



## **The Role of Agricultural Technology Development in Increasing Rice Farming Income in Banua Baru Village, Wonomulyo District**

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Received : June 10, 2025

Revised : June 23, 2025

Published: June 30, 2025

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### **ABSTRACT**

*The development of agricultural technology plays an essential role in increasing rice farming productivity and income, especially in Banua Baru Village, Wonomulyo District, Polewali Mandar Regency. This study aims to analyze the role of agricultural technology in increasing rice productivity, identify obstacles faced by farmers, and formulate strategic recommendations. This research uses a descriptive qualitative approach involving four farmers as informants. Data were collected through interviews, field observations, and document analysis. The findings show that the adoption of technologies such as superior rice varieties, the legowo planting system, and agriculture machinery (tractors, water pumps, combine harvesters) has increased rice yields by 25-30% and reduced production costs by up to 15%. However, farmers still face barriers such as high initial investment, rising fuel prices, and limited access to technical training. This study recommends expanding subsidies for equipment, strengthening agriculture extension services, and improving irrigation infrastructure to optimize the use of agriculture technology in rural areas.*

**Keywords:** Agricultural Technology, Rice Farming, Productivity, Technology Adoption, Banua Baru Village

### **INTRODUCTION**

Indonesia is known as an agricultural country that has great potential in the agricultural sector. The choice to develop an economy and industry based on agriculture is not without reason, considering that this country is blessed with abundant natural resources, extensive human resources, and agricultural traditions that have been deeply rooted in people's lives since ancient times. This situation provides a strong foundation for Indonesia to make the agricultural sector the main pillar of national development, both in order to meet the food needs of the community and as the main supporter of the national economy. However, the development of the agricultural sector cannot be separated from the need for adequate infrastructure development, the application of modern technology, and the strengthening of supporting industries such as the distribution of agricultural products, product processing, and the development of sustainable markets and products (Nisa & Susanto, 2022).

Amidst great opportunities, the Indonesian agricultural sector also faces various complex challenges. The increasing population growth has caused national food needs to increase significantly. On the other hand, the availability of productive agricultural land is increasingly limited due to land conversion, urbanization, and environmental degradation. In addition, global climate change has a direct impact on cropping patterns, water availability, and the potential for pests and plant diseases. This challenge is exacerbated by the fact that the interest of the younger generation in agricultural professions is decreasing, along with the perception that jobs in this sector are less promising in terms of economy and social prestige. Agriculture is a sector that plays an important

role in meeting people's food needs and supporting the economy, especially in an agricultural country like Indonesia. In this context, agricultural technology is a strategic solution that cannot be ignored. Agricultural technology not only includes machines and mechanical tools, but also includes cultivation techniques, land management, precision fertilization, smart irrigation, to agricultural digitalization through the Internet of Things (IoT) and big data. The main purpose of implementing this technology is to increase labor productivity, land use efficiency, and reduce production costs, so that the harvest is more optimal with more efficient costs (Thompson & Darwish, 2019).

In practice, rice plant maintenance - one of the main commodities in Indonesia requires the adoption of technology from the pre-harvest stage such as selecting superior seeds and modern planting systems, to the post-harvest stage such as drying, milling, and packaging the harvest. The application of appropriate technology has been proven to increase production yields and provide higher economic benefits for farmers (Sitorus & Santoso, 2022).

Agricultural technology is present as a solution to overcome these challenges. Agricultural technology in a broad sense aims to increase labor productivity, increase land productivity, and reduce production costs (Thompson & Darwish, 2019). Maintenance of rice plants from pre-harvest to post-harvest requires the adoption of technological innovation in order to achieve abundant results and obtain more profits (Ernawati et al., 2021).

Wonomulyo District in Polewali Mandar Regency is known as an area with a majority of the population who depend on the agricultural sector for their livelihood. The great potential in improving the regional economy, especially in meeting food needs, is supported by fertile areas and strategic economic routes. One of the villages in this district, namely Banua Baru Village, consists of four hamlets with a population that continues to grow. Based on data from the Central Statistics Agency (BPS) of Polewali Mandar Regency, the population of Wonomulyo District in 2021 reached 51,616 people, an increase from 45,858 people in 2011.

Although specific data on the population of Banua Baru Village in 2022 is not available in existing sources, the population growth in Wonomulyo District shows a significant increasing trend. Therefore, the development of agricultural technology in Polewali Mandar, especially in Banua Baru Village, is the main focus to increase rice farming production and support regional food security. (Statistik et al., 2022).

After 2021, the development of agriculture technology in Banua Baru Village has increasingly aligned with national trends, particularly with the introduction of tools such as drones, artificial intelligence, precision sensors, and modern biotechnology. These innovations have become especially relevant for smallholder farmers in Banua Baru, who are beginning to adopt modern practices to enhance productivity and sustainability. Hermawan & Putri (2023) argue that such technologies not only increase yields but also promote efficient resource use. At the policy level, Ahmat et al. (2018) explain that the Ministry of Agriculture has provided machinery assistance programs since 2015, selecting tools that match farmers socio-economic conditions. Suhartono et al. (2021) emphasize the importance of agriculture as a human-centered system, while Andriaty & Setyorini (2012) highlighted information barriers that hinder rural farmers in adopting innovations. In Banua Baru, these issues are still evident. Dharma et al. (2022) add that high investment cost and limited skills remain key obstacles, suggesting the need for continuous and local adaption of technological development.

The development of agricultural technology in Banua Baru village is not only machines for plowing fields or what are called tractors, but there are also machines for harvesting rice, namely "threshers", the farming community in Banua Baru village calls them "doros". This machine functions to thresh rice from its stems. In ancient times, farming communities in Banua Baru Village still used simple tools to thresh rice with its stalks, and used full human power. Agricultural technology tools or what are usually called tractors in Banua villages only became known in 2007, these agricultural machines make things easier for people in New Banua. Increasingly sophisticated technological advances really help farmers to produce their agricultural products. This is the subject of research in an article entitled "The Role of Agricultural Technology Development in Increasing Rice Farming Income in Banua Baru Village, Wonomulyo District, Polewali Mandar Regency".

Despite the many studies on agricultural technology adaption in Indonesia, there remains a lack of in-depth investigation at the micro-regional level, especially in village such as Banua Baru that are just beginning to adopt modern farming practices. Previous research has predominantly focused on larger agricultural centers or generalized data across provinces. This creates a research gap in understanding the localized effects, challenges, and economic outcome of technology adaption for rice farming in rural communities. Therefore, this study seeks to fill this gap by focusing on Banua Baru Village as a case study. The novelty of this research lies in its exploration of how small-scale farmers in a specific rural area adapt to technological interventions and the extent to which these technological contribute to increased income and farming efficiency.

## RESEARCH METHODS

This study is a qualitative descriptive study that aims to understand the phenomenon of the application of agricultural technology implementation in a holistic manner, using narrative description and verbal data. The research was conducted in Banua Baru Village, Wonomulyo District, Polewali Mandar Regency, chosen due to its significant agriculture land area and the presence of farmers who have started to adopt rice farming technologies.

The research participant consisted of members of the farming community, including landowners, rice farmers, farmers wives, and children who are involved in agricultural activities. The sample included four farmers from Banua Baru Village. The data collected were qualitative in nature, comprising primary data from interviews and direct field observations, and secondary data obtained from books, notes, and local community documents.

Data collection techniques include observation to directly examine the research setting, interviews using a guided question format to gather primary data from respondents, and documentation in the form of written records, images, and other supporting materials

To ensure the validity and reliability of the interview instruments, a pilot test was conducted with two respondents outside the main research sample. The aim was to refine and improve the clarity, relevance, and structure of the interview questions. In addition, data triangulation was applied by comparing findings from interviews, field observations, and supporting documents. This approach strengthened the credibility and accuracy of the data collected.

Data analysis was carried out through the collection and examination of documentation, a review of relevant aspects of technological developments, descriptive analysis of the findings, and the formulation of preliminary conclusions to address the research objectives.

## RESULTS AND DISCUSSION

### Types of Agricultural Technology Applied

Farmers in Banua Baru Village have adopted various agricultural technologies to increase their productivity. One of the main technologies used is superior rice varieties such as Ciherang and Inpari, which are known to be resistant to pests and diseases and have higher yield potential compared to local varieties. These varieties are implemented by utilizing technical guidance from local agricultural extension workers.

In addition, farmers also use the jajar legowo planting system, which is designed to increase the efficiency of sunlight absorption and maximize plant growth space. This system is implemented with the help of training held by local farmer groups, although it takes more time in the early stages of land preparation. In terms of mechanization, the use of agricultural machinery (alsintan) such as tractors for land processing and water pumps for irrigation greatly helps reduce time and labor. These tools are usually obtained through government subsidy programs or rental systems from farmer cooperatives. The impact is very pronounced during the dry season, where irrigation becomes more effective and consistent.

Other technologies include organic fertilizers which are starting to be in demand because of their benefits for long-term soil fertility. This fertilizer is usually made by farmers themselves by utilizing agricultural waste, although most still face challenges in terms of production scale. The vision of agriculture entering the 21st century is modern, resilient and efficient agriculture. To realize this vision of agriculture, the mission of agricultural development is to empower farmers towards an independent, advanced, prosperous and equitable farming community. Agricultural product processing can be in the form of simple processing such as cleaning, grading, packaging or it can also be in the form of more sophisticated processing, such as milling, powdering, extraction and distillation, frying, spinning, canning and other manufacturing processes (Helmy Purwanto 2009). The use of this technology as a whole has increased the average harvest from 5 tons/ha to 6.25 tons/ha, and helped reduce production costs by 15%. However, support in the form of training and access to new technologies is still needed to expand its adoption. Farmers in Banua Baru Village have started using technologies such as superior rice varieties (Ciherang, Inpari), the legowo planting system, agricultural machinery (tractors, water pumps), and organic fertilizers. This technology significantly increases efficiency and production results.

### Results of Interviews with Farmers

In in-depth interviews with several farmers in Banua Baru Village, various backgrounds and experiences related to the application of agricultural technology were revealed.

- a. Farmer A (45 years old, managing 1.5 ha of rice fields): Farmer A is one of the first farmers to try superior varieties such as Ciherang in early 2024. He explained that by using this variety, his harvest increased by almost 30%. "Before, I only got 4.5 tons per hectare, but now I can get up to 6 tons. However, the initial cost of buying superior seeds is quite high, so I have to borrow capital from the

- cooperative."
- Farmer B (50 years old, owns 2 ha of land): This farmer has been using agricultural machinery (alsintan) such as water pumps since 2024. "Since using a water pump, I am calmer during the dry season. The irrigation process is faster and more even. However, the price of fuel is a challenge because it continues to rise."
  - Farmer C (38 years old, owns 2 ha of land): Farmer C started implementing the legowo planting system after attending training from an agricultural extension worker in 2024. "Initially, it was more work, because the planting distance had to be adjusted. But the results were satisfactory. My harvest increased by about 20% compared to the previous planting pattern." He also hopes that there will be more training so that this technique can be applied more effectively.
  - Farmer D (60 years old, owns 2 ha of land): Farmer D started switching to using organic fertilizer after hearing about its benefits for long-term soil fertility since 2024. "I tried to make my own organic fertilizer from agricultural waste, but it was difficult to do alone. If the government could provide subsidies for organic fertilizer, more people would be interested."

The interviews show that while agricultural technology has had a positive impact on yields and production efficiency, challenges such as initial costs, fuel prices, and access to training and subsidies remain major obstacles. Each farmer has different needs, so a more personalized and sustainable approach is needed.

- Farmer A (45 years old): "By using superior varieties such as Ciherang, my yields have increased by almost 30%. However, the initial cost of buying seeds is quite high."
- Farmer B (50 years old): "I started using a water pump machine last year. The irrigation process is faster, and I don't have to worry during the dry season. However, the price of fuel is often a constraint."
- Farmer C (38 years old): "The legowo planting system does take more time at the beginning, but the yields are much better than the old method. I hope there will be further training on this technique."
- Farmer D (60 years old): "We need government support for organic fertilizer subsidies. Many farmers want to switch to organic fertilizers but they are more expensive than chemical fertilizers."

Farmers in Banua Baru Village have adopted various agricultural technologies to increase their productivity. The main technologies identified include:

**Table 1.** Increasing Income From Rice Farming In Banua Village

| Technology                 | Implementation                                                                                            | Impact                                                                        | Income        | Significance |
|----------------------------|-----------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------|---------------|--------------|
| Superior Varieties         | Use of Ciherang and Inpari varieties with technical guidance from extension workers.                      | The harvest yield increased by 25-30%.                                        | >Rp 5.000.000 | Significant  |
| Combine Harvester          | Used to speed up the harvesting process. This tool is rented through a farmer cooperative.                | Harvest time is reduced by 50%, labor is more efficient.                      | >Rp 7.000.000 | Significant  |
| Legowo Row Planting System | Implemented through farmer group training to increase the efficiency of plant growing space.              | Production increased by about 20%, space efficiency is higher.                | >Rp 5.000.000 | Significant  |
| Pest Control Tools         | Application of pheromone-based pest traps and environmentally friendly pesticides..                       | Reduction in pest attacks by up to 40%.                                       | >Rp 5.000.000 | Significant  |
| Water pump                 | Used for irrigation during the dry season. Purchased through government subsidies or farmer cooperatives. | More consistent irrigation, the risk of crop failure decreases significantly. | >Rp 5.000.000 | Significant  |
| Organic fertilizer         | Produce your own organic fertilizer from agricultural waste or buy it at the local market.                | Soil fertility increased, crop yields increased by 15%.                       | >Rp 5.000.000 | Significant  |

Source: Primary data processed by researchers, 2025

Based on the table above, various innovations in agriculture continue to be developed to increase productivity and efficiency of farming businesses. One of the main factors is the use of superior varieties that can provide higher yields and are resistant to pests and climate change. A study by (Subekti, 2021), (Rebekka &

Ginting, 2018), and (Purbata et al., 2020) shows that the use of superior varieties in rice cultivation can increase more uniform plant growth and better harvest yields. In addition, the legowo planting system is also an effective method in rice cultivation. Research by (Amiroh, 2018) found that the adoption of this planting system technology has reached 68% in several regions, contributing significantly to increasing rice production. In addition to planting methods, the use of organic fertilizers also plays an important role in increasing soil fertility and crop yields. A study conducted by Devi Yulianti et al. showed that the provision of liquid organic fertilizer in the 4:1 legowo planting system in swampy land was able to increase rice yields by up to 7.68 tons/ha, higher than the average yield of the Inpari 32 variety of 6.30 tons/ha. Meanwhile, in the harvesting process, the use of combined harvesting machines is increasingly in demand because it can save time and labor compared to traditional methods. For plant protection, various pest control tools are also being developed to reduce dependence on chemical pesticides that can have a negative impact on the environment. In addition, the use of water pumps in modern irrigation systems increasingly supports the availability of water for plants, especially in the dry season.

With these innovations, the agricultural sector can further develop towards a more efficient and sustainable system. Therefore, research and adoption of appropriate technology are needed so that farmers can optimally utilize these advances in increasing their agricultural output. In in-depth interviews, several farmers shared specific experiences related to the implementation of technology in the agricultural sector. Farmer A, a 45-year-old farmer with 1.5 hectares of rice fields, used the superior Ciherang variety and reported an increase in yield of almost 30%, although he faced obstacles in the form of high initial costs that required capital loans. Meanwhile, Farmer B, a 50-year-old farmer with 2 hectares of land, adopted a combine harvester and water pump, which made the harvesting and irrigation processes faster and more efficient, although it required subsidized fuel for its operation. Farmer C, a 38-year-old member of a farmer group, implemented the *jajar legowo* planting system which was initially difficult to implement, but managed to increase yields by 20%. On the other hand, Farmer D, a 60-year-old traditional farmer, produces organic fertilizer from agricultural waste, which produces more fertile soil, but is constrained by the lack of additional tools to speed up the production process.

The impact of implementing this technology is quite significant, including increasing average rice productivity from 5 tons per hectare to 6.25 tons per hectare. The use of a combination harvester and water pump has also been proven to reduce processing time by up to 50%. In addition, pest control tools contribute to reducing plant damage due to pest attacks by up to 40%. However, the adoption of this technology is not free from various obstacles, such as the difficulty of accessing capital to buy heavy equipment such as harvesters, the high operational costs of agricultural machinery due to rising fuel prices, and the lack of training and technical assistance, especially in the use of pest control technology. This combination of benefits and challenges reflects the need for further support for farmers in utilizing technology optimally.

From early 2024 to the end of 2024, the development of technology implementation in the agricultural sector experienced several significant changes. In several regions, the government has begun to increase subsidies for agricultural equipment and machinery (*alsintan*) and expand access to funding for small farmers through the People's Business Credit (KUR) program. This has helped some farmers reduce the financial burden of adopting new technologies. In addition, there has been an increase in awareness among farmers about the importance of using digital technology-based agricultural methods, such as monitoring soil moisture with sensors and AI-based weather applications, which help them make more accurate decisions regarding irrigation and fertilization. However, throughout 2024, challenges remain, especially related to fluctuations in fuel prices and the availability of spare parts for agricultural equipment. Some farmers who adopt technology have difficulty maintaining equipment due to the lack of trained technicians in their areas. In addition, unpredictable weather factors are also a challenge in the implementation of several agricultural technologies, such as automatic irrigation which is less effective during extreme rainfall. Therefore, the sustainability of technology adoption in the agricultural sector still requires synergy between the government, technology providers, and farmer communities to ensure that the innovations implemented can provide long-term benefits sustainably.

### Obstacles in Technology Adoption

In addition to the challenges mentioned above, access to capital is one of the main obstacles faced by farmers in adopting agricultural technology. Many farmers, such as Farmer A, have difficulty obtaining financing to purchase relatively expensive agricultural tools and machinery (*alsintan*). In addition, the lack of training and technical assistance also worsens the situation. For example, technologies such as pest control tools or modern planting systems such as *jajar legowo* require special knowledge that has not been fully communicated to all farmers. This is exacerbated by inadequate agricultural infrastructure in several areas, especially irrigation systems that are still not optimal. For example, although water pumps can help improve irrigation efficiency, the limited availability of good irrigation networks often hinders the widespread adoption of technology. The combination of these obstacles suggests that comprehensive support in the form of access to capital, training, and infrastructure improvements are essential to drive sustainable transformation of the agricultural sector.

## CONCLUSION

The development of agricultural technology has had a significant positive impact on increasing the productivity of rice farming in Banua Baru Village, as seen from the various experiences of farmers who have succeeded in increasing their harvests. However, as previously described, this success still faces a number of challenges, such as the difficulty of accessing capital, lack of technical training, and inadequate agricultural infrastructure. To overcome these obstacles, strategic steps are needed, including increasing access to capital through subsidy programs or soft loans that can help farmers obtain agricultural tools and machinery (alsintan). In addition, the implementation of ongoing extension and training is very important to increase the capacity of farmers, especially in the use of modern technology such as *jajar legowo* and pest control tools. Strengthening agricultural infrastructure, especially irrigation systems, is also a priority so that efficiency in water management can be achieved. Close collaboration between the government, private institutions, and farmer groups is key to accelerating the adoption of sustainable agricultural technology, so that the positive results that have been achieved can be felt more widely by farmers in the region.

This study acknowledges certain limitations, including the relatively small number of informants and the qualitative nature of the analysis, which may not capture broader statistical patterns. Future research is encouraged to adopt a mixed-method approach involving a larger sample size, as well as quantitative analysis to strengthen generalizability. Additionally, in-depth studies on specific technology, such as the economic feasibility of organic fertilizers or digital-based irrigation, would further enrich the discourse on agricultural modernization in rural Indonesia.

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