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Sustainable rice farming in West Java, Indonesia: The application of a cost-efficient organic farming approach

Imam Hartono Bangun*[1], Rudy Sembiring[2], Chakrapani Ruddraramker[3], Muhammad Rizky Syam[4]

[1] Universitas Muhammadiyah Sumatera Utara, Faculty of Agriculture, Mukhtar Basri No. 3, Medan 20238, Indonesia

[2] PT United Alacrity, Cempaka Putih Timur No. 118 Cempaka Putih, Jakarta 10510, Indonesia

[3] UAL Biotech Pte. Ltd, 101 Cecil Street, 14-09 Tong Eng Building, Singapore 069533, Singapore

[4] PT Vilanusa Indah Agroservices, Villa Nusa Indah 3 KB 3/1, Gunung Putri, Bojong Kulur, Bogor Regency, West Java 16960, Indonesia

* Corresponding author

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Abstract: West Java, known as one of the largest rice producers in Indonesia, boasts considerable agricultural potential waiting to be harnessed. Recognising the significance of sustainable agricultural practices, the adoption of biofertilisers emerges as a promising strategy. This environmentally friendly approach not only offers economic benefits but also contributes to the preservation of the local ecosystem. Furthermore, implementing biopesticides for pest management complements these efforts by addressing pest resistance, ultimately enhancing agricultural productivity in the region. This study intends to demonstrate advantages of the organic farming system over inorganic farming in rice yield, economy, and sustainable farming in West Java, Indonesia. A non-factorial randomised complete block design was used: T_0 = inorganic farming, T_1 = 100% dosage organic farming, T_2 = 100% dosage semi-organic farming, T_3 = 50% dosage organic farming, and T_4 = 50% dosage semi-organic farming. In conclusion, this research underscores the substantial potential benefits of biotechnology-based techniques, particularly organic farming systems (OFS). While the implementation of the OFS may not significantly impact certain plant growth parameters, the study emphasises its positive sustainability and economic feasibility. Advocating for the adoption of organic farming practices in West Java and neighbouring regions is crucial for a more sustainable and productive agricultural future.

Keywords: agricultural sustainability, fertilisation, inorganic farming, organic farming, rice cultivation

INTRODUCTION

The rapid growth of the global population has poses challenges to meet food requirements, becoming a major challenge for many nations, including Indonesia. Given the substantial population growth, notably in Indonesia, ranking as the fourth most populous country globally with 273 mln people in 2022, addressing the demands for food has become a pressing issue, urging the need for crucial strategies in maintaining food security. Indonesia, a leading rice producer worldwide (BPS, 2022), saw the production of approximately 55.27 mln Mg of paddy in 2021, with rice being a staple food (Marwan *et al.*, 2022). Among the regions, West Java boasts the highest rice production (Hendrani, Nugraheni and Karliya, 2022). Factors influencing food production, especially rice, which is a vital staple for the Indonesian population, need to be carefully considered.

Ensuring food security presents a significant challenge, primarily due to the impact of climate change and the increased use of synthetic fertilisers and pesticides in agriculture. This intensification of agricultural practices has adversely affected soil health. However, this issue can be addressed through a sustainable bioproduction approach (Zeng, 2019). The approach prioritise biodiversity, long-term human well-being, and sustainable development, aligning with the goals of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES-CF). Science policies play a crucial role in managing chemicals and waste while mitigating pollution (Díaz *et al.*, 2015). A global cessation of inorganic fertiliser and pesticide use is imperative, considering their adverse effects such as heightened soil salinity, accumulation of heavy metals, water eutrophication, nitrate buildup (Savci, 2012), and increased greenhouse gas emissions (Walling and Vaneeckhaute, 2020).

One approach to implementing sustainable bioproduction approach systems involves utilising organic fertilisers, organic pesticides, and organic biostimulants to enhance sustainable agricultural production (Seneviratne *et al.*, 2011). Notably, the direct application of beneficial microbial consortium-based biofertilisers, soil amendments, or suitably supporting carriers has shown promising effects and innovation (Singh, 2015). Moreover, several research projects have focused on the utilisation of household waste and animal manure as organic fertilisers (Munar, Bangun and Lubis, 2018; Idris *et al.*, 2023). Additionally, the exploration of bacterial consortia as biofertilisers have been undertaken to improve the accessibility of essential macronutrients like nitrogen (N) (Cai-xia, Jing-jing and Ru-zhen, 2018), phosphorus (Ghosh *et al.*, 2016; Munar *et al.*, 2022), and potassium (Bangun, Hanum and Sabrina, 2023; Bangun *et al.*, 2024). Biofertilisers support a cost-effective, eco-friendly technology that significantly enhances soil fertility (Daniel *et al.*, 2022). The use of biopesticides for pest control enhances agricultural productivity by reducing pest resistance (Zuma *et al.*, 2023). Recent research indicates that the sustainability level improving rice production in West Java is generally moderate. This is influenced by six pivotal factors: land status, utilisation of organic pesticides and fertilisers, land conversion, rice cultivation management, availability of water pumps, and the number of tractors. The profound way to elevate rice production sustainability in West Java is to prioritise the use of organic fertilisers and organic pesticides (Rachman *et al.*, 2022).

This study utilised Zymo Biogrow, an outstanding natural product that enhances plant growth, improves soil quality, and stimulates beneficial microbial activity, bringing numerous advantages to farmers. In this investigation, Zymo Biogrow was employed due to its remarkable properties in promoting plant growth, enhancing soil quality, and encouraging beneficial microbial activity, providing various advantages to farmers (Ferganix, 2023). Additionally, Xymo Bugtrol served as an organic biopesticide, Xymo Biofert was used as a soil conditioner, and Merlyn Nutrex was utilised as an organic natural ionic mineral. Lastly, the integration of Xymo Max Spread as an organic adjuvant was also part of the study. All these products are organic inputs certified to INDOCERT (Ref. No. TN/I/1020). This study intends to demonstrate the advantages of the organic farming system (OFS) over inorganic farming (IOF) in rice yield, economy, and sustainable farming in West Java, Indonesia. The research posited that the implementation of the OFS, either in full or in part, in West Java, Indonesia, will yield rice crops at least equivalent to the IOF, while providing greater economic benefits and supporting agricultural sustainability.

MATERIALS AND METHODS

STUDY SITE

Field research was conducted in Bogor, West Java, Indonesia (N 6°30'22; E 107°02'55; 176.12 m elevation) from March to July 2021. The soil conditions are determined by Alfisols which have a slightly acid soil reaction (pH 5.6–6.0). The annual mean precipitation is 3,181 mm·year^{-1} (Sofyan, 2021) and temperature 26°C (Sarwono, 2022).

MATERIALS

Materials used were paddy seeds (‘Inpari 32’), Zymo Biogrow as biofertiliser (Tab. 1), Xymo Biofert as a soil conditioner, Merlyn Nutrex as an organic natural ionic mineral, Xymo Bugtrol as a biopesticide, Xymo Max Spread as an organic adjuvant, rice husk, compost, urea, SP-36, and potassium chloride, nutrient agar medium (Travers, Martin and Reichelderfer, 1987), XLD Agar (Taylor and Schelhart, 1971), MacConkey agar medium (Jung and Hoilat, 2022), and tobacco leaves (*Nicotiana tobaccum* L.).

Table 1. Composition of Zymo Biogrow

Parameter	Unit	Content
Bacillus sp.	CFU·g^{-1}	3.28·10^{8}
Escherichia coli	MPN·g^{-1}	<30
Salmonella sp.	MPN·g^{-1}	<30
Hiversensitivitas	–	negative
Material breaking organic	–	positive
Physical appearance	–	gray to blackish gray
Formulation type	–	powder
Active ingredient	%	79% of organic matter and 15–20% minerals

Source: own elaboration.

TOOLS

The tools used were hoes, sprayers, digital scales (SF-400), and digital pH meters (ITUIN), Erlenmeyer 250 cm^3, graduated cylinder, test tube, test tube rack, dropper pipette, variable volume pipette, analytical balance (FUJITSU: FS-AR 210 g × 0.0001 g/0.1 mg), knife, Petri dish, oven, syringe (1 cc), tweezers, rotary shaker (Hz-300), incubator (Memmert IN55), Bunsen lamp, refrigerated cabinet, laminar air flow, autoclave (American 75X), micropipette 100–1000 mm^3 (DRAGONLAB), pipette tips, label paper, plastic wrap, aluminium foil, tissue, and cotton.

RESEARCH METHOD

A non-factorial randomised complete block design (RCBD) was used: T_0 = control (inorganic farming) (IOF), T_1 = 100% dosage organic farming system (OFS), T_2 = 100% dosage semi-organic farming (SOF), T_3 = 50% dosage organic farming (OFS), and T_4 = 50% dosage semi-organic farming (SOF). An experimental plot of 100 m^2 consisting of three replications with 15 plots (Tab. 2, Fig. 1).

Table 2. Composition details and applied schedule treatment

ID	Treatment	Days after transplanting (DAT)										
		7	22	27	30	37	42	52	57	67	72	82
T_0	urea[1)]	50			50							
	DAP[1)]	25			25							
	potassium chloride[1)]	25			25							
	Plenum 50 WG[3)]			2.0		2.0		2.0		2.0		
	Alika 247 ZC[3)]					0.2		0.2		0.2		
T_1	Zymo Biogrow[1)]	10										
	Xymo Biofert[1)]	2.5										
	rice husk[1)]	500										
	vermicompost[1)]	250										
	Merlyn Nutrex[2)]		0.5			0.5		0.5		0.5		0.5
	Xymo Biofert[2)]		1.5			1.5		1.5		1.5		1.5
	Xymo Max Spread[2)]		0.1	0.1		0.1	0.1	0.1	0.1	0.1	0.1	0.1
	Xymo Bugtrol[2)]			1.0			1.0		1.0		1.0	
T_2	Zymo Biogrow[1)]	10										
	Xymo Biofert[1)]	5.0										
	DAP[1)]	50										
	Merlyn Nutrex[2)]		0.5			0.5		0.5		0.5		0.5
	Xymo Biofert[2)]		1.5			1.5		1.5		1.5		1.5
	Xymo Max Spread[2)]		0.1		0.1	0.1		0.1	0.1	0.1		0.1
	Xymo Bugtrol[2)]				1.0				1.0			1.0
T_3	Zymo Biogrow[1)]	5.0										
	Xymo Biofert[1)]	1.25										
	rice husk[1)]	250										
	vermicompost[1)]	125										
	Merlyn Nutrex[2)]		0.25			0.25		0.25		0.25		0.25
	Xymo Biofert[2)]		0.75			0.75		0.75		0.75		0.75
	Xymo Max Spread[2)]		0.05	0.05		0.05		0.05		0.05		0.05
	Xymo Bugtrol[2)]			0.50								
T_4	Zymo Biogrow[1)]	5.0										
	Xymo Biofert[1)]	2.5										
	DAP[1)]	25										
	Merlyn Nutrex[2)]		0.25			0.25		0.25		0.25		0.25
	Xymo Biofert[2)]		0.75			0.75		0.75		0.75		0.75
	Xymo Max Spread[2)]		0.05		0.05	0.05		0.05	0.05	0.05		0.05
	Xymo Bugtrol[2)]				0.50				0.50			0.50

[1)] Broadcast application (kg·ha^{-1}).
[2)] Foliar applied and all product possible mix application (cm^3·dm^{-3}).
[3)] Foliar applied and used based on pest condition (g·dm^{-3} or cm^3·dm^{-3}).
Explanation: Plenum 50 WG (250 g·ha^{-1} lowest and upper 350–400 g·ha^{-1}).
Source: own elaboration.

DATA ANALYSIS

Data were analysed statistically using the analysis of variance (ANOVA) and Duncan Multiple Range Test (DMRT) at 5% (Skillings, 2018). The cost analysis uses the calculation of economic analysis with profit and $R{\cdot}C^{-1}$ variables (Tung, 1992).

Linear models follow the formula prescribed by Agresti (2015):

$$\gamma_{ij} = \mu + T_i + \alpha_j + \varepsilon_{ij} \tag{1}$$

where: Y_{ij} = response value of the variable for unit j in block i, μ = overall average of the dependent variable, T_i = treatment

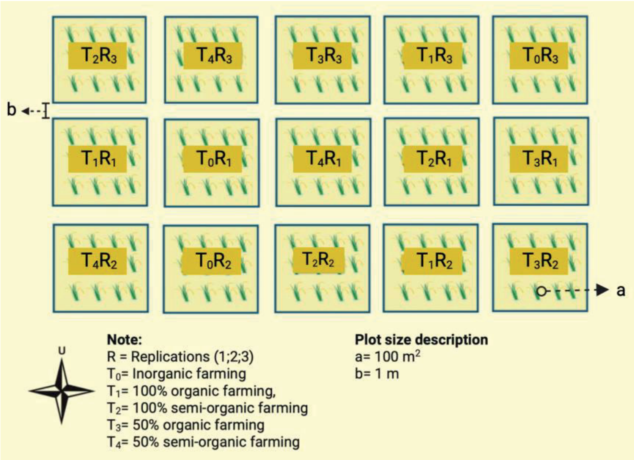

Fig. 1. Scheme of the experiment; source: own elaboration

effect of the agricultural system factor at the level i (i = 1, 2, ..., t), a_j = block effect of the unobserved factor in block j (j = 1, 2, ..., b), e_{ij} = measurement error or noise that the factors in the model cannot explain, t, b = last variable in the sequence.

The revenue-cost ratio (RCR) follows the formula prescribed (Tung, 1992):

$$RCR = \frac{R}{C} \tag{2}$$

where: R = total revenue, C = total production costs.

RESEARCH IMPLEMENTATION

The land had been processed and ploughed with a tractor until was suitable for planting. Two weeks later, soil harrowing and levelling were carried out. Subsequently, the land was divided into plots, and channels were created for water intake and drainage. Treatments were randomised in repetitions (blocks). 'Inpari 32' rice variety was planted using a direct seeding system without the need for seedling transplantation, and after 14 days since the seedlings were moved, all treatments were applied manually to the plots (Tab. 1). This study also utilised bio-rodenticides to control rat and snail pests throughout the area, using DTK AG (10 kg·ha^{-1}) mixed with sand based on pest conditions. The land was consistently flooded during the growth period, with water sourced from the irrigation system by local farmers. Harvesting was carried out 90 days after seedling transplantation (DAT).

The assessment of plant growth and production involves the following observational parameters.

1. Plant height (cm); the measurement of plant height is taken from adventitious roots to the highest rice leaf following the procedure outlined by. The number of samples per treatment plot is 10 plants, and measurements are conducted at observation intervals: 31, 61, and 88 DAT.
2. Number of tillers; calculated by counting the tillers that have grown and have perfectly opened leaves, following the procedure by Fageria (2007). The number of samples per treatment plot is 10 plants, and observations are made at intervals: 31, 61, and 88 DAT.
3. Grain yield (kg·ha^{-1}), measured at 90 DAT by weighing all harvested grain clusters, which were clean and separated from the panicles following the procedure outlined by Fageria (2007).

RESULTS AND DISCUSSION

EFFECT OF THE ORGANIC FARMING SYSTEM OVER INORGANIC FARMING

Sustainable bioproduction systems have developed differently in each country over the last few years. Various kinds of biotechnology-based technologies have been overgrown over the last 10 years. Research report on the use of the OFS show increased plant growth in terms of the plant height and the number of tillers at three distinct growth stages 31, 60, and 88 DAT, in Table 3.

Table 3. Influence of treatment on the growth attributes at different stages days after transplanting (DAT) ($p < 0.05$)

Treatment	Plant height (cm)			Number of tillers		
	31 DAT	60 DAT	88 DAT	31 DAT	60 DAT	88 DAT
T_0	54.60	82.80	79.73	24.13	17.87	17.06
T_1	52.53	79.87	82.67	24.40	19.67	18.53
T_2	50.67	75.67	82.93	24.40	17.60	19.40
T_3	50.40	80.07	82.00	23.93	18.07	17.46
T_4	51.60	86.53	87.13	21.27	18.87	18.13
Mean	51.96	80.99	82.89	23.63	18.41	18.12
CD (p = 0.05)	NS	NS	NS	NS	NS	NS
CV (%)	2.43	4.62	3.53	6.25	7.25	7.84

Explanations: NS = non-significant, CV = coefficient of variation, CD = critical difference.
Source: own study.

We found that applying the OFS does not significantly affect the observed plant height and number of tillers. However, using the organic farming system with T_3 (50% dosage OFS) can increase rice plant height better than using inorganic farming across all observed stages. Meanwhile, in observing the number of tillers, employing the organic farming system at T_1 = (100% dosage OFS) increased the number of tillers more significantly than the use of the IOF at all observed stages. Regarding production results, the use of the OFS mixed with rice husk and compost in the same treatment can yield results comparable to those of the IOF (Fig. 2).

Moreover, the use of organic fertiliser at a dose of T_3 = 50% OFS can yield results with only a 7% difference compared to the IOF, despite the tendency for the IOF to incur higher cost than the OFS. In summary, this study shows that rice yields can be increased by applying Zymo Biogrow (5 kg·ha^{-1}) mixed with Xymo Biofert (1.25 kg·ha^{-1}), rice husk (250 kg·ha^{-1}), and compost (125 kg·ha^{-1}) along with the application of organic foliar fertiliser Merlyn Nutrex (0.25 cm^3·dm^{-3} water) as additional nutrition for rice plants. The use of this fertiliser package in soil can increase soil fertility, improve soil texture, enhance nutrient conditions, act as a stimulant, and improve soil aeration.

Several factors influence the increase in production, primarily driven by the increase in rice plant biomass, including plant height and the number of tillers. In organic farming practices, pest control using organic pesticides requires attention. This study also incorporated the use of the Xymo Bugtrol

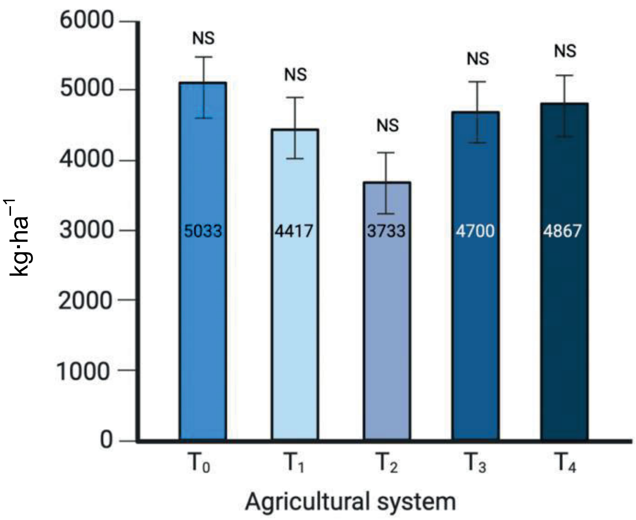

Fig. 2. Grain yield as influenced agriculture system treatment; significant differences are represented by ANOVA ($p < 0.05$); T_0 = control (inorganic farming – IOF), T_1 = 100% dosage organic farming system (OFS), T_2 = 100% dosage semi-organic farming (SOF), T_3 = 50% dosage organic farming (OFS), and T_4 = 50% dosage semi-organic farming (SOF); source: own study

(0.5 $cm^3 \cdot dm^{-3}$ water) biopesticide for insect pests control, combined with Xymo Maxspread (0.05 $cm^3 \cdot dm^{-3}$ water) as an adjuvant to complement the treatment group.

CORRELATION BETWEEN PARAMETERS

Generally, OFS applications show significant correlations with plant height and yield variables. However, there is no significant impact on other parameters, although all variables have a positive correlation after applying the OSF (Tab. 4).

The correlation results confirmed a significant positive linear correlation (0.885) between the yield and plant height at 60 DAT, classified as very strong in increasing the yield per hectare. This phenomenon arises because taller plants tend to generate larger biomass, leading to increased photosynthesis in rice plants at 60 DAT, thus yielding more produce. We believe that the increase in crop yields also correlates with the number of tillers at 60 DAT, despite lacking a significant effect.

COST ADVANTAGE ANALYSIS

The cost-benefit analysis uses the $R \cdot C^{-1}$ (revenue cost ratio) method to assess how much profit is after using OFS than IOF (Tab. 5).

Table 5. Cost analysis of the application of organic farming system rather than inorganic farming using the revenue cost ratio ($R \cdot C^{-1}$)

Treatment	Material costs	Operational cost	Total cost	Income	$R \cdot C^{-1}$
	IDR[1]				
T_0	3,814,500	430,000	4,244,500	22,648,500	5.3
T_1	2,314,184	1,100,000	3,414,184	19,876,500	5.8
T_2	2,355,719	1,175,000	3,530,719	16,798,500	4.7
T_3	1,157,092	1,100,000	2,257,092	21,150,000	8.9
T_4	1,177,859	1,175,000	2,352,859	21,901,500	9.3

[1] IDR 10,000 = USD 0.61.
Explanations: T_0, T_1, T_2, T_3, and T_4 as in Fig. 2.
Source: own study.

The cost-benefit analysis has been completed, revealing varying and non-patterned cost reductions for each treatment. The use of T_1 = 100% dose of OSF can save production costs by 17% (IDR 830,316), T_2 = 100% dosage SOF can save production costs by 20% (IDR 713,781), T_3 = 50% dosage OSF can save production costs by 47% (IDR 1,987,408), and T_4 = 50% dosage SOF can save the cost by 45% (IDR 1,891,641) compared to the IOF. Additionally, the observed distribution cost value of the $R \cdot C^{-1}$ ratio of OFS increased compared to the IOF.

DISCUSSION

The variety used in this study, 'Inpari 32', produced 6.3 $Mg \cdot ha^{-1}$ with a plant height of 97 cm and exhibited resistance to lodging. 'Inpari 32' is characterised by low production but high resistance to pests and diseases (Jahari, Usman and Sinaga, 2020). Overall, vegetative observations of plant height and number of tillers showed no significant effect after administering OFS, SOF

Table 4. Correlation between parameters observed after application system agriculture at different stages days after transplanting (DAT)

Variable	Plant height 30 DAT	Plant height 60 DAT	Plant height 80 DAT	No. of tillers 30 DAT	No. of tillers 60 DAT	No. of tillers 80 DAT	Yield 90 DAT
Plant height 30 DAT	1000	0.383	–0.475	0.127	0.122	–0.512	0.336
Plant height 60 DAT	0.383	1000	0.432	–0.814	0.352	–0.579	0.885*
Plant height 88 DAT	–0.475	0.432	1000	–0.839	0.402	0.4	0.152
No. of tillers 30 DAT	0.127	–0.814	–0.839	1000	–0.247	0.112	–0.568
No. of tillers 60 DAT	0.122	0.352	0.402	–0.247	1000	0.091	0.335
No. of tillers 88 DAT	–0.512	–0.579	0.4	0.112	0.091	1000	–0.822
Yield 90 DAT	0.336	0.885*	0.152	–0.568	0.335	–0.822	1000

* Correlation is significant at the 0.05 level (2-tailed).
Source: own study.

and IOF. However, during the initial growth period from 1 to 60 DAT, both plant height and number of control tillers were higher. On the 88 DAT observation, the plant height and the number of tillers in the OFS and SOF treatments surpassed those in the IOF (Tab. 3).

The results of this investigation are based on the short-term duration of one growing season. Meanwhile, using organic-based approaches typically require a longer time to show their effects compared to inorganic methods. During the research, it was observed that the OFS response took longer to show its impact on supporting plant growth, including plant height and the number of tillers. This differs from the response seen with the IOF, which typically shows effects in less than five days.

This factor also contributes to the relatively lower attractiveness of the OFS among farmers. Research conducted in close proximity to farmers' rice planting locations clearly shows that the initial morphology of the plants is superior when using the IOF and other conventional crops. In Indonesia, most farmers still use inorganic fertilisers as their main choice. A study has found that the usage of fertilisers and chemicals in tidal swamp lands is still high (Purba *et al.*, 2020). Organic-based fertilisers that slowly decompose are intended to produce a small quantity of nutrients for an extended time. Nitrogen (N), phosphorus (P) and potassium (K) are the three crucial macronutrients that support plant growth. Manufactured inorganic fertilisers contain high proportion of dissolved N and are easily soluble in water. Although almost all organic fertilisers have crude N in a balanced part that dissolves for a long time, organic fertilisers can reduce the impact of eutrophication, groundwater contamination, and excessive fertilisation (Shaji, Chandran and Mathew, 2021).

The research findings on rice yield observations reveal that the use of the IOF had the highest results compared to other treatments. However, the use of OFS and SOF at different doses produces various responses in rice plant yield variables. Notably, the use of organic fertiliser with T_3 = 50% dosage OFS can offset the yield of rice plants in the IOF (Fig. 2), showing a significant positive linear correlation with plant height (0.885) – Table 4. We believe this effect is attributed to the symbiotic relationship between the OFS, rice husk, and compost, enhancing nutrient availability and absorption. The interaction between rice husk and OFS can increase yield by about 13.3% compared to the IOF (Turmuktini *et al.*, 2012). Therefore, the use of organic fertilisers is recommended to increase soil fertility in the Jiangxi Region, China (Dong *et al.*, 2012).

Rice productivity is significantly higher after adding manure and straw. Various organic fertilisers can increase the nutrient content of albic paddy soil, stimulate enzyme activity, and affect the biomass and microbial structure. Adding manure or straw increases microbial biomass and positively affects soil fertility and ecological buffering capacity. These findings imply that different organic fertilisers promote soil biochemical and microbial characteristics, ultimately improving the soil quality for albic rice (Zhang *et al.*, 2015).

While semi-organic treatment can be an option, we suggest using 100% organic farming and utilising agricultural and household waste as additional nutrition to protect the environment. Studies have shown that the integrated use of organic amendments and 25% RFD of NPK fertiliser significantly increases dehydrogenase, alkaline phosphatase, urease activity, and microbial biomass carbon compared to unfertilised control plots (Meena *et al.*, 2022). Additionally, the foliar application of potassium phosphate fertiliser affects the nutrient uptake of several rice varieties, including N, P, K, and Na (Barus, Rosmayanti and Chairani, 2018).

Cost calculations have revealed that while using inorganic fertilisers can increase production, it also entails higher cost than the OFS. The IOF requires higher material espenses, unlike organic fertilisers, which incur higher operational costs. These results show that the material costs for fertilisers can be reduced by using organic alternatives, thereby reducing overall planting expenses. The application of the OFS demonstrates a reduction in material costs across all treatments except for control group. Specifically, producing organic fertiliser T_3 = 50% OFS can produce cost savings of 47% (IDR 1,987,408) compared to the IOF.

The highest *RCR* was observed in the use of the OFS combined with the SOF or the T_4 treatment = 50% SOF (*RCR* = 9.3) and T_3 = 50% dosage OFS (*RCR* = 8.9). Based on this data, we believe that using the OFS reduces rice production efficiency and incur costs and environmental health losses. Research conducted in South Sumatra revealed that out of 93 rice farms studied, 44 farms (47.31%) were efficient, five farms (5.38%) were inefficient in scaling up yield, and 44 farms (47.31%) were inefficient in decreasing yield. Notably, inputs such as N, P, and K fertilisers, herbicides, insecticides, and fungicides had a significant positive impact on rice production in the tidal lowlands of South Sumatra (Purba *et al.*, 2020).

CONCLUSIONS

The development of biotechnology-based techniques, especially organic farming systems (OFS), holds substantial promise for enhancing sustainability and economic viability in agriculture, as evidenced by the findings of this research. Despite negligible impacts on certain plant growth parameters, the study underscores the overall positive implications of OFS adoption. Economic analysis demonstrates substantial cost savings, with organic fertiliser dosages yielding up to a 47% reduction in expenses compared to inorganic alternatives. These findings emphasize the dual benefits of sustainability and economic feasibility associated with organic farming. Given these insights, advocating for the widespread adoption of organic farming techniques, particularly in regions like West Java, Indonesia, is imperative. Policymakers, farmers, and agricultural stakeholders should prioritise the implementation of organic farming practices to foster a more sustainable and productive agricultural future.

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CONFLICT OF INTERESTS

All authors declare that they have no conflict of interests.

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