Farmers' Perception of Biofertilizer Effectiveness in Rice Farming in San Agustin, Sagbayan, Bohol

Kim C. Abico*, Jemma Lucitte A. Cabrillos, MSc

College of Science and Management, Bachelor of Science in Environmental Science, Bohol Island State University- Clarin Campus, Philippines

***Corresponding Author**

DOI: https://doi.org/10.51584/IJRIAS.2026.111500012

Received: 29 April 2026; Accepted: 05 May 2026; Published: 23 May 2026

ABSTRACT

This study aimed to assess farmers' perceptions of the effectiveness of biofertilizer application in rice farming in San Agustin, Sagbayan, Bohol. The study assessed the efficacy of biofertilizers for plant height, tiller count per plant, and rice quality, while also investigating the presence of significant differences among these variables. The study posited that no significant differences would exist among the three measures. Moreover, the researcher utilized a descriptive-survey research approach, employing a validated, researcher-developed questionnaire with 0.92 reliability index was administered to 100 purposively selected DA-registered rice producers. Additionally, interviews and field observations were performed to enhance the collected data. Reliability testing produced satisfactory to commendable alpha values, affirming the instrument's consistency. Formal coordination with municipal and barangay officials was conducted for data collection, and statistical analysis was performed using the weighted mean and Friedman test. The results indicated that biofertilizers were regarded as somewhat efficient in improving plant height (M=3.55), the number of tillers per plant (M=3.40), and rice quality (M=3.40) by which both of the three results were interpreted as Moderately Effective. Moreover, the results indicated substantial disparities between plant height and both tiller count and rice quality; however, no significant difference was seen between tiller number and rice quality, thus the null hypothesis is not accepted. These findings demonstrate that biofertilizers had a more significant impact on vegetative development than on grain attributes. In conclusion, while biofertilizers provide quantifiable advantages in rice agriculture, their efficacy is contingent upon soil conditions, microbe formulations, and administration methods. The study advocates for enhancing farmer education, incorporating biofertilizers with additional nutrient sources, advancing extension services, and guaranteeing the accessibility of superior microbial goods. Finally, additional research is recommended to investigate long-term field results and refine application techniques.

Keywords: Biofertilizers, efficacy, soil conditions, agriculture, plant height, tillers, rice quality

INTRODUCTION AND RATIONALE

Farming is not simply about growing crops; it's about caring for the soil that nourishes us. Biofertilizers, containing beneficial microorganisms, were essential for improving soil fertility and facilitating plant growth via processes such as biological nitrogen fixation, phosphate solubilization, and the activation of plant growth-promoting rhizobacteria (Ajmal et al., 2018; Atieno et al., 2020). The Department of Agriculture Philippines, in partnership with the University of the Philippines Los Baños, has promoted the utilization of biofertilizers through projects like Bio-N fertilizer, established under DA Memorandum Order No. 42, s. 2022. Notwithstanding these initiatives, the diminishing use of biofertilizers in rice farming has led to a heightened reliance on synthetic fertilizers, prompting apprehensions about soil degradation, environmental sustainability, and long-term agricultural production. The dilemma is exacerbated by the scarcity of factual, context-specific data assessing the efficacy of biofertilizers which is especially those disseminated via government initiatives

in enhancing rice production, crop quality, and vegetative development. Moreover, in Barangay San Agustin, Sagbayan, Bohol, farmers are skeptical about adopting biofertilizers due to obstacles such as irregular crop yields, diminished tillering, and ongoing dependence on chemical fertilizers. The current literature (e.g., Othman et al., 2015) highlights the ability of biofertilizers to improve nutrient availability and promote sustainable crop production; nevertheless, the lack of localized evidence limits farmers' informed decision-making. Therefore, it is essential to systematically evaluate the efficacy of biofertilizers in this context by analyzing critical agronomic parameters, such as plant height, tiller count per plant, and rice grain quality. This study's conclusions aim to enhance evidence-based agricultural practices, reinforce policy implementation, and encourage the broader adoption of sustainable fertilization systems that boost farm productivity and environmental protection.

METHODOLOGY

Research Design. This study utilized a descriptive survey design to gather relevant information on the effectiveness of biofertilizer application on rice plant height, the number of tillers per plant, and rice quality.

Environment and Respondents. The study was conducted at Barangay San Agustin in the municipality od Sagbayan. Additionally, the respondents of this study were the 100 purposively selected rice farmers in the said barangay.

Instrument. This study utilized a researcher-developed survey questionnaire to evaluate the efficacy of biofertilizers as organic fertilizers in rice growing in Barangay San Agustin, Sagbayan, Bohol. Furthermore, the survey questionnaire comprised of five questions and employed a 4-point Likert scale to assess the efficacy of biofertilizers supplied by the Department of Agriculture and applied in the study region. Moreover, A pilot test of the self-developed questionnaire was executed at a neighboring locality in Sagbayan, Bohol, selected for its analogous characteristics and proximity to Barangay San Agustin. Thirty participants engaged in the pilot testing to assess the reliability (overall 0.89 reliability index), clarity, translated into Mother-Tongue Based Multilingual Education) , and appropriateness of the questionnaire items about the study objectives.

Procedure. After obtaining ethical approval and permissions from the Campus President, Department of Agriculture Bohol Officer-In-Charge and the Local Chief Executive of Sagbayan, surveys were administered to farmer-respondents. Confidentiality was assured. Completed questionnaires were tallied, tabulated, analyzed and interpreted with the assistance of a statistician.

Statistical Treatment. The Weighted Mean was used to determine the effectiveness of biofertilizer application as an organic fertilizer in rice farming in San Agustin, Sagbayan, Bohol. Furthermore, the Friedman test was used to determine whether there was a significant difference in the effectiveness of biofertilizer use on rice plants in terms of plant height, number of tillers per plant, and rice quality.

RESULTS AND DISCUSSION

Level of Effectiveness

Table 1 presents the level of biofertilizer effectiveness as perceived by the respondents in terms of key agronomic indicators, including plant height, number of tillers per plant, and rice grain quality.

STATEMENT	MEAN	SD	DESCRIPTIVE RATING
1. The use of biofertilizers has significantly improved the height of rice plants.	3.82	0.39	Highly Effective
2. Rice plants treated with biofertilizers grew taller at a faster rate than those without biofertilizer application.	3.78	0.42	Highly Effective
3. The frequency of biofertilizer application has a direct impact on the final height of rice plants.	3.56	0.50	Highly Effective

4. Biofertilizers promoted early height development in rice crops.	3.54	0.50	Highly Effective
5. Proper application of biofertilizers has led to taller rice plants compared to insufficient or excessive application.	3.42	0.50	Moderately Effective
6. Biofertilizers improved root development, which in turn increased plant height.	3.42	0.50	Moderately Effective
7. Types and brands of biofertilizers affected the height of rice plants in varying degrees.	3.42	0.55	Moderately Effective
8. Applying biofertilizers at different growth stages impacted the final height of rice plants.	3.39	0.53	Highly Effective
9. A combination of biofertilizers and organic compost enhances the growth and height of rice plants.	3.51	0.50	Highly Effective
10. Insufficient use of biofertilizers resulted in stunted growth and reduced plant height.	3.51	0.50	Highly Effective
Composite Mean	**3.55**	**0.51**	**Moderately Effective**

The highest-rated mean response of 3.82, item number 1, indicated *that "The use of biofertilizers has significantly improved the height of rice plants."* With a descriptive rating of "Highly Effective", this reflects substantial consensus among respondents that biofertilizers enhance rice growth and vitality. The findings corroborate the research of Shanmugam *et al.* (2022), which reported that integrating biofertilizers with organic fertilizers improved chlorophyll synthesis and plant stature. Similarly, Sharma and Shrestha (2020) found that rice plants treated with biofertilizers and chemical fertilizers showed increased height and yield, aligning with farmers' observations and prior scientific findings.

Meanwhile, the statement with the lowest mean rating, averaging 3.39, item number 8, suggested that "*Applying biofertilizers at different growth stages impacted the final height of rice plants*." Despite being described as "Highly Effective", it received the least consensus among respondents, implying uncertainty about the optimal timing for biofertilizer application. This indicates that although farmers recognize its potential benefits, its efficacy may fluctuate under varying conditions.

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Overall, the composite mean of 3.55 (SD = 0.51) is classified as "Moderately Effective", reflecting a generally favorable yet cautious perception of biofertilizer use among farmers. The moderate standard deviation suggests that while most respondents agree on its advantages, differences in soil conditions, management practices, and biofertilizer quality influence the observed outcomes. This observation is consistent with the conclusions of Shanmugam *et al.* (2022), Aung *et al.* (2022), and Sharma and Shrestha (2020), all of whom emphasized that the effectiveness of biofertilizers depends on proper management, soil health, and integration with other fertilizer types. Additionally, Belmonte *et al.* (2025) and Hidalgo *et al.* (2024) further stress that biofertilizer outcomes depend heavily on microbial compatibility with local soils, which explains the moderate response observed in the farmer data.

Table 1.2 presents the responses of 100 farmer respondents on the efficacy of biofertilizers in increasing the number of tillers per rice plant, illustrated by mean scores and standard deviations that reflect farmers' perceptions of biofertilizers' role in tiller development under local conditions.

Table 1.2
Level of Biofertilizer Effectiveness in terms of Number of Tillers Per Plant

STATEMENT	MEAN	SD	DESCRIPTIVE RATING
1. The application of biofertilizers increased the number of tillers per rice plant.	3.45	0.52	Moderately Effective
2. Rice plants treated with biofertilizers developed more tillers compared to those grown without biofertilizers.	3.44	0.50	Moderately Effective
3. The type and amount of biofertilizer applied increased the number of tillers per rice plant.	3.25	0.48	Moderately Effective
4. Biofertilizers enhanced the health and productivity of tillers in rice plants.	3.24	0.51	Moderately Effective
5. More frequent and proper application of biofertilizers has led to an increased number of tillers per rice plant.	3.45	0.56	Highly Effective
6. Rice plants grown with biofertilizers produced tillers earlier compared to those using synthetic fertilizers.	3.53	0.58	Highly Effective
7. Biofertilizers enhanced nutrient absorption, which leads to an increase in the number of productive tillers.	3.51	0.58	Moderately Effective
8. The number of tillers per plant is enhanced with biofertilizer application despite environmental factors.	3.34	0.54	Moderately Effective
9. Excessive application of biofertilizers has strengthen tillers, improving their productivity.	3.42	0.50	Moderately Effective
10. The number of tillers per rice plant increased when biofertilizers were applied along with proper water and soil management.	3.38	0.49	Moderately Effective
Composite Mean	**3.40**	**0.53**	**Moderately Effective**

The statement with the highest rating, with a score of 3.53, was "*Rice plants grown with biofertilizers produced tillers earlier compared to those using synthetic fertilizers*," found in item number 6. This was characterized as "Highly Effective," indicating robust consensus among respondents that biofertilizers facilitate earlier tiller emergence. This perspective aligns with the research by Harahap *et al.* (2023), which found that plant growth-promoting rhizobacteria (PGPR) expedite early vegetative growth through hormonal stimulation, specifically by increasing auxin and cytokinin production, thereby inducing earlier tiller emergence. Torres and Manalang (2024) similarly found that PGPR-based biofertilizers enhanced early tiller emergence in lowland rice by 18–22% compared with treatments using solely synthetic fertilizers, corroborating farmers' observations that biofertilizers promote earlier and more robust tillering. These studies elucidate the molecular mechanisms root stimulation, nitrogen fixation, and hormone regulation that explain why farmers observe early tiller emergence as a highly effective outcome of biofertilizer application.

Conversely, the lowest-rated statement, item number 4, "*Biofertilizers enhanced the health and productivity of tillers in rice plants*," received a mean score of 3.24 and was described as "Moderately Effective." This lower rating suggests limited confidence among farmers in biofertilizers' ability to improve tiller quality or productivity. While respondents generally recognize that biofertilizers may increase tiller numbers, they remain uncertain about their influence on tiller robustness and yield contribution. This observation may stem from inconsistent field outcomes under varying environmental conditions.

The overall composite mean of 3.40 (SD = 0.53), classified as "Moderately Effective", reflects a moderately positive yet cautious outlook among farmers regarding the influence of biofertilizers on tiller production. The

moderate variability suggests that while most respondents perceive clear benefits, differences in soil type, management practices, and biofertilizer formulation leads to inconsistent results. This collective perspective aligns with Wang's (2024) findings, which highlighted that microbial inoculants enhance nutrient absorption and stress resilience thereby supporting tiller development though outcomes vary by site and crop management conditions.

Table 3 presents the findings on the efficacy of biofertilizers in improving rice quality in Barangay San Agustin, Sagbayan, Bohol. The table presents farmers' perceptions of biofertilizer impacts on grain attributes, including aroma, flavor, milling yield, and overall consumer appeal, as indicated by mean ratings and standard deviations.

Table 3 Level of Biofertilizers Effectiveness in terms of Rice Quality

STATEMENT	**MEAN**	**SD**	**DESCRIPTIVE RATING**
1. The biofertilizers given by the Department of Agriculture improved the overall quality of rice grains.	3.47	0.50	Moderately Effective
2. Farmers noticed that rice grown with biofertilizers has a better smell and taste.	3.43	0.52	Moderately Effective
3. Using biofertilizers gives more whole rice grains after milling, with fewer broken grains.	3.33	0.51	Moderately Effective
4. Biofertilizers make rice plants stronger and more resistant to diseases, helping produce better grains.	3.39	0.51	Moderately Effective
5. Rice produced with biofertilizers looks better and is more preferred by consumers.	3.39	0.49	Moderately Effective
Composite Mean	**3.40**	**0.51**	**Moderately Effective**

The highest mean rating of 3.47 (SD = 0.50) was recorded for the statement, "*The biofertilizers provided by the Department of Agriculture improved the overall quality of rice grains*" (Item No. 1), described as "Moderately Effective." This suggests that respondents generally agreed that biofertilizers enhanced the physical and sensory qualities of rice, including improved aroma, taste, and visual appearance. The low variability indicates consistent positive experiences among farmers, likely due to improved nutrient uptake and healthier panicle development. This finding aligns with Singh *et al.* (2021), who reported that biofertilizers increase grain protein and micronutrient content, enhancing flavor and texture. Similarly, Abhilash *et al.* (2016) observed that microbial inoculants promote starch accumulation and grain filling, improving both aroma and market appeal. These studies substantiate the current findings by highlighting the biological mechanisms by which biofertilizers improve grain composition, underscoring their significance in achieving better-quality, more marketable rice.

Conversely, the lowest mean rating of 3.33 (SD = 0.51) was observed for the statement, "*Using biofertilizers gives more whole rice grains after milling, with fewer broken grains*" (Item No. 3), which was also rated "Moderately Effective." This indicates that farmers noted only minor improvements in milling outcomes. The moderate variability implies inconsistent experiences, likely due to differences in milling practices, grain maturity, and moisture content. This observation corresponds with Das *et al.* (2019) and Mishra and Dash (2020), who reported that postharvest rice quality depends not only on fertilization but also on harvest timing and grain moisture. Sahoo *et al.* (2023) further emphasized that biofertilizers improve grain composition but have only a limited direct effect on milling quality.

Furthermore, the composite mean of 3.40 (SD = 0.51) indicates an overall rating of "Moderately Effective," suggesting that farmers recognized biofertilizers as beneficial for improving rice quality. However, the effects were moderate and not uniform. This finding indicates that biofertilizers enhance the appearance and aroma of grains but are influenced by external factors such as soil fertility, irrigation, and harvesting conditions. This aligns with Kumar *et al.* (2020) and Wang (2024), who found that biofertilizer effectiveness is context-dependent and best realized when integrated with balanced nutrient management and favorable field

conditions. Additional studies such as Hidalgo *et al.* (2024) and Osman *et al.* (2025) confirm that biofertilizers improve grain morphology but are highly sensitive to climate variability, thereby moderating their perceived effectiveness.

Difference on the Level of Effectiveness

The significant difference indicates whether one category's answer is statistically different from another's using a Friedman test. Plant height, number of tillers per plant, and rice quality are considered variables in the study that explain differences in the effectiveness of biofertilizer application in rice plants in Barangay San Agustin, Sagbayan, Bohol.

Table 4 Difference in the level of Biofertilizers among the Three Attributes

Comparison	x^2	df	∞	p-value	Interpretation	Decision
Plant height vs. Number of tillers per plant	23.7	2	0.05	$< .001$	Significant	Reject Ho
Plant height vs. Rice Quality	23.7	2	0.05	$< .001$	Significant	Reject Ho
Number of tillers per plant vs. Rice quality	23.7	2	0.05	$.938$	Not Significant	Failed to reject Ho

The results reveal that there are significant differences in the level of effectiveness of biofertilizer application when comparing plant height with number of tillers per plant ($\chi^2 = 23.7$, df = 2, $p < .001$) and plant height with rice quality ($\chi^2 = 23.7$, df = 2, $p < .001$), leading to the rejection of the null hypothesis in both cases. This indicates that biofertilizer application has a varying and statistically significant influence on these growth and yield-related parameters, suggesting that improvements in plant height are meaningfully associated with changes in tillering and grain quality. However, no significant difference was found between the number of tillers per plant and rice quality ($\chi^2 = 23.7$, df = 2, $p = .938$), resulting in the failure to reject the null hypothesis for this comparison. This implies that while biofertilizers may independently affect vegetative growth and yield attributes, the relationship between tiller production and grain quality is not statistically evident in this study. Overall, the findings suggest that biofertilizer effectiveness varies across different rice growth indicators, with certain parameters being more responsive than others.

Moreover, Zhao *et al.* (2019) and Wang *et al.* (2021) established that excessive tillering might result in competition among tillers for nutrients, light, and water, potentially undermining grain filling and uniformity. Koutroubas et al. (2020) asserted that rice quality traits, such as head rice recovery and grain appearance, are predominantly influenced by genotype, environmental circumstances, and post-harvest management, rather than tiller count. Thus, whereas tillering affects yield potential, its impact on the fundamental quality attributes of rice grains is limited and indirect.

CONCLUSIONS

The study shows that farmers in San Agustin, Sagbayan, Bohol generally find biofertilizers moderately beneficial in improving rice growth, particularly in enhancing plant height and soil fertility, though their effectiveness depends on factors such as soil conditions, product quality, and proper application. The results suggest that biofertilizers have a stronger impact on vegetative growth than on yield and grain quality, reinforcing previous findings that combining them with organic or inorganic fertilizers leads to better outcomes. Overall, biofertilizers play an important role in promoting sustainable agriculture by reducing dependence on chemical inputs and improving soil health, but maximizing their benefits requires improved farmer knowledge on proper use and integrated nutrient management.

RECOMMENDATIONS

1. The Department of Agriculture may strengthen training, monitoring, and support programs to enhance the proper and effective use of biofertilizers among farmers.
2. Farmers may integrate biofertilizers with organic and inorganic fertilizers and participate in training to improve sustainable crop production.

3. Local government units may promote and support biofertilizer adoption through awareness campaigns, training, farm machineries' and inclusion in agricultural development plans.
4. Future researchers may investigate the long-term effects, efficiency, and economic feasibility of biofertilizers under varying environmental conditions.

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