers use certified seeds	Seeds are produced by farmers independently
The number of seeds planted exceeds the number recommended	The number of seeds planted is lower than recommended

Table 3. Fertilizers and pesticides inputs on conventional rice fields

Types of fertilizers and pesticides	Average usage (ha ⁻¹)	Recommendation (ha ⁻¹)
Urea (kg)	194.53	250
SP36 (kg)	0.00	100
NPK (kg)	100.78	150
Organic (kg)	0.00	500
Pesticide (L)	1.38	2

Table 4. Fertilizers and pesticides inputs on organic rice fields

Types of fertilizers and pesticides	Usage interval (ha ⁻¹)	Average usage (ha ⁻¹)	Average usage (ha ⁻¹)
Manure (kg)	600–4,500	1,495.0	4,176.0
Compost (kg)	0–400	65.0	181.6
Bokashi fertilizer (kg)	200–2,000	615.0	1,717.8
Liquid fertilizer (Liters)	1–8	3.3	9.1
Biopesticides (Liters)	1–6	2.2	6.0

Table 5. Soil quality of conventional and organic rice fields

Category of soil fertility (Balittanah, 1999)	Conventional	Organic
CEC:S ₁ (>16 cmol kg ⁻¹)	19.24	23.24
KB: S ₁ (>36%)	42.17	56.00
pHH ₂ O (pH 5.5–7.0)	6.5	6.5
Organic C (%)	1.05%	2.51%
S ₁ (>1.5%)		
S ₂ (0.8–1.5%)		
S ₃ (<0.8%)		
Nitrogen (N)	0.20%	0.44%
Low (0.1–0.2%)		
Medium (0.21–0.5%)		
Phosphor (P ₂ O ₅)	12.06	12.20
Very low (<10 ppm P)		
Low (10–25 ppm P)		
Medium (26–45 ppm P)		
High (46–60 ppm P)		
Potassium (K ₂ O)	40	42
Very low (<10 mg 100 g ⁻¹)		
Low (10–20 mg 100 g ⁻¹)		

Medium (21–40 mg 100 g⁻¹)

High (41–60 mg 100 g⁻¹)

Note :

KB: Soil organic matter content

S₁: Highly Suitable (Organic C > 1.5%)

S₂: Moderately Suitable (Organic C 0.8–1.5%)

S₃: Marginally Suitable (Organic C < 0.8%)

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7. Editor Decision

- e. Decision** : Accept Submission 10-12-2024)
f. Editor Version : 87956-261981-3-ED.docx (10-09-2024)
: 87956-261981-4-ED.docx (07-10-2024)
g. Author Version : 87956-254745-7-ED.docx (08-12-2024)
: 87956-254745-8-ED.docx (08-12-2024)

[STJSSA] Editor Decision (ACCEPTED)



Sains Tanah Journal

Tue, Dec 10, 2024,
3:19 PM

to me, Ida, Sitti, Abdel, Abdel

Dear Nurliani:

We have reached a decision regarding your submission to SAINS TANAH - Journal of Soil Science and Agroclimatology, "COMPARISON OF CONVENTIONAL AND ORGANIC PADDY CROPPING SYSTEMS IN SOUTH SULAWESI, INDONESIA".

Our decision is to: Accept Submission for Publication.

You will be duly informed about the next procedure. You can view the status of your article at any time by checking your Author's account after logging.

Best regards.

Dr. Komariah
Associate Editor in Chief of SAINS TANAH
Department of Soil Science, Faculty of Agriculture, Sebelas Maret University
(Scopus Author ID: 48661102400)
sainstanah@mail.uns.ac.id

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REBUTTAL LETTER

Reviewer B:

Introduction				
Reviewer's Comment			Author's Response	
Reference should be cited to support statements. The detail comments and suggestion re mentioned in the attached file. Also, I have reworded the sentences kindly go through that and confirm if you are in agreement.			We have carefully reviewed and addressed the revisions as per your feedback. References have been added to support the statements, and we have incorporated the reworded sentences where appropriate.	
Comments on manuscript:				
Page number	Line number	Reviewer's Comment	Author's Revision	
1	28-29	Cite reference to support the statement	We have added a reference from Maro'ah et al. (2022) to the sentence.	
1	30	Reference??	We have added a reference from Ifadah et al (2021) to the sentence.	
1	32	Please cite some references to support your statement if possible.	We have added a reference from Zikria & Damayanti (2019) to the sentence.	
1	41	Write what one sentence about organic farming as an option for economically feasible and ecological sustainable.	Organic farming serves as an economically feasible and ecologically sustainable alternative by promoting cost-effective practices that conserve natural resources and maintain soil health.	
2	7-8	Define/ elaborate semi-organic farming system as it would of great interest to the international readers.	We have addressed your comment by defining the term semi-organic farming system in the revised manuscript. The updated sentence now clarifies that semi-organic farming combines elements of organic	

			and conventional farming practices to balance ecological benefits and productivity.	
2	16	Write the country name along with the place	Indonesia.	
2	22-23	How organics reduce air intake. Application of organics improve physical properties of soil and improve water and air intake.	Improved soil physical properties, enhanced water.	
2	24	Mention improved or reduced energy efficiency	Improved energy efficiency.	
3	1	Give reference such as reports etc. to support statement	We have added a reference from Ansar & Dirawan (2023) to the sentence.	
Materials and Methods				
Reviewer's Comment			Author's Response	
Use of Kruskal-Wallis test was mentioned in materials and methods but significance is not shown in Tables for the parameters. Also how land quality index was calculated is not written.			We have revised the manuscript to replace the Kruskal-Wallis test with the independent t-test for comparing the quality and productivity of conventional and organic rice fields. Additionally, we have included an explanation of how the land quality index was calculated in the materials and methods section.	
Comments on manuscript:				
Page number	Line number	Reviewer's Comment	Author's Revision	
4	5	Write it as grain productivity as you are writing in results and the graphs. Maintain uniformity of terms throughout the manuscript.	Grain productivity.	

4	6-8	I could not find the use of Kruskal-Wallis test for quality and productivity of conventional and organic rice fields	We have replaced the Kruskal-Wallis test with the Independent t-test, which is a parametric statistical method used to compare the means of two independent groups: conventional and organic rice productivity. The results, presented in Table 1, show that the average productivity of conventional rice (5,536 kg ha ⁻¹) is significantly lower than that of organic rice (6,285 kg ha ⁻¹). The independent t-test analysis confirms this difference, with a significance value of 0.000 (2-tailed), which is less than the alpha level of 0.05. This rejects the null hypothesis (H ₀) and indicates a significant difference in productivity between the two systems.
Results			
Reviewer's Comment			Author's Response
Results on land quality index is not presented through it is mentioned in discussion. The average values should also include standard deviation (SD) for organic and conventional rice fields for every quantitative trait if Kruskal-Wallis test is not employed.			We have revised the manuscript by adding details on how the land quality index was calculated in the Land Quality section of the Results. The calculation method, using the Square Root Method Index (Sys et al., 1991) with modifications based on irrigated paddy field criteria (Sys et al., 1993), has been included to provide clarity. Additionally, we have ensured that the average values for quantitative traits, including standard deviations (SD), are presented in the tables where applicable.
Comments on manuscript:			
Page number	Line number	Reviewer's Comment	Author's Revision
5	19	Please check the unit	We have corrected the unit to cmol(+) kg ⁻¹ .
5	19	Please assure this is the correct unit of CEC	We have corrected the unit to >16 cmol (+) kg ⁻¹ .
Discussion			
Reviewer's Comment			Author's Response
Authors need to mention references to support their statement while justifying the findings and should relate their findings with			We have addressed your suggestions by adding appropriate references to support our statements and justifying our findings in relation to previous studies.

earlier one. Also mention the abbreviation for its first use in each section.			Additionally, we have ensured that all abbreviations are defined at their first use in each section.
Comments on manuscript:			
Page number	Line number	Reviewer’s Comment	Author’s Revision
5	26-31	Where is the land quality index data and how it was calculated	The supporting data and the method used to calculate the land quality index have been provided in Table 6.
5	26-31	Where is the data??	We have included the supporting data in Table 6. For the land suitability index values for the different suitability classes, we referred to Sys et al. (1991).
6	11	Provide reference to support your statement.	We have added a reference from Indriyati et al. (2024) to the sentence.
6	36-37	Elaborate the abbreviation	We have elaborated on the abbreviation SL-PTT as Integrated Crop Management Field School for Rice in the revised manuscript.
7	2-4	First mention what is S1 and S2?	We have added an explanation for the terms S1 and S2 in the revised manuscript to clarify their meaning as land suitability classes.
7	37	Where the data is presented	We have revised the data and added Table 6 to provide a clearer presentation of the land quality index values for conventional and organic rice fields, along with their respective suitability categories.
8	4-7	Where is the result of statistical significance	The sentence has been revised to include the statistical significance result, and a reference to Table 7 has been added for clarity.
Conclusion			
Reviewer’s Comment			Author’s Response
It could be modified based on the finding.			We have modified the relevant section based on the findings to improve clarity and alignment with the results.
Figure and table			
Reviewer’s Comment			Author’s Response

I have reworded the sentences and made changes in the tables/figure kindly go through that and confirm if you are in agreement. Further, many suggestions/comments are given in detail in the attached word file in track change mode for improvement of the manuscript.			Thank you for your detailed feedback and for rewording the sentences as well as making changes to the tables/figures. I appreciate the effort and time you have taken to help improve the manuscript.
Comments on manuscript:			
Page number	Line number	Reviewer's Comment	Author's Revision
8	2	The units of grain productivity is missing in Y-axis. Please correct the figure incorporating the unit in Y-axis.	Thank you for your observation regarding the units on the Y-axis. We would like to clarify that the unit (kg/ha) is already present in the Y-axis label of the figure 1.
9	Table 3	Kindly elaborate what does organic means here? Is it organic manure??	The term "organic" in this context refers specifically to organic manure.
9	Table 3	Here also mention the units of fertilizers and pesticides after their name and write only (ha ⁻¹) under the heading like usage, average usage	We have fixed it.
9	Table 4	Kindly check headings. Why both are named as average usage	We have fixed it.
9	Table 4	Why 0.36 is written as super script for usage interval and average usage I think it should be ha-1.	We have fixed it.
9	Table 4	check	We have fixed it.
9	Table 4	Put a dot after 5	We have fixed it.

9	Table 5	Use standard deviation along with the average values for each soil parameters for conventional and organic rice fields.	We have added the standard deviation alongside the average values for each soil parameter presented in Table 5 for both conventional and organic rice fields.
9	Table 5	Title of table 5 could be written as Soil quality of conventional and organic rice fields	Soil quality of conventional and organic rice fields.
9	Table 5	What is KB please mention below the table and also its grading and CEC grading like S1, S2.	We have fixed it.

8. Copyediting (10-12-2024)

Copyediting

Copyedit Instructions

Review Metadata

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1. Initial Copyedit	2024-12-10	—	2025-01-05
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Copyedit Comments  No Comments

Initial Copyedit
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SAINS TANAH – Journal of Soil Science and Agroclimatology

Journal homepage: <http://jurnal.uns.ac.id/tanah>



Comparison of conventional and organic paddy cropping systems in South Sulawesi, Indonesia

Nurliani¹, Ida Rosada¹, Sitti Rahbiah¹, Sitti Nurani Sirajuddin^{2,3}, Abdel Razzaq M. Al-Tawaha⁴, Abdel Rahman Mohammad Said Al-Tawaha⁵

¹ Agribusiness Study Program, Faculty of Agriculture, Universitas Muslim Indonesia

² Department of Socio Economics, Faculty of Animal Husbandry, Hasanuddin University, Indonesia

³ Faculty of Animal Husbandry and Fisheries, Universitas Sulawesi Barat, Indonesia

⁴ National Agricultural Research Center (NARC-Jordan), Amman, Jordan

⁵ Department of Biological sciences, Al-Hussein bin Talal University, Maan, Jordan

ARTICLE INFO	ABSTRACT
Keywords: Chemical input Grain productivity Rice Soil fertility Article history Submitted: 2024-06-10 Revised: 2024-11-20 Accepted: 2024-12-10 Available online: 2024-12-31 Published regularly: December 2024 * Corresponding Author Email address: nurliani.karman@umi.ac.id	Rice is the food source for the community, including in the South Sulawesi area. Consequently, proper management is needed to support optimal production results. Several farmers are currently starting to develop organic farming systems due to the shortcomings of the conventional farming system such as the use of chemical inputs, land degradation, and decreased production. This study aims to compare the organic farming developed by farmers with conventional farming systems in terms of land ownership, input, soil quality, and productivity. This research used a simple random sampling method to collect land and production data from 130 farmers (90 conventional, 40 organic). In general, in South Sulawesi, the organic farming system is better than conventional farming systems. The inputs in the conventional are certified seeds, chemical fertilizers, and pesticides, which will affect costs and have an effect in the long term. Meanwhile, in an organic farming system, seed needs are met independently by farmers, using organic materials (manure, compost, bokashi) and biopesticides. Productivity also shows that the organic farming system increases production than conventional farming. In the future, farmers can start to develop an organic farming system by adding various organic ingredients to support their field performance.
How to Cite: Nurliani, Rosada, I., Rahbiah, S., Sirajuddin, S.N., Al-Tawaha, A.R.M., Al-Tawaha, A.R.M.S. (2024). Combine Application of Oxidized Biochar and Phosphate Solubilizing Bacteria Enhances Available Phosphorus and Maize Yield in an Acid Soil. <i>Sains Tanah Journal of Soil Science and Agroclimatology</i>, 21(2): xxx-xxx. https://doi.org/10.20961/stjssa.v21i2.87956	

1. INTRODUCTION

Rice production in Indonesia is currently aimed at meeting its growing domestic demand. The average rice consumption per capita in Indonesia is notably high, reaching 81.23 kg per capita per year (BPS, 2024). To fulfill this demand, various policy programs have been implemented. However, the adoption of technology packages oriented toward synthetic chemical farming systems has led to the degradation of the soil's physical and chemical properties (Maro'ah et al., 2022). The lack of organic matter application in the soil has exacerbated the decline in the quality of paddy fields, particularly in terms of soil fertility (Ifadah et al., 2021). Farmers tend to overuse inorganic fertilizers, exceeding recommended doses, which, over time, contributes to the deterioration of soil quality in paddy fields (Zikria & Damayanti, 2019).

The use and management of land for economic growth purposes and food availability often seem to be in conflict with efforts to preserve natural resources, especially rice fields. In fact, land management for that purpose should be carried out without damaging the environment, or at least efforts must be made to balance these two components can approach ideal conditions. Consequently, the ideal field management application is economically feasible and ecologically sustainable (Indahyani & Maga, 2023). One effort that can be made is to support organic farming carried out by farmers on a massive scale. Organic farming systems have experienced rapid development in European and American countries. The rate of organic food sales in these countries has ranged from 20% to 25% per year over the last decade (Zulvera et al., 2014). Organic farming serves

[STJSSA] Copyediting Review Request (due date: January 5, 2025)

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to me

Dear Nurliani:

Your submission "Comparison of conventional and organic paddy cropping systems in South Sulawesi, Indonesia" for SAINS TANAH - Journal of Soil Science and Agroclimatology has been through the first step of copyediting, and is available for you to review by following these steps.

1. Click on the Submission URL below.
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This is the last opportunity to make substantial copyediting changes to the submission. The proofreading stage, that follows the preparation of the galley, is restricted to correcting typographical and layout errors.

If you are unable to undertake this work at this time or have any questions, please contact me. Thank you for your contribution to this journal.

Dr. Komariah

Associate Editor in Chief of SAINS TANAH

Department of Soil Science, Faculty of Agriculture, Sebelas Maret University

(Scopus Author ID: 48661102400)

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[STJSSA] Copyediting Review Acknowledgement

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Mon, Jan 6, 4:51 PM (11
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Dear Nurliani:

Thank you for reviewing the copyediting of your manuscript, "Comparison of conventional and organic paddy cropping systems in South Sulawesi, Indonesia," for SAINS TANAH - Journal of Soil Science and Agroclimatology. We look forward to publishing this work.

Dr. Komariah

Associate Editor in Chief of SAINS TANAH

Department of Soil Science, Faculty of Agriculture, Sebelas Maret University

(Scopus Author ID: 48661102400)

sainstanah@mail.uns.ac.id

9. Paper published (08-01-2025)

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