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EFFECTS OF DIFFERENT TYPES OF ORGANIC FERTILIZER PLUS INDIGENOUS MICROORGANISM (IMO) ON THE GROWTH AND YIELD OF LOWLAND RICENSIC RC 160 VARIETY

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ABSTRACT----------
The use of organic fertilizers has become increasingly popular due to their potential to improve soil fertility, reduce environmental pollution, and enhance crop yields. This study was carried out at Purok 2, Kipalili San Isidro Davao del Norte, Philippines, from December 2021 to April 2022. This experimental study aimed to investigate the effect of different organic fertilizers plus Indigenous microorganism (IMO) in the lowland with 160 rice variety, specifically, the study aimed: (1.) to determine the effect of different organic fertilizers plus Indigenous Microorganism (IMO) on the characteristics of rice NSIC RC 160 variety and yield components. (2.) to identify which treatment will give the optimum yield of rice NSIC RC 160 variety as affected by different organic fertilizer plus Indigenous Microorganism (IMO). (3.) to evaluate the economic profitability of rice NSIC RC 160 variety as affected by different organic fertilizer plus Indigenous Microorganism (IMO). Additionally, the study was laid out in a Randomized Complete Block Design with five treatments and three replications, Treatments were as follows. T1 (RR of NPK) T2 (Vermicast + IMO), T3 (Pig manure + IMO), T4 (Chicken Manure + IMO), T5 (Vermicast + Pig Manure + Chicken Manure + IMO). The different data gathered were statistically analyzed using the Analysis of Variance for comparison of means. However, results revealed that Organic Fertilizer plus Indigenous Microorganism (IMO), showed highly significant result in 2 of the data weight of 1000 grains and grain yield. The plant height, number of Panicle length and number of tillers, number of productive tillers showed no significant difference. In terms of economic analysis result revealed that treatment 4 with an RPC Value of 105. 64 % obtained the highest percentage of return on Production while T3 obtained the lowest RPC value. These findings suggest that organic fertilizer can be a viable alternative to chemical fertilizers in promoting sustainable rice production. Further studies on the long-term effects of organic fertilizer on soil quality and plant health are recommended.
KEYWORDS: *rice, organic fertilizer, Indigenous Microorganism (IMO), NSIC RC 160 variety----------*

INTRODUCTION

The pervasive use of chemical fertilizers over recent decades has influenced agricultural practices globally, leading to a simplistic view of soil as merely a medium for plant roots rather than a complex, living biosphere filled with numerous species essential for plant growth. This approach has particularly been evident in the widespread implementation of intensive monoculture practices, which, while initially boosting crop yield, gradually lead to a decline in soil productivity even in integrated paddy fields (FFTC, 1998). Additionally, studies from tropical Asian countries have demonstrated that organic farming, when practiced alone, may not provide sufficient nutrients to crops, suggesting a necessity for the integration of basal chemical fertilizers to achieve optimal plant growth.

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Moving to a broader international context, rice (Oryza sativa L.) serves as a staple food for more than two billion people in Asia alone, with its importance extending to hundreds of millions in Africa and Latin America. Within Southeast Asia, rice constitutes about 60% of human food consumption, highlighting its critical role in regional food security (Buresh, 2005). A significant portion of Asian rice is produced in irrigated areas, which are vital for the livelihood of approximately 2.2 billion people reliant on the sustainable productivity of these ecosystems.

Focusing on the national level in India, particularly in the northeastern region, rice dominates as the chief staple food, occupying more than 80% of the cultivated area. Despite this extensive cultivation, the region only contributes 7.8% to the total national rice production, resulting in a deficit of approximately 1.77 million tonnes (Tomar & Das, 2011). Among the various factors contributing to low productivity, inadequate nutrition, particularly nitrogen deficiency, has been identified as a significant constraint (Azad & Lehiri, 2001; Bastia, 2002).

Locally, the challenge is compounded by economic constraints faced by farmers, who often cannot afford the high costs of chemical fertilizers. These farmers typically apply only low levels of manure due to the limited availability of resources, despite the region being rich in other organic biomass such as weed, litter, leaves, and twigs, which are essential for nutrient supplementation (Das, 2006; Ghosh et al., 2010). Utilizing these organic resources could not only improve rice productivity but also help address environmental issues associated with the use of inorganic fertilizers.

Moreover, the adoption of natural farming techniques, which emphasize the importance of soil health and the utilization of Indigenous Microorganisms (IMOs), can significantly enhance crop yield. These microorganisms, adapted to local environmental conditions, are crucial for maintaining soil fertility and plant health.

Furthermore, this study aims to address the technical knowledge gap among farmers regarding optimal fertilizer management. Although synthetic fertilizers provide a quick solution to nutrient deficiency, their prolonged use can lead to soil acidity and ecological damage. By promoting organic farming practices, this research seeks to restore soil fertility, improve yields, and encourage sustainable agricultural practices among local farmers, thereby enhancing both economic stability and food security. As future agriculturists, our vision includes not only advancing sustainable agriculture but also ensuring that neighboring farmers adopt these beneficial practices, contributing to a broader impact on the community and the environment.

General Objectives

Generally, the study was conducted to evaluate the effect of different organic fertilizers plus Indigenous microorganism (IMO) in the lowland with 160 rice variety, specifically, the study aimed:

Specific objectives

1.to determine the effect of different organic fertilizers plus Indigenous Microorganism (IMO) on the characteristics of rice NSIC RC 160 variety and yield components;

2.to identify which treatment will give the optimum yield of rice NSIC RC 160 variety as affected by different organic fertilizer plus Indigenous Microorganism (IMO); and

3.to evaluate the economic profitability of rice NSIC RC 160 variety as affected by different organic fertilizer plus Indigenous Microorganism (IMO).

MATERIALS AND METHODS

Materials

The materials used were seed (NSIC RC 160), fertilizer, Indigenous Microorganism (IMO), sacks, sprayer, land area, bolo, carabao, weighing scale, tape measure, molasses and record book.

Methodology

Location and Duration of the Study

The study was conducted at Purok 2, Kipalili, San isidro Davao del Norte from December 2021 to April 2022.

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Soil Sampling and Analysis
Complete soil sample was taken initially from the area before land preparation using X pattern. The soil sample was air dried for 7 days and brought to Department of Agriculture, Bureau of Soil Laboratory, Agdao, Davao City for the analysis and fertilizer recommendation.

Experimental Design and treatments
The study was laid out in a Randomized Complete Block Design (RCBD) with five treatments and three replications The treatments were as follows.
T1- RR of NPK
T2- Vermicast + IMO
T3- Pig manure + IMO
T4- Chicken Manure + IMO
T5- Vermicast + Pig Manure + Chicken Manure + IMO

RESULTS AND DISCUSSIONS

Plant height (cm)
Table 1 shows the mean of plant height of rice as applied by different organic fertilizer plus Indigenous Microorganism on the growth and yield of NSIC RC 160.

As presented by the data, Treatment 1 obtained the highest mean of 105.64cm followed by Treatment 2 with the mean of 104.81cm and Treatment 3 obtained the mean of 104.55cm and Treatment 5 with the mean of 104.48cm it was followed by Treatment 4 which obtained the lowest mean of 104.38cm. The result indicated that using of different organic fertilizer plus Indigenous microorganism greatly affects the plant height of rice.

The Analysis of Variance (ANOVA) revealed that there were no significant differences among treatments.
The result was supported by the findings of Muhammad et al. (2008) and Sarker et al. (2004) when they stated that the increased in plant height was due to the application of organic and chemical fertilizers. Microbial action and improved physical condition of soil was due to nutrient availability from organic sources which greatly affects the height of the plant.

Table 1. Plant Height (cm) of NSIC RC 160 as Affected by Different Organic Fertilizer Plus Indigenous Microorganism.

Treatment	Replication			Treatment	
	I	II	III	Total	Mean
T_1=RR of NPK	105.69	105.49	105.74	316.92	105.64
T_2= Vermicast + IMO	104.69	104.78	104.95	314.42	104.81
T_3= Pig manure + IMO	104.44	104.46	104.74	313.64	104.55
T_4= Chicken Manure + IMO	104.3	104.42	104.43	313.15	104.38
T_5= Vermicast + Pig Manure + Chicken Manure + IMO	104.68	104.34	104.43	313.45	104.48

C.V%=4.13%
Ns=not significant

Panicle Length
Table 2 shows the mean of panicle length as influenced by applying different organic fertilizer plus Indigenous microorganism on the growth of NSIC RC160.

As presented by the data, Treatment 1 obtained the highest mean of 26.49cm followed by Treatment 5 with the mean of 25.57cm and Treatment 2 obtained the mean of 24.99cm and Treatment 4 with the mean of 24.00cm it was followed by Treatment 3 which obtained the lowest mean of 23.99cm. The result indicated that using of different organic fertilizer plus Indigenous microorganism greatly affected the length of panicle.

The Analysis of Variance (ANOVA) revealed that there were no significant differences among treatments.

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Dobermann and Fairhust (2000) cited that the application of Nitrogen fertilizer could increase the panicles length which largely determined the yield capacity of rice.

Moreover Salem (2006) stated that application of (FYM) such as chicken manure and pig manure along with Nitrogen fertilizer significantly increased the panicle length of rice.

Table 2. Panicle Length (cm) of NSIC RC 160 as Affected by Different Organic Fertilizer Plus Indigenous Microorganism.

Treatment	Replication			Treatment	
	I	II	III	Total	Mean
T_1=RR of NPK	27.08	26.22	26.18	79.48	26.49
T_2= Vermicast + IMO	25.16	25.66	24.16	74.98	24.99
T_3= Pig manure + IMO	23.56	24.24	24.16	71.96	23.99
T_4= Chicken Manure + IMO	23.2	24.74	24.06	72.00	24.00
T_5= Vermicast + Pig Manure + Chicken Manure + IMO	25.64	25.00	26.06	76.70	25.57

C.V%=1.80%
Ns=not significant

Number of Tillers

Table 3 shows the mean of Number of tillers as influenced by applying different organic fertilizer plus Indigenous microorganism on the growth of NSIC RC160.

As presented by the data, Treatment 1 obtained the highest mean of 24.2 followed by Treatment 5 with the mean of 23.6, Treatment 2 and Treatment 3 obtained the same mean of 23.53 and Treatment 4 which obtained the lowest mean of 22.93. The result indicated that using of different organic fertilizer plus Indigenous microorganism greatly affected the number of tillers.

The Analysis of Variance (ANOVA) revealed that there were no significant differences among treatments. Nevertheless, the application of N fertilizer may increase the number of productive tillers (Budhar and Palaniappan 1996). However, not every tiller contributes similarly to high productivity (Sahu et al. 2004).

In addition, Mirza (2010) stated that the number of tillers increased due to application of combined organic fertilizers and chemical fertilizers. Organic sources offer more balanced nutrition to plants which positively affect the number of tillers in plants Miller (2007.)

Table 3. Number of Tillers of NSIC RC 160 as Affected by Different Organic Fertilizer Plus Indigenous Microorganism.

Treatment	Replication			Treatment	
	I	II	III	Total	Mean
T_1=RR of NPK	24.2	24.4	24	72.6	24.2
T_2= Vermicast + IMO	23.8	23.6	23.2	70.6	23.53
T_3= Pig manure + IMO	23.6	23.6	23.4	70.6	23.53
T_4= Chicken Manure + IMO	23	22.8	23	68.8	22.93
T_5= Vermicast + Pig Manure + Chicken Manure + IMO	23.4	23.6	23.8	70.8	23.6

C.V%=1.91%
Ns=not significant

Number of productive Tillers

Table 4 shows the mean of Number of productive tillers as influenced by applying different organic fertilizer plus Indigenous microorganism on the growth of NSIC RC160.

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As presented by the data, Treatment 1 obtained the highest mean of 22.33 followed by Treatment 2 and Treatment 3 obtained the same mean of 20.33, Treatment 5 obtained with the mean of 20.4 and Treatment 4 obtained the lowest mean of 19.6. The result indicated that using of different organic fertilizer plus Indigenous microorganism greatly affected the number of productive tillers.
The Analysis of Variance (ANOVA) revealed that there were no significant differences among treatments.

Miller (2007) and (Rakshit et, al., 2008) also reported a similar result in rice study. According to the study, the maximum numbers of productive tiller were observed in all plants treated with combined organic and chemical fertilizers.

Table 4. Number of Productive Tillers of NSIC RC 160 as Affected by Different Organic Fertilizer Plus Indigenous Microorganism.

Treatment	Replication			Treatment	
	I	II	III	Total	Mean
T_1=RR of NPK	22.20	22.60	22.20	67.00	22.33
T_2= Vermicast + IMO	20.40	20.60	20.00	61.00	20.33
T_3= Pig manure + IMO	20.40	20.40	20.20	61.00	20.33
T_4= Chicken Manure + IMO	20.20	19.00	19.60	58.80	19.60
T_5= Vermicast + Pig Manure + Chicken Manure + IMO	20.60	20.00	20.60	61.20	20.40

C.V%=26.91%
Ns=not significant

Number of Non-Productive Tiller

Table 5 shows the mean of non-productive tiller as influenced by applying different organic fertilizer plus Indigenous microorganism on the growth of NSIC RC160.

As presented by the data, Treatment 2 and Treatment 4 obtained the same highest mean of 3.27 followed by Treatment 5 and Treatment 3 with the same mean of 3.2 and Treatment 1 obtained the lowest mean of 1.87. The result indicated that using of different organic fertilizer plus Indigenous microorganism greatly affected the number of non-productive tillers.

The Analysis of Variance (ANOVA) revealed that there were no significant differences among treatments.
Tillering is an important trait for grain production and is thereby an important aspect in rice yield. Mirza et al. (2010) reported an increase in number of productive tillers in rice plants due to influence of different fertilizer combinations. According to them a greater number of productive tillers per square meter might be due to more availability of Nitrogen which plays a vital role in cell division. Organic sources offer more balanced nutrition to the plants, especially micro nutrients which positively affect number of productive tillers in plants (Miller, 2007).

Table 5. Number of Non-Productive Tillers of NSIC RC 160 as Affected by Different Organic Fertilizer Plus Indigenous Microorganism.

Treatment	Replication			Treatment	
	I	II	III	Total	Mean
T_1=RR of NPK	2	1.8	1.8	5.6	1.87
T_2= Vermicast + IMO	3.4	3.2	3.2	9.8	3.27
T_3= Pig manure + IMO	3.2	3.2	3.2	9.6	3.2
T_4= Chicken Manure + IMO	2.8	3.8	3.2	9.8	3.27
T_5= Vermicast + Pig Manure + Chicken Manure + IMO	2.8	3.6	3.2	9.6	3.2

C.V%=25.99
Ns=not significant

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Weight of 1000 Grains (g)

Table 6 shows the mean of Weight of 1000 grains as influenced by applying different organic fertilizer plus Indigenous microorganism on the growth of NSIC RC160.

As presented by the data, Treatment 1 obtained the highest mean of 26.67 followed by Treatment 3 with the mean of 26.33 and Treatment 2, Treatment 4, and Treatment 5 obtained the same mean of 26.00. The result indicated that using of different organic fertilizer plus Indigenous microorganism greatly affected the grain weight of rice.

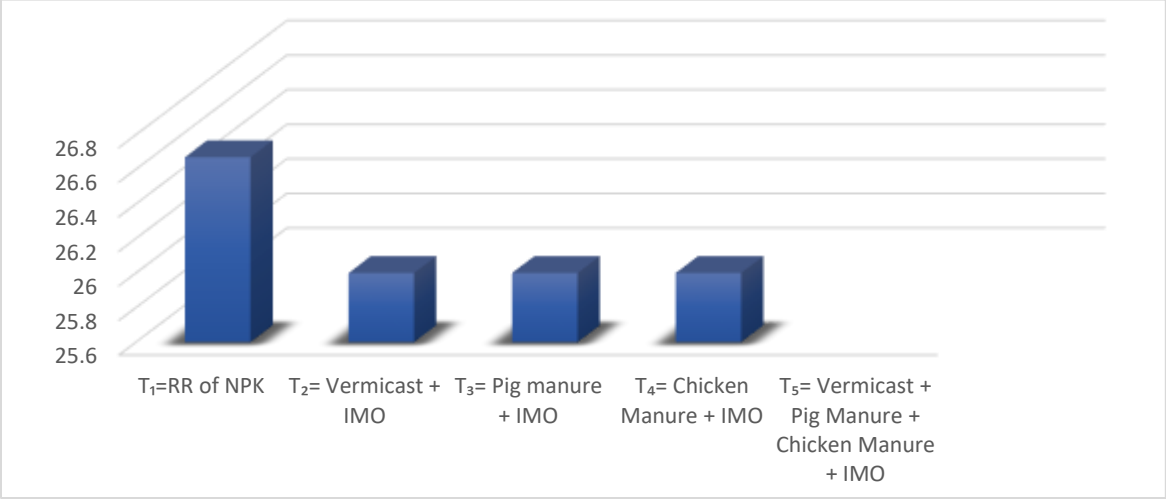

Figure no. 1 Weight of 1000 Grains (g)

The Analysis of Variance (ANOVA) revealed that there was a significant difference among treatments.
According to Samin (2011) plant and microorganism lived symbiotically in natural environment. Beneficial microorganisms such as IMO formulation produce nutrients, hormones and antibiotics in small quantities and plant. This was a positive implication that the usage of IMO increases the quality of grain specifically on its weight.

Alam (2017) also cited that the application of IMO can increased plant growth, physiology and nutrient uptake of rice. IMO formulation was potentially to be used as bio-fertilizer and bio-regulator also. It could be an approach to reduce environmental pollution due to excessive use of chemical fertilizer in order to produce a safer staple food.

In addition, Fageria (2009) stated also that increase in 1,000-grain weight may due to increase in N–absorption by the plant and advanced photosynthetic rates.

Supported by Yang et, al., (2004) that it was recorded 1000-grain weight was increased by the application of chemical fertilizer along with organic manure.

Table 6. Weight of 1000 Grains (g) of NSIC RC 160 as Affected by Different Organic Fertilizer Plus Indigenous Microorganism.

Treatment	Replication			Treatment	
	I	II	III	Total	Mean
T_1=RR of NPK	26	27	27	80	26.67[b]
T_2= Vermicast + IMO	26	26	26	78	26.00[b]
T_3= Pig manure + IMO	27	26	26	79	26.33[a]
T_4= Chicken Manure + IMO	26	26	26	78	26.00[a]
T_5= Vermicast + Pig Manure + Chicken Manure + IMO	26	26	26	78	26.00[a]

C.V%=1.97%
**=highly significant

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Grain Yield (tons/ha)

Table 7 shows the mean of Grain Yield as influenced by applying different organic fertilizer plus Indigenous microorganism on the growth of NSIC RC160.

Data shows that the Treatment 1 obtained the highest mean of 5.74 followed by Treatment 4 with the mean of 5.47 and Treatment 5 obtained the mean of 5.36 and Treatment 2 obtained the mean of 5.30 followed by Treatment 3 which obtained the lowest mean of 5.18. The result indicates that using of different organic fertilizer plus Indigenous microorganism greatly affects in the grain yield of rice.

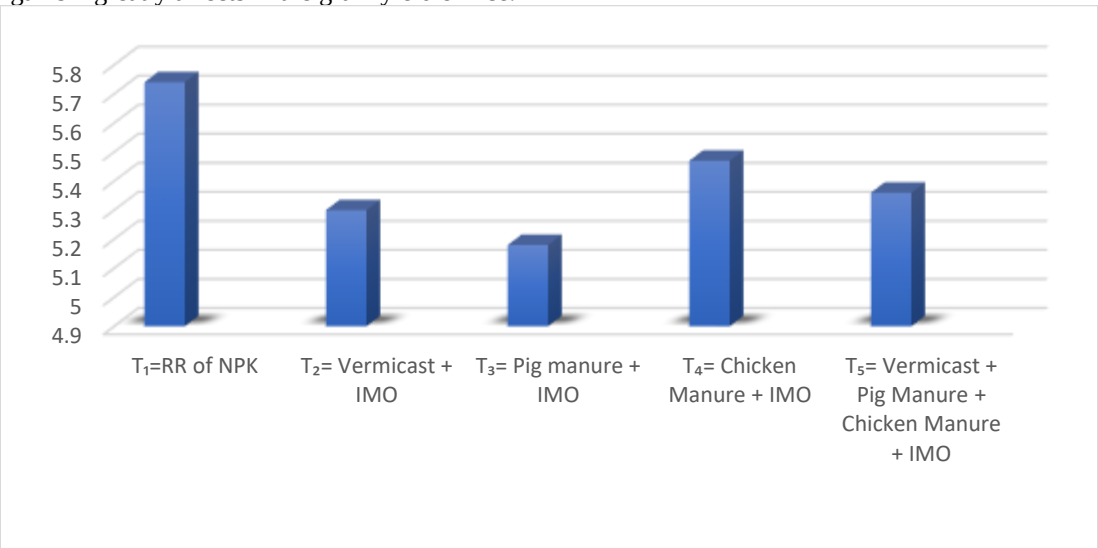

Figure no. 2 Grain Yield (tons/ha)

The Analysis of Variance (ANOVA) revealed that there was a significant difference among treatments. However, Treatment 5 was significantly different to all of the other treatments.

Moreover, the increase in NPK fertilizer rate may have increased the grain yields which may be due to the adequate supply of nutrients to the crops to produce higher panicle numbers associated with higher percentage of productive tillers. Further, the increase in NPK rate may aid in higher spikelet sterility. Thus, contributing to higher rate of grain filling that may increase yields (Yoshida, 1981).

However, Vermicompost or any organic fertilizer not only increases yield of rice but can also substitute chemical fertilizer to some extent (Sharma et al., 2008; Guera, 2010).

Also, increase in grain yield due to application of organic matter was observed by Ram et, al., (2000) and Singh et, al., (2001).

Sarwar et, al., (2008); and Ali et, al., (2012) also claimed the increased yields of rice with the use of organic manures alone or in combination with chemical fertilizers.

Table 7. Grain Yield (ton/ha) of NSIC RC 160 as Affected by Different Organic Fertilizer Plus Indigenous Microorganism.

Treatment	Replication			Treatment	
	I	II	III	Total	Mean
T_1=RR of NPK	5.27	5.99	5.95	17.21	5.74
T_2= Vermicast + IMO	5.15	5.47	5.29	15.91	5.30
T_3= Pig manure + IMO	5.27	5.12	5.16	15.55	5.18
T_4= Chicken Manure + IMO	5.65	5.22	5.54	16.41	5.47
T_5= Vermicast + Pig Manure + Chicken Manure + IMO	5.55	5.54	4.98	16.07	5.36

C.V%=5.39%
**=highly significant

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Cost and Return Analysis

Table 8 show the cost and return of the application of different types of organic fertilizer plus the Indigenous Microorganism (IMO) on the growth and yield of lowland rice NSIC RC 160 Variety. The result showed that the highest percentage of return on Production cost (RPC) was obtained from the treatment 4 RPC Value of 105. 64 %, treatment 1 with PRC value of 104. 31%, Treatment 5 RPC Value of 102. 23%, Treatment 2 RPC value of 100.50% and Treatment 3 obtained the lowest RPC value of 98. 05%

Result revealed that the different rates of NPK Fertilizers supplemented with Indigenous Microorganism (IMO) showed good result in terms of economic benefits and it was highly recommended.

Table 8. Cost and Return Analysis as influenced by Application of Different types of Organic Fertilizer Plus Indigenous Microorganism (IMO) on the Growth and Yield of lowland rice NSIC RC 160 Variety.

Treatment	Yield Kg/ha	Gross Income (Php)	Production cost (Php)	Net Income (Php)	RPC (%)
T_1=RR of NPK	5740	103, 320	50, 570	52, 750	104.31
T_2= Vermicast + IMO	5300	95, 400	48,080	48, 320	100.50
T_3= Pig manure + IMO	5180	93, 240	47, 080	46, 160	98.05
T_4= Chicken Manure + IMO	5470	98,460	47, 880	50, 580	105.64
T_5= Vermicast + Pig Manure + Chicken Manure + IMO	5360	96, 480	47, 620	48, 860	102.23

Conclusions

The study's findings highlight the potential of chicken manure, especially when combined with Indigenous Microorganisms (IMO), to support the growth of NSIC RC 160 rice. Although chicken manure ranked second in terms of performance after synthetic fertilizers, it showed considerable benefits in terms of economic return and soil health improvement. Given the negative long-term environmental impacts associated with synthetic fertilizers, chicken manure presents a viable organic alternative that can sustainably support agricultural productivity.

Recommendations

To leverage the benefits of chicken manure as a sustainable alternative to synthetic fertilizers, it is recommended that farmers adopt an **Integrated Fertilizer Management Approach**. By combining chicken manure with reduced quantities of synthetic fertilizers, farmers can balance nutrient supply, minimize environmental impacts, and reduce input costs. **Proper Composting of Chicken Manure** is crucial; it minimizes pathogens, stabilizes nutrients, and reduces odors, ensuring its effectiveness and safety as a fertilizer. Training programs on proper composting techniques should be widely available to farmers.

Additionally, **Optimal Application Practices** are also essential. Farmers should apply chicken manure preferably before planting and employ appropriate application methods such as broadcasting or banding to maximize nutrient efficiency and crop availability. **Regular Soil Testing** is recommended to monitor nutrient levels and adjust management practices accordingly, ensuring ongoing soil health and sustainability.

Furthermore, **Supportive Policies and Incentives** are crucial for encouraging the adoption of organic fertilizers. Advocacy for subsidies or incentives can help farmers transition to more sustainable practices. As well as, establishing **Local Composting Facilities** could support farmers who lack the resources to compost on-site. Finally, extending **Outreach and Support Programs** can provide farmers with the knowledge and resources needed to effectively implement the use of chicken manure. By demonstrating the benefits and sharing success stories, these programs can encourage wider adoption of sustainable farming practices. Collectively, these recommendations aim to enhance agricultural productivity while promoting environmental sustainability.

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