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Research Paper

Evaluation of the Implementation of Precision Agricultural Technology on Tidal Land: Case Study in Tanjung Baru Village, Muara Padang, Banyuasin Regency, South Sumatra of Indonesia

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Abstract
The study aims to evaluate the application of precision farming technology in Tidal Land, Tanjung Baru Village, Muara Padang, Banyuasin. The study uses quantitative and qualitative approaches with field observation and survey methods and in-depth interviews. The population of the study was all farmers who manage agricultural land in Tanjung Baru Village. The research sample was taken purposively, namely farmers who have implemented or tried to implement precision farming. The number of samples was 30 farmers. Data collected included the use of precision farming technology, the obstacles faced and its impact on farmer productivity and welfare. In addition, the experience of farmers in implementing precision farming and identifying proposed solutions was also studied. Results of this study are that the majority of farmers in Tanjung Baru Muara Padang Banyuasin village were aged 41-50 years (46.7 percent), with an even level of education between high school, junior high school, and elementary school graduates. The largest land ownership is 3-5 hectares (53.3 percent). As many as 93.3 percent of respondents have implemented precision farming technology, with tractors and combine harvesters as the most commonly used technology. GIS technology is used by 23.3 percent of respondents, drones by 10 percent, and plowing tools and machines and GRPS systems by 3.3 percent of respondents each. The main reasons for using technology are to increase farming productivity, reduce costs, and increase farming efficiency. Respondents want easy access to technology (50 percent), technical assistance (26.7 percent), and subsidy and financial assistance (20 percent). As many as 90 percent of respondents stated that they would continue to use precision farming technology in the future. More than 30 percent of respondents suggested assistance with precision farming tools and education and training, while 20 percent suggested the provision of water pumps. This indicates the need for comprehensive and sustainable support to increase the adoption of precision farming technologies.

Keywords
Precision Agriculture, Productivity, Rural Development, Technology Adoption, Tidal Land

1. INTRODUCTION

Precision agriculture is a modern approach to agricultural land management that utilizes advanced technology to improve efficiency and productivity. This approach involves the use of software, hardware, and analytical data to optimize the use of resources such as water, fertilizers, and pesticides and to monitor soil and crop conditions in real time. In many developed countries, the concept of precision agriculture has shown significant results in increasing crop yields and reducing production costs (Zhang et al., 2002; Whelan and McBratney, 2003). However, the implementation of this concept in developing countries, including Indonesia, still faces various challenges and obstacles (Simatupang and Syafa'at, 2002; Reichardt and Jürgens, 2009) such as as realising cross-sectoral integration, combining top-down and bottom-up planning, and creating credibility for a new policy initiative (Mitchell, 1994).

Tanjung Baru Village, located in the Muara Padang area, Banyuasin, is one of the areas with great agricultural potential, especially on tidal land. Tidal land has unique characteristics and is often challenging, such as fluctuations in water levels, high salinity levels, and the risk of inundation. Farmers in this village generally rely on traditional farming methods that are not always effective in overcoming these challenges. Therefore, the implementation of the concept

of precision agriculture in Tanjung Baru Village is very relevant to evaluate (Soetanto and Widodo, 2018; Zhang et al., 2002; Whelan and McBratney, 2003).

This study aims to evaluate the implementation of the precision agriculture concept in Tanjung Baru Village, Muara Padang, Banyuasin. The main focus of this study is to understand the extent to which precision agriculture technology has been implemented by local farmers, as well as to identify the obstacles and challenges faced in the implementation process. In addition, this study also seeks to find solutions that can be adopted to improve the implementation of precision agriculture in this area (Simatupang and Syafa'at, 2002; Hidayat, 2019; Reichardt and Jürgens, 2009).

Through surveys and interviews with farmers, village officials, and other related parties, this study will collect empirical data on actual conditions in the field. The analysis of these data is expected to provide a comprehensive picture of the effectiveness of precision agriculture in Tanjung Baru Village and provide practical recommendations that can be implemented to optimize the agricultural system in this area (Simatupang and Syafa'at, 2002; Reichardt and Jürgens, 2009).

Thus, this study not only aims to evaluate the current conditions but also to make a significant contribution to improving the quality of agriculture in Tanjung Baru Village, which is ultimately expected to improve farmer welfare and food security in the area (Budi and Adi, 2021; Zhang et al., 2002; Whelan and McBratney, 2003). This study aims to evaluate the implementation of the precision agriculture concept in Tanjung Baru Village, Muara Padang, Banyuasin, and to find effective solutions to overcome various problems faced by farmers in implementing precision agriculture technology.

2. EXPERIMENTAL SECTION

The methodology of this study was designed to evaluate the implementation of the precision agriculture concept in Tanjung Baru Village, Muara Padang, Banyuasin, and to find effective solutions in overcoming various problems faced by farmers. This study uses quantitative and qualitative approaches with survey methods and in-depth interviews. The study was conducted in Tanjung Baru Village, Muara Padang, Banyuasin Regency, South Sumatra. This location was chosen because it has great agricultural potential on tidal land. The population of the study was all farmers who manage agricultural land in Tanjung Baru Village. The research sample was taken by purposive sampling, namely farmers who have implemented or tried to implement precision agriculture technology. The number of samples taken was 30 farmers out of 130 farmers. The data collected included general information on respondents, use of technology, impacts of technology use, obstacles in using technology and suggestions and recommendations.

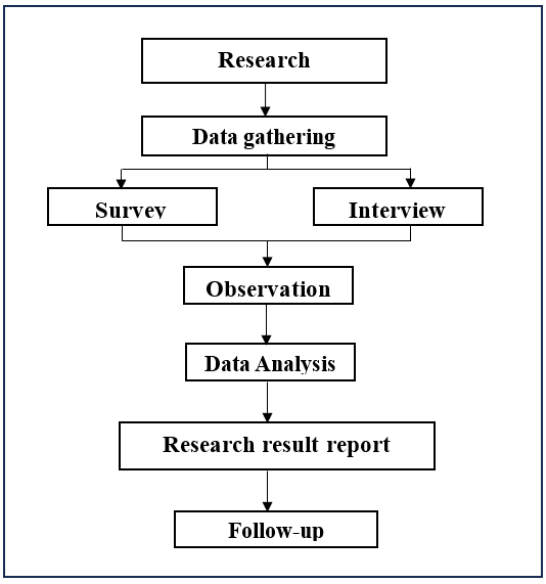

Figure 1. Research location in South Sumatra Province, Indonesia

3. RESULT AND DISCUSSION

Based on the results of field observations and interviews with respondents and in-depth interviews with resource persons in Tanjung Baru Muara Padang Banyuasin village, information about the respondents was obtained (Table 1). Of the respondents who were selected intentionally, 46.7 percent were farmers aged 41-50 years, followed by farmers aged 51-65 as many as 23.3 percent, farmers aged 15-30 years as many as 16.7 percent and farmers aged 31-40 years as many as 13.3 percent. The selected responses have a relatively similar proportion, namely 33.7 percent graduated from high school, with a percentage of around that also being those who graduated from junior high school and graduated from elementary school. The land ownership with the largest area owned by the respondents is 3-5 ha owned by 53.3 percent of respondents, while 40 percent of respondents have a land area of 1-2 ha, and only 6.7 percent of respondents have a land area of >5 hectares.

How many respondents apply precision farming, the type of technology applied and the reasons for using the technology for farmers in Tanjung Baru Muara Padang Banyuasin village can be seen in Table 2. As many as 93.3 percent of respondents are farmers who apply precision farming technology, and only 6.7 percent of respondents do not apply precision farming. The types of technology used by the respondents are tractors for soil cultivation and combine harvesters for harvesting. Both technologies are used by 30 percent of respondents each. Meanwhile, GIS technology is used by 23.3 percent of respondents, while drones are used by 10 percent of respondents. As for the tools and machines for plowing and the GRPS system, they are each used by 3.3 percent of respondents. What are the

Table 1. General Information of Respondents

No	Farmer's Age	Percent	Education	Percent	Land Area (ha)	Percent
1	15-30	16,7	SD	30	1-2	40
2	31-40	13,3	SMP	33,3	3-5	53,3
3	41-50	46,7	SMA	33,7	>5	6,7
4	51-65	23,3				

reasons they use technology in their farming efforts, the most common is because of the increase in the productivity of their farming efforts - where 40 percent of respondents answered this way. 33.3 percent of respondents answered that the reason they use technology is because it can reduce costs. As many as 26.7 percent of respondents answered because it increases the efficiency of their farming efforts.

What is the impact of the use of precision agricultural technology in Tanjung Baru Village, Muara Padang, Banyuasin? The answers are presented in Table 3. The biggest impact of technology use is on productivity changes of 10-20 percent as stated by 66.7 respondents. Even 23.3 percent of respondents admitted that the use of technology has increased their rice productivity by 30 percent or more. Ten percent of respondents admitted that technology has improved the productivity of the rice they plant by 21-30 percent. The use of precision agricultural technology has reduced operational costs on their land as recognized by 76.7 percent of respondents. There are also 20 percent of respondents who admit that the use of technology reduces operational costs by 21-30 percent. Study by Lencsés et al. (2014) showed a similar findings.

What is the impact of the use of precision agricultural technology in Tanjung Baru Village, Muara Padang, Banyuasin? The answers are presented in Table 3. The biggest impact of technology use is on productivity changes of 10-20 percent as stated by 66.7 respondents. Even 23.3 percent of respondents admitted that the use of technology has increased their rice productivity by 30 percent or more. Ten percent of respondents admitted that technology has improved the productivity of the rice they plant by 21-30 percent. The use of precision agricultural technology has reduced operational costs on their land as recognized by 76.7 percent of respondents. There are also 20 percent of respondents who admit that the use of technology reduces operational costs by 21-30 percent (GAO, 2024).

This study was also designed to examine what solutions respondents wanted, and whether they were still willing to use precision farming technology in the future, followed by their suggestions and recommendations for future improvements. The answers to these questions are presented in Table 4. This table shows that most respondents (50 percent) wanted easy access to technology. In addition, respondents wanted easy technical assistance. Around 26.7 percent wanted this. Furthermore, respondents wanted subsidies and financial assistance, which was voiced by 20 percent of the total respondents. 90 percent of respondents will continue to use precision farming technology in the future. What is also interesting is that respondents proposed a number of suggestions and recommendations for future improvements. More than 30 percent of respondents proposed assistance with precision farming tools and education & training. There were 20 percent of respondents who proposed the procurement of water pumps for them.

Based on the results of field observations and interviews with respondents and in-depth interviews with resource persons in Tanjung Baru Muara Padang Banyuasin village, information was obtained regarding the characteristics of the respondents (Table 1). Of the respondents who were selected intentionally, 46.7 percent were farmers aged 41-50 years, followed by farmers aged 51-65 years as many as 23.3 percent, farmers aged 15-30 years as many as 16.7 percent, and farmers aged 31-40 years as many as 13.3 percent. The proportion of respondents' education was relatively the same, namely 33.7 percent graduated from high school, with almost the same percentage for those who graduated from junior high school and elementary school. The majority of respondents, namely 53.3 percent, had a land area of 3-5 ha, while 40 percent of respondents had a land area of 1-2 ha, and only 6.7 percent of respondents had a land area of more than 5 hectares.

The results of this study are in line with research conducted by Setiawan (2018), which found that the majority of farmers in the area were in the 40-50 year age range and had similar levels of education, with most only completing primary to secondary education. The study also showed that agricultural land ownership among farmers was mostly in the range of 2-5 hectares, with very few farmers having more than 5 hectares of land. Changing in farm size in fifteen countries was already stated by Cornia (1985).

Another study by Rahmawati (2016); Mardiharini et al. (2023) also showed a similar pattern, where the majority of farmers in rural areas had limited land area and low levels of education. This study emphasizes the importance of increasing access to education and training for farmers to improve their productivity and welfare.

Based on the results of observations and interviews in Tanjung Baru Muara Padang Banyuasin village, it was

Table 2. Use of Precision Agricultural Technology

No	Implementing Precision Agricultural	Percent	Type of Technology	Percent	Reason for Use	Percent
1	Yes	93,3	Tractor	30	Reduce Costs	33,3
2	No	6,7	Combine Harvester	30	Increase Productivity	40
3			Plow	3,3	Efficient	26,7
4			Drone	10		
5			GPS System	3,3		
6			GIS	23,3		

Table 3. Impact of Using technology

No	Impact of using Technology on Productivity	Percent	Reducing Operating Costs	Percent	Influencing Resource Usage	Percent
1	10-20%	66,7	10-20%	76,7	Fertilizer	33,3
2	21-30%	10	21-30%	3,3	Water	33,3
3	$>$ 30%	23,3	$>$ 30%	20	Soil	33,4

Table 4. Obstacles in The Use of precision Agricultural Technology

No	Main Obstacles	Percent	Training	Percent	Training Provider	Percent
1	High cost	33,3	Yes	46,7	Goverment	33,3
2	Lack of knowledge or skills	33,4	No	53,3	Research Institute	3,3
3	Access to technology is limited	33,3			Skilled Farmer	10
4					No Training	53,3

Table 5. Solutions and Recommendations

No	Proposed solution	Percent	Willingness to use technology in the future	Percent	Suggestions and recommendations	Percent
1	Training and Education	3,3	Yes	90	Water pump	20
2	Subsidies and Financial Assistance	20	No	10	Fertilizer & Pesticide	10
3	Better Technical Support	26,7			Tool assistance	33,3
4	Easier access to technology	50			Precision Agriculture Training Education	36,7

found that 93.3 percent of respondents were farmers who applied precision farming technology, and only 6.7 percent did not apply it. The types of technology used by respondents included tractors for soil cultivation and combine harvesters for harvesting, each of which was used by 30 percent of respondents. GIS technology was used by 23.3 percent of respondents, drones by 10 percent of respondents, while plowing tools and machines and GRPS systems were each used by 3.3 percent of respondents. The main reasons for using this technology were increasing farming productivity (40 percent of respondents), reducing costs (33.3 percent of respondents), and increasing farming efficiency (26.7 percent of respondents).

This study is in line with previous research findings. For example, research by Sari et al. (2019) showed that the adoption of precision farming technology among farmers in various regions of Indonesia is also high, with tractors and combine harvesters being the most commonly used technologies. The study also highlighted that increased productivity and reduced costs are the main reasons for farmers to adopt precision farming technology.

Research by Wahyuni (2020) found that the use of GIS and drone technology in precision farming is increasing among farmers who want to improve the efficiency and effectiveness of their land management. This study also shows that farmers who use advanced technologies such as drones tend to have significant improvements in the efficiency of their farming efforts.

Based on the results of observations and interviews in Tanjung Baru Muara Padang Banyuasin village, this study also examines the solutions desired by respondents, their willingness to continue using precision agriculture technology in the future, and suggestions and recommendations for future system improvements. The results are presented in Table 4, which shows that the majority of respondents (50 percent) want easy access to technology. In addition, 26.7 percent of respondents want easy technical assistance, and 20 percent of respondents want subsidies and financial assistance. As many as 90 percent of respondents stated that they would continue to use precision agriculture technology in the future. The suggestions and recommendations for future improvements include assistance with precision agriculture tools and education and training (more than 30 percent of respondents) and procurement of water pumps (20 percent of respondents).

The results of this study are consistent with several previous studies. Research by Jatnika et al. (2017) emphasized that one of the main obstacles to the adoption of precision agriculture technology is limited access to technology. The results of this study are in line with these findings, where 50 percent of respondents want easy access to technology. Research by Sari et al. (2019) shows that many farmers want technical assistance to operate new technology and financial assistance to overcome high initial costs. This is consistent with the finding that 26.7 percent of respondents want technical assistance and 20 percent want subsidies and financial assistance. Research by Wahyuni (2020) found that the majority of farmers who have adopted precision agriculture technology tend to want to continue using it in the future because of the significant benefits to productivity and efficiency. This is in line with the finding that 90 percent of respondents will continue to use precision agriculture technology in the future. The finding that more than 30 percent of respondents proposed assistance with precision agriculture tools and education and training, and 20 percent proposed the procurement of water pumps, is consistent with research by Nugroho et al. (2018), which shows that education and training as well as infrastructure support are key to the successful implementation of precision agricultural technology.

4. CONCLUSIONS

Based on the results of this study, it was concluded that the majority of farmers in Tanjung Baru Muara Padang Banyuasin village were aged 41-50 years (46.7 percent), with an even level of education between high school, junior high school, and elementary school graduates. The largest land ownership is 3-5 hectares (53.3 percent). As many as 93.3 percent of respondents have implemented precision farming technology, with tractors and combine harvesters as the most commonly used technology (30 percent each). GIS technology is used by 23.3 percent of respondents, drones by 10 percent, and plowing tools and machines and GRPS systems by 3.3 percent of respondents each.

The main reasons for using technology are to increase farming productivity (40 percent of respondents), reduce costs (33.3 percent of respondents), and increase farming efficiency (26.7 percent of respondents). Respondents want easy access to technology (50 percent), technical assistance (26.7 percent), and subsidy and financial assistance (20 percent). As many as 90 percent of respondents stated that they would continue to use precision farming technology in the future. More than 30 percent of respondents suggested assistance with precision farming tools and education and training, while 20 percent suggested the provision of water pumps. This indicates the need for comprehensive and sustainable support to increase the adoption of precision farming technologies.

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