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Adoption of Organic Fertilizer Use in the Cultivation of IF 20 Rice Varieties by the Gemah Ripah Farmers' Group as Part of the Agricultural Revolution Initiative

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Abstract: Sumedang Regency is one of the main food buffer zones in West Java, yet rice productivity is threatened by soil degradation caused by excessive use of inorganic fertilizers. This initiative aims to encourage the adoption of organic fertilizers, including rice husk biochar and fermented animal manure, and to raise farmers' awareness of sustainable soil fertility. Implemented in May 2026 in Banyuasih Village, Tanjungkerta District, the initiative included soil test-based outreach, technical mentoring, and demonstration plots covering 2 hectares. Results show that adoption rates rose from 33.3% to 88.9% of farmers; soil organic matter content increased from 1.85% to 2.12%; rice growth and yield components (IF 20) improved by up to 31.3%; and estimated yield increased by 24.1% compared to conventional practices. It is concluded that combining scientific evidence, accessible inputs, and intensive mentoring effectively accelerates the adoption of sustainable agricultural technologies.

Keywords: Technology Adoption, Organic Fertilizer, IF 20 Rice Variety, Soil Fertility, Agricultural Revolution.

Introduction

Rice is a strategic food commodity that serves as the primary source of carbohydrates for more than 90% of Indonesia's population. Sumedang Regency, as one of the food-producing regions in West Java Province, has more than 28,000 hectares of rice paddies, contributing 180,000 metric tons of rice production per year in 2024. However, rice farming productivity in this region faces serious challenges due to long-term soil degradation resulting from excessive fertilization practices that rely solely on inorganic fertilizers (Marina et al., 2024).

The continuous use of urea and NPK fertilizers without the addition of organic matter has been shown to increase soil acidity, reduce organic matter content, and decrease the availability of micronutrients essential for plant growth. Research findings by Dewi et al. (2026) indicate that the use of inorganic fertilizers without organic matter support only increases crop yields during the initial growing season but reduces productivity by 12–18% in subsequent growing seasons due to soil nutrient imbalances. These conditions have also been observed on farmland in Banyuasih Village, Tanjungkerta Subdistrict, Sumedang Regency.

Based on the results of soil sample analysis conducted at the Bogor Agricultural Institute (ICBB) in May 2026, the soil fertility conditions of the Gemah Ripah Farmers' Group are as follows:

Table 1. Results of Soil Fertility Analysis for Rice Farmland

Test Parameters	Result	Suitability Criteria for Rice	Notes
Soil Reaction (pH)	5.8 – 6.2	5.5 – 7.0	Still acceptable, but at risk of becoming acidic if urea fertilization continues
Total N Content	0.25 %	≥ 0.30%	Low, requires addition of organic matter

Source: Primary data from laboratory tests conducted by ICBB Bogor (2026).

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The conditions above indicate that although the land is still suitable for rice cultivation, low levels of the micronutrients Zn and Fe, as well as the risk of soil acidification, may hinder the growth of new high-yielding varieties such as IF 20. This variety has a high yield potential of 7–9 metric tons per hectare but requires a balance of macro- and micronutrients as well as stable soil conditions to reach its maximum potential (Dewi et al., 2026).

The role of organic materials such as rice husk charcoal and fermented animal manure (KOHE) is crucial for improving the physical, chemical, and biological properties of the soil. Rice husk charcoal increases soil porosity, retains moisture, and serves as a habitat for beneficial microorganisms, while KOHE provides a complete range of nutrients, including the micronutrients that are limited in the target soil. This aligns with the findings of Harti et al. (2025) that the application of liquid and solid organic fertilizers can increase the availability of micronutrients by up to 40% compared to the use of inorganic fertilizers alone.

Although its benefits have been scientifically proven, the adoption of organic fertilizers among rice farmers in Banyuasih Village remains very low. Before this initiative was implemented, only 3 out of 9 farmer group members were willing to adopt it, with the main barriers being the high cost of transporting organic materials, a lack of understanding regarding proper application rates, and the absence of tangible evidence of changes in soil conditions on their land. Similar barriers to the adoption of agricultural technologies were also reported in a study by Marina et al. (2025), which stated that direct mentoring and the provision of production inputs are key factors in increasing the adoption of innovations at the farmer level.

This activity was carried out as part of the Sumedang Regency Agricultural Revolution Program (Revolper) with the following objectives: first, to encourage farmers to use organic materials—specifically rice husk charcoal and KOHE—on fields where nutrient levels have been tested; second, to raise farmers' awareness and understanding of the role of organic materials in supporting optimal growth of the IF 20 rice variety and maintaining long-term soil fertility. This activity is also in line with the principles of integrated crop management, which has been proven to increase productivity while improving the cost efficiency of farming operations (Dinar et al., 2026; Syamsiah et al., 2025).

Visually, the difference in soil conditions before and after organic matter application can be illustrated as follows:

Figure 1. Soil Conditions before the Addition of Organic Matter

It is hoped that this initiative will serve as a model for the adoption of sustainable agricultural technologies that can be replicated by other farmer groups in the Tanjungkerta subdistrict and throughout Sumedang Regency, in line with efforts to develop modern agribusiness based on the conservation of natural resources (Marina et al., 2026).

Method

May 2026 on the farmland of members of the Gemah Ripah Farmers' Group in Banyuasih Village, Tanjungkerta Subdistrict, Sumedang Regency, covering a total target area of 2.00 hectares. The methods used combined a participatory outreach approach, direct technical assistance, the implementation of demonstration plots, and periodic monitoring, in line with the principles of integrated crop management to increase technology adoption at the farmer level (Dinar et al., 2026; Syamsiah et al., 2025).

The initial phase of the activity began with verifying land conditions and providing production inputs in accordance with recommendations based on soil analysis results. The main materials prepared included rice husk charcoal, cow manure that had undergone a fermentation process for at least 4 weeks (KOHE), liquid organic fertilizer (POC), " " rice seeds of the IF 20 variety, and NPK supplemental fertilizer. All production inputs were distributed directly to each farmer's plot to reduce transportation costs, which had been a major barrier to the initial adoption of organic materials (Marina et al., 2025).

The next phase involved outreach and technical training attended by all members of the farmers' group. These activities provided detailed information on soil fertility analysis results, the risks of soil quality degradation due to excessive inorganic fertilization, as well as the benefits and proper application methods of rice husk charcoal and KOHE. This participatory approach proved effective in enhancing farmers' understanding and readiness to adopt agricultural innovations (Marina et al., 2024).

Cultivation was carried out according to the schedule and standards for the demonstration plot over 16 weeks, from land preparation through harvest. Soil preparation was performed using a hand tractor, followed by the application of a basal fertilizer consisting of a mixture of rice husk charcoal and KOHE at a rate of 502 kg per hectare to improve soil structure before planting. Follow-up fertilization was carried out alternately using POC and NPK according to the plant's growth phase, with dosages adjusted to prevent nutrient imbalances (Dewi et al., 2026).

Result and Discussion

Increased Adoption of Organic Materials

The community service activity demonstrated tangible success in changing farmers' attitudes and practices regarding the use of organic fertilizers. Before the activities were implemented, only 3 out of 9 members of the Gemah Ripah Farmers' Group—or about 33.3%—were willing to apply organic materials to their fields. The main barriers cited by farmers were the high cost of transporting organic materials, a lack of confidence in the tangible benefits for their fields, and a long-standing habit of relying solely on inorganic fertilizers.

Figure 3. Documentation of activity stages: (a) Preparation and packaging of organic fertilizer production materials; (b) Application of base fertilizer to the demonstration plot; (c) Rice paddy harvest of the IF 20 variety

Following the implementation of outreach based on soil test data, technical assistance, and the direct distribution of production inputs to the field sites, the number of farmers adopting the practice increased to 8, or 88.9%, with a total applied land area reaching 1.71 hectares. This increase in adoption aligns with the findings of Marina et al. (2025), who stated that presenting scientific evidence regarding soil conditions and ensuring easy access to production inputs are the most effective key factors in driving the adoption of agricultural innovations at the farmer level. Extension workers and technical advisors also play a crucial role; as reported by Apriyani et al. (2024), intensive guidance can increase farmers' readiness to adopt new technologies by up to 52%.

Table 2. Comparison of Technology Adoption before and After the Activities

Indicator	Before Activities	After Activities	Increase
Number of farmers adopting the technology	3 people	8	+5
Adoption rate	33.3%	88.9%	+55.6%
Area of land under cultivation	0.86 ha	1.71 ha	+0.85 ha

Source: Primary data from the Gemah Ripah Farmers' Group (2026)

Improvement in Soil Fertility

The application of a mixture of rice husk charcoal and fermented cow manure (KOHE) had a visible positive impact on the physical and chemical conditions of the soil after one growing season. Physically, the soil became looser, darker in color, and its water-holding capacity increased by about 25% compared to the initial condition. Chemically, the soil pH remained stable within the range of 6.0–6.4, thereby reducing the risk of acidification caused by urea fertilizer use. Organic matter content increased from 1.85% to 2.12%, while the availability of the micronutrients Zn and Fe rose to 0.78 ppm and 3.65 ppm, respectively, though they had not yet reached optimal levels. This demonstrates that the addition of organic matter in accordance with the recommendations of the ICBB Bogor is capable of addressing nutrient deficiencies while balancing soil conditions, consistent with the explanation by Harti et al. (2025) that organic fertilizer serves as both a nutrient source and a long-term soil conditioner.

Figure 2. Dry and compacted soil conditions before treatment (left) and after KOHE treatment (right). Figure 3. Overview of soil conditions after treatment and planting.

Figure 3. Rice Seedling Growth under Various Fertilizer Dose Treatments in Paddy Fields.

Growth and Yield Components of IF 20 Rice

The IF 20 rice variety planted on land treated with organic matter showed better growth compared to farmers' previous conventional practices. Plant height at 6 weeks after planting reached 71.5 cm, an increase of 14.8%; the number of tillers per clump increased by 31.3%; and the percentage of surviving plants reached 95.8%. During the reproductive phase, panicle length and the number of grains per panicle increased by 12.6% and 21.2%, respectively. These advantages resulted from the combination of organic and inorganic fertilizers, which provided balanced and sustainable nutrition, including the micronutrients Zn and Fe—which are essential for leaf and panicle formation. This aligns with the findings of Dewi et al. (2026), who concluded that the synergy between organic matter and NPK fertilizer can increase rice growth and yield components by up to 25% compared to single-component inorganic fertilization.

Table 3. Comparison of Rice Growth and Yield Components

Observation Parameters	Conventional Practice	Use of Organic Materials	Percentage Increase
Plant Height (6 MST)	62.3 cm	71.5 cm	+14.8%
Number of tillers per clump	11.2 stems	14.7 stems	+31.3%
Percentage of surviving plants	87.4%	95.8%	+9.6%
Average panicle length	21.4 cm	24.1 cm	+12.6%
Number of grains per ear	118 grains	143 grains	+21.2%

Source: Data from UNWIM Revolper demonstration plot observations (2026)

Productivity and Economic Viability of Farming

The increase in yield components is directly proportional to the final productivity. The estimated yield of milled dry paddy reached 7.2 metric tons per hectare, an increase of 24.1% compared to the average conventional yield of 5.8 metric tons per hectare. Although production costs rose by 4.4% due to the addition of organic inputs, revenue increased significantly more, resulting in a 48.6% rise in net profit per hectare and an increase in the R/C ratio from 1.80 to 2.15. These figures indicate that rice farming using organic inputs is far more economically viable and profitable. These results are supported by the findings of Umyati et al. (2025), who showed that improvements in organic-based fertilizer management can significantly enhance the efficiency and profitability of rice farming. Furthermore, the sustainable use of organic materials is predicted to reduce the need for inorganic fertilizers by up to 20% in the next growing season, thereby making production costs more efficient and resilient in the face of fertilizer price fluctuations and climate change (Marina et al., 2024; Marina et al., 2025).

Table 4. Comparative Feasibility Analysis of Farming Operations

Economic Components	Conventional Practices	Use of Organic Materials	Notes
Productivity per hectare	5.8 metric tons	7.2 metric tons	Up 24.1%
Total cost per hectare	Rp 12,850,000	Rp 13,420,000	Up 4.4%
Gross revenue per hectare	Rp 23,200,000	Rp 28,800,000	Up 24.1%
Net profit per hectare	Rp 10,350,000	Rp 15,380,000	Up 48.6%
R/C Ratio	1.80	2.15	More viable

Source: Analysis of field data and farmer-level unhusked rice prices in Sumedang (July 2026)

Figure 2. Comparison of rice plant growth (top) and rice clumps ready for harvest with organic treatment (bottom)

Conclusion

Community service activities as part of the Agricultural Revolution have significantly increased the adoption of organic fertilizers in the cultivation of IF 20 rice at the Gemah Ripah Farmers' Group in Banyuasih Village, Tanjungkerta Subdistrict, Sumedang Regency. The number of farmers applying organic materials increased from 3 to 8, with a total cultivated area reaching 1.71 hectares. The application of a mixture of rice husk charcoal and fermented cow manure (KOHE), in accordance with recommendations based on soil analysis results, improved soil structure, stabilized soil acidity, and increased the availability of the micronutrients Zn and Fe, which were previously low.

The improved soil conditions had a positive impact on crop growth and yield, as evidenced by increases in plant height, the number of tillers, panicle length, and the number of grains per panicle compared to conventional practices. Milled dry paddy productivity reached 7.2 metric tons per hectare—a 24.1% increase—resulting in a 48.6% rise in farmers' net profit and a R/C ratio of 2.15, indicating excellent business viability. Based on these results, it can be concluded that the use of organic materials is a strategic step toward maintaining sustainable soil fertility while simultaneously boosting productivity and income for rice farmers.

It is recommended that ongoing extension activities be carried out during the next planting season to monitor long-term changes in soil fertility and to expand the application of this technology to other farmer groups in the surrounding area. Additionally, farmers should be empowered to produce their own organic fertilizer to further reduce production costs.

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