Agro Bali : Agricultural Journal
Vol. 8 No. 2: 474-488, July 2025

e-ISSN 2655-853X
https://doi.org/10.37637/ab.v8i2.2264

Manokwari Rice Farmers Adaptation: Response to Rice Price Fluctuations

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Article history: submitted: February 16, 2025; accepted: June 22, 2025; available online: July 27, 2025

Abstract. The rice price fluctuations are a significant challenge for farmers in Indonesia, including in Manokwari, West Papua, which plays a strategic role as a food granary. This research aims to (1) identify the various adaptation strategies of rice farmers in Manokwari Regency in facing rice price fluctuations; (2) analyze internal factors (such as social capital, access to resources, farmer household characteristics); and (3) analyze external factors (such as government policies, institutional support, local market conditions) that influence these adaptation decisions. This research addresses the gap in in-depth studies on specific adaptation dynamics in Manokwari. Using a mixed-methods approach with a sequential exploratory design, qualitative data (in-depth interviews, observations) and quantitative data (questionnaire surveys) were collected from rice farmers in Prafi District. Data were analyzed thematically for qualitative data and using descriptive statistics and logistic regression for quantitative data. The research findings indicate that farmers adopt various adaptation strategies such as income diversification, the use of new technologies, and changes in cultivation practices. Influential external factors include government policies related to prices, market conditions, and institutional support. Significant internal factors include adaptive capacity, social capital, access to resources, as well as literacy levels and trust in others, which proved to be highly significant in strategy adoption. Price fluctuations have a tangible impact on the socio-economic aspects of farmers, pressuring income and welfare. This research concludes that enhancing farmers' adaptive capacity requires holistic interventions that comprehensively address internal and external factors.

Keywords: adaptation strategies; agricultural resilience; price fluctuations; rice farmers

INTRODUCTION

Rice is a major food commodity for most of the world's population, especially in Asia, including Indonesia. As an agricultural country, the lives of the majority of Indonesians are highly dependent on agricultural products, especially rice. In recent decades, the dynamics of rice prices in global and local markets have shown significant fluctuations, not only influenced by production and consumption factors but also by government policies, climate change, and other external factors (Wahyudi, 2023); (Sakina, 2020); (Gapari, 2021). Rice price fluctuations are also a serious concern in Indonesia. In early 2024, people complained about the increase in rice prices triggered by extreme weather conditions and crop failures due to the El Nino storm. Additionally, rising world rice prices and scarcity also affect rice prices in local markets, as well as unstable geopolitical conditions (Salman, D, Yassi, A, & Bahsar, E, 2023); (Rasmikayati, E, Saefudin, B. R, Rochdiani, D, & Natawidjaja, R. S, 2020).

Increasing rice prices on the one hand can increase farmers' incomes, but on the other hand, farmers also face challenges such as increasing production costs, access to capital and technology, and market uncertainty. During the period from 2015 to 2022, national rice production experienced a decline of 0.23% per year, which had a serious impact at the end of 2022 with a sharp increase in rice prices at the consumer level (Wahyudi, 2023). These price fluctuations affect farmers' incomes and decisions, who respond by adjusting their production behavior (land area, inputs, technology investment, diversification, insurance) and consumption behavior (preferences, substitution, savings (Daud, I, Kuswinanti, T, Kaimuddin, K, Suryani, A, & Yusri, M, 2024); (Pandeya, S, et al., 2024). However,

e-ISSN 2655-853X
https://doi.org/10.37637/ab.v8i2.2264

farmers face various constraints such as lack of infrastructure, low availability and quality of inputs, high production costs, risk of crop failure, low paddy prices, and minimal empowerment and support.

Manokwari, with a land potential of up to 10,000 hectares and production reaching 3.7 tons of dry milled grain per hectare (Papuabaratnews, 2022) has a strategic role as an important food barn for Papua. This condition highlights the importance of developing and managing the rice farming sector in the West Papua region to support local food security. Rice farmers in the rice center area of Manokwari Regency are required to adapt to often unpredictable rice price fluctuations, which have a significant impact on the economic stability and social aspects of the farming community (Perdinan, P, Atmaja, T, Adi, R. F, & Estiningty, 2018). These adaptation dynamics are important to study, considering Manokwari's strategic role and the importance of rice as a major commodity. Farmer adaptation is not only limited to production or sales decisions but also involves long-term strategies such as income diversification, the use of agricultural technology innovations, and changes in cropping patterns.

The main focus of this research is to analyze the adaptation strategies of rice farmers in Manokwari Regency to rice price fluctuations, as well as to identify internal factors (social capital, access to resources) and external factors (government policies, institutional support) that influence these adaptation decisions. Although there has been much research on the impact of rice price fluctuations on farmers in general and various adaptation strategies in different regions, research that specifically and in-depth examines the adaptation dynamics of rice farmers in Manokwari Regency to rice price fluctuations is still limited. Specifically, there are not many studies that comprehensively identify and analyze the combination of internal factors (such as the specific social capital of farmer communities in Manokwari, their access to local resources) and external factors (such as the effectiveness of local government policies, the role of specific institutional support in Manokwari) that simultaneously influence the variety of adaptation strategies chosen by rice farmers in the region. This research aims to fill this gap by providing an in-depth understanding of farmer adaptation mechanisms in the local context of Manokwari, which has unique socio-economic and agroecological characteristics.

Based on the background and main focus of the research, the objectives of this research are: To identify the various adaptation strategies undertaken by rice farmers in Manokwari Regency in facing rice price fluctuations. To analyze the internal factors (such as social capital, access to resources, farmer household characteristics) that influence the adaptation decisions of rice farmers in Manokwari Regency. To analyze the external factors (such as government policies, institutional support, local market conditions) that influence the adaptation decisions of rice farmers in Manokwari Regency.

METHODS

Research Approach

This research will use a mixed methods approach, which combines qualitative and quantitative methods in a balanced manner. This approach was chosen because it can provide a more comprehensive and in-depth understanding of the adaptation strategies of rice farmers in Manokwari Regency to rice price fluctuations, as well as the factors influencing them. Qualitative methods will be used to explore in-depth the experiences, perceptions, and adaptation dynamics of farmers, while quantitative methods will be used to measure the prevalence of adaptation strategies and to statistically analyze the relationships between variables.

Research Design

The research design used in this study is sequential exploratory, which is collecting and analyzing qualitative data then collecting

e-ISSN 2655-853X
https://doi.org/10.37637/ab.v8i2.2264

and analyzing quantitative data.

In this study, in the first stage, collecting and analyzing qualitative data in answering the first and second problem formulations, namely how are the dynamics of adaptation of rice farmers in Manokwari Regency in responding to rice price fluctuations and what factors influence farmers' adaptation decisions in dealing with rice price fluctuations. Then the second stage, collecting and analyzing quantitative data in this case to answer the third problem formulation, namely, how do rice price fluctuations impact the socio-economic aspects of rice farmers' lives?

Research Location

The research will be conducted in Manokwari Regency, West Papua Province, with a focus on Prafi District, which is a rice production center.

Population and Sample

The population of this study is rice farmers in Manokwari Regency. Samples will be selected randomly from several villages within the Prafi District administration. The number of samples will be determined based on statistical analysis to ensure adequate representation. According to sampling is a process of selecting and determining the type of sample and calculating the size of the sample that will be the subject or object of research. In this study, sampling used a purposive technique (Sukmadinata, 2007). The main consideration for using purposive sampling is its suitability for the qualitative research goal of obtaining an in-depth and rich understanding of informants' experiences and perceptions regarding adaptation strategies, as the researcher intentionally selects individuals who possess specific knowledge, experience, or characteristics that are most relevant.

The determination of the number of samples used the Isaac and Michael formula with a precision or error tolerance of 10% as shown in Equation 1 (Sugiyono, 2015).

$$S = \frac{\lambda^2 \times N \times P \times Q}{d^2(N-1) + \lambda^2 + P \times Q} \quad \text{.....1)}$$

Description:

s: total sample

λ^2: Chi square whose value depends on the degree of freedom and error tolerance. For a degree of freedom of 1 and an error tolerance of 10%, the Chi square value = 2.706

N: total population

P: True value (0.5)

Q: False value (0,5)

d: Difference between the sample mean and the population mean.

Bias difference 0.01; 0.05; 0.1

In using the Isaac and Michael formula, the first step is to determine the error tolerance limit. This error tolerance limit is expressed in percentage. The smaller the tolerance limit, the more accurate the sample describes the population. For example, a study was conducted with an error tolerance limit of 10% = 0.1, meaning it has an accuracy level of 90%.

Data Collection Techniques

The technique used in this sequential exploratory research design for data collection is carried out sequentially in data collection. The data taken, both qualitative and quantitative data, will support each other. In this study, qualitative data collection uses: a) Observation is data collection carried out by systematically observing and recording the symptoms being. b) Questionnaire Survey is carried out using a structured questionnaire to collect quantitative data on farmers' adaptation strategies to rice price fluctuations. And c) Documentary studies are a data collection technique by collecting and analyzing written and unwritten documents such as images of documents, both written and electronic documents. Quantitative data uses: In-depth interviews are conducted with several selected farmers to gain a deeper understanding of the factors that influence their adaptation decisions

The data sources used are primary and secondary data sources. Primary data sources

e-ISSN 2655-853X
https://doi.org/10.37637/ab.v8i2.2264

are data taken from the field (enumerator) obtained through observation, interviews, and questionnaires (Sani, A & Machfudz, M, 2010) and secondary sources are research data sources obtained by researchers indirectly through intermediary media (obtained and recorded by related agencies and/or other parties _(Indriantoro, N & Supomo, B, 1999).

Data Analysis

a) Quantitative Analysis. The questionnaire survey data will be analyzed using descriptive statistical techniques and regression analysis to evaluate the relationship between relevant variables.
b) Qualitative Analysis. The interview data will be analyzed thematically to identify emerging patterns and themes related to factors influencing farmers' adaptation decisions to changes in rice prices. Logistic regression is used to understand how certain factors influence farmers' decisions to adapt to changes in rice prices. The regression model uses Equation 2.

$$\boldsymbol{log(p/(1-p)) = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \cdots + \beta_n X_n \ldots} 2)$$

Description:
p : Probability of an event (e.g., farmers adapt)
1-p : Probability of the opposite event (farmers do not adapt)
log (p / (1-p)): Logit or logarithmic probability. This is a transformation of the probability p into a linear scale.
β_0 : Constant (intercept)
β_1 , β_2 , ..., βn: Regression coefficients for each predictor variable (X_1 , X_2 , ..., Xn)
X_1 , X_2 , ..., X_n: Predictor variables (e.g., literacy rate, trust in others, etc.)

Research Ethics

This research will adhere to the principles of research ethics, including the security of information provided by research subjects, anonymity, and the required consent for participation from all respondents.

RESULTS AND DISCUSSIONS

The adaptation dynamics of rice farmers in Prafi Sub-district are a complex response to various external and internal pressures. On the one hand, external factors such as the government's price policy (SPHP) and market competition depress selling prices at the farm level, resulting in very thin profit margins. On the other hand, internal factors such as limited access to superior seeds, fertilizers and technical knowledge further aggravate their conditions. Faced with this situation, farmers are not standing still. They are actively developing various adaptation strategies to survive and improve their welfare. The following analysis will integrate quantitative and qualitative findings to understand not only what strategies they choose, but also why they are adopted.

External Factors

a. Government Policy

Field findings that farmers sell their milled rice to traders for IDR 13,500 and to BUMDes for IDR 12,800 further clarify the complex dynamics related to rice prices in Prafi District and their impact on farmers. The selling price from farmers to traders is the same as the SPHP price at the consumer level (IDR 13,500) indicates the potential for tight competition, even the possibility of price absorption by traders. This means that traders may take advantage of the existence of SPHP to suppress the purchase price from farmers, considering that consumers have the option to buy rice at the same price through government programs. Furthermore, the lower selling price to BUMDes (IDR 12,800) indicates a difference in the mechanisms and objectives between sales to traders and to BUMDes. BUMDes, as an economic institution oriented towards community empowerment, may provide lower prices with the aim of helping farmers and ensuring the absorption of their harvest, even with a smaller profit margin.

This condition has several important implications. First, farmers are in a difficult position in determining selling prices.

e-ISSN 2655-853X
https://doi.org/10.37637/ab.v8i2.2264

Pressure from SPHP at the consumer level and the difference in purchase prices between traders and BUMDes force farmers to accept relatively low prices, which has the potential to reduce their profits. Second, the price difference between traders and BUMDes shows the important role of BUMDes in stabilizing prices at the farmer level and providing alternative markets for them.

However, the capacity of BUMDes to absorb all of the farmers' harvests needs to be further evaluated. Third, these findings underline the need for more comprehensive intervention from the government to protect farmers, for example through setting a fairer floor price for grain, strengthening farmer institutions, and increasing supply chain efficiency.

b. Market Conditions

Field findings show that market conditions in Prafi District and Manokwari Regency, when associated with field information on exchange rates and production costs, indicate complex and multidimensional problems. At the Prafi District level, limited market access and high price fluctuations place farmers in a vulnerable position. Dependence on collectors or BUMDes, without a fair pricing mechanism, makes it difficult for farmers to get prices that are commensurate with their production costs. Competition with rice from outside the region, including SPHP rice, further depresses the price of local rice. This condition is exacerbated by high production costs, which include the price of agricultural inputs such as fertilizers and pesticides, labor costs, and transportation costs that may be high given the geographical conditions and infrastructure in the area.

At the Manokwari Regency level, a more integrated market with regional and national markets brings its own challenges. Rice prices in Manokwari are influenced by broader market dynamics, including import policies and price fluctuations in other regions. Consumer preferences and the role of traders and distributors also influence prices and profit margins. In this context, information on farmers' very small profit margins (2.93%) is crucial. This thin margin indicates that farmers are barely making adequate profits from their farming efforts, and could even potentially suffer losses if there are adverse price fluctuations or increases in production costs. The ever-increasing cost of living, including basic necessities and health services, is further worsening farmers' economic conditions.

The interplay between market conditions and the challenges faced by farmers creates a vicious cycle that is difficult to break. Pressure on selling prices due to limited market access and competition, coupled with high production costs, results in very small profit margins. This condition is exacerbated by the ever-increasing cost of living. As a result, farmers have difficulty meeting their living needs, reinvesting in their farming businesses, or even simply surviving. This condition threatens the sustainability of rice farming in Prafi District and the welfare of farmers as a whole.

Previous research by (Rozi, F, et al., 2025), demonstrated that limited market access and price fluctuations significantly affected farmers' well-being in various regions of Indonesia. Their study revealed that farmers with better market access, whether through cooperatives or partnerships with the private sector had higher bargaining power and achieved more stable selling prices. Similar findings were reported by (Leunda Martiarena, M, et al., 2025), who emphasized the crucial role of farmer institutions in mitigating price uncertainties and enhancing supply chain efficiency. Based on these studies, it could be concluded that without strong institutional support and appropriate policy interventions, farmers in Prafi District would continue to face challenges in sustaining their agricultural livelihoods.

c. Institutional/Institutional Support

The results of interviews and observations in the field related to the problem of farmers' limited access to production inputs and knowledge in Prafi District are multidimensional problems that

e-ISSN 2655-853X
https://doi.org/10.37637/ab.v8i2.2264

are interrelated and worsen the economic conditions of rice farmers in Prafi District. Limited access to superior seeds that are resistant to pests and diseases is not just a matter of physical availability of seeds, but also reflects weaknesses in the seed system and dissemination of agricultural technology.

Farmers who still rely on local seeds or seeds of unassured quality are at high risk of crop failure due to pest and disease attacks, as well as low productivity potential. In fact, several superior rice varieties have been recommended and are commonly used in Manokwari, such as the Inpari 30, Inpari 32, Inpari 47, Cigeulis, Ciherang, and Mekongga varieties. The inability of farmers to access these superior varieties indicates problems in the seed supply chain, information, and technology adoption at the farmer level.

This is exacerbated by limited access to quality fertilizers that are essential for plant growth and development. This limited access can be caused by an inefficient distribution chain, expensive fertilizer prices, or a lack of information on the right type and dosage of fertilizer. In fact, the government has set the Highest Retail Price (HET) for subsidized fertilizers in 2022, namely SP-36 IDR 2,400 per kg, ZA IDR 1,700 per kg, NPK IDR 2,300 per kg, Urea IDR 2,250 per kg, Organic Granules IDR 800 per kg, Organic Liquid IDR 20,000 per liter, and Special NPK IDR 3,300 per kg. The inability of farmers to access subsidized fertilizers according to the HET indicates problems in the distribution of subsidized fertilizers, possibly caused by a long and convoluted distribution chain, hoarding practices by irresponsible individuals, or a lack of socialization regarding the subsidized fertilizer program to farmers.

Untimely irrigation support is a classic problem in irrigation systems in Indonesia, and Prafi District seems to be no exception. Irregular irrigation, whether due to damaged irrigation infrastructure, poor water management, or natural factors, has a direct impact on rice growth and yields. Water is a crucial factor in rice cultivation, and a lack or excess of water at certain growth stages can cause significant losses. Furthermore, limited agricultural machinery, such as tractors, planting machines, and harvesting machines, makes the cultivation process less efficient and takes longer. This not only results in increased labor costs, but also potential crop losses due to late harvests.

An equally important aspect is the limited skills and knowledge of farmers in controlling pests and diseases, as well as the application of modern cultivation techniques. These limitations often lead to inappropriate or excessive use of pesticides, which have negative impacts on the environment, farmer health, and the quality of the harvest. Lack of knowledge about efficient cultivation techniques also leads to low productivity and suboptimal use of resources (Samui, S, et al., 2024). All of these problems are interrelated and form a vicious circle that is difficult to break. Limited access to quality production inputs (seeds and fertilizers), inadequate irrigation support, limited agricultural machinery, and lack of farmer knowledge, together suppress productivity, increase production costs, and ultimately reduce farmer profit margins, as previously analyzed.

Therefore, effective interventions must be holistic and integrated, with a focus on strengthening institutions at the farmer level. This institutional strengthening includes strengthening farmer groups or cooperatives as a forum for collective access to production inputs, facilitating access to information and technology, and increasing farmer capacity through ongoing training and extension (Maharjan, K. L, Gonzalvo, C. M, & Baggo, J. C, 2025). In addition, improving irrigation infrastructure and providing affordable agricultural machinery are also important steps. Interventions that only focus on one aspect will not be effective in addressing this complex problem. An integrated and sustainable approach, involving active farmer participation, is key to increasing farmer productivity and welfare in Prafi District, West Papua.

e-ISSN 2655-853X
https://doi.org/10.37637/ab.v8i2.2264

Internal Factors

a. Adaptation Capacity

The results of this study indicate that the level of education of farmers dominated by elementary school graduates (44.4%) indicates limited access to modern agricultural information and technology. This highlights the need for training and education programs that can improve farmers' knowledge and skills in adopting more efficient and sustainable agricultural practices. Most farmers in this area have more than 20 years of farming experience, which is an important asset in facing market changes. This experience provides farmers with local knowledge and practical skills that can be used to overcome challenges, including fluctuations in rice prices. However, farmers' courage in taking risks to try new varieties or alternative farming techniques is also a determining factor in their adaptation capacity.

Access to economic resources, such as capital and financing, also affects farmers' ability to adapt. Farmers who have access to these resources can more easily invest in new technologies or diversify their farming businesses, thereby reducing the negative impacts of price fluctuations. In addition, strong social networks and community support, such as farmer groups, can increase adaptive capacity through information and resource sharing. Linear regression analysis shows that rice price fluctuations have a significant impact on farmers' socio-economic aspects. Farmers with high adaptive capacity are able to cope with the negative impacts of rice price fluctuations more effectively. This can be seen from their ability to reduce losses or avoid crop failures through crop diversification or changes in marketing strategies.

The research findings show the importance of strengthening the adaptive capacity of lowland rice farmers in Prafi District through a series of integrated interventions. Agricultural education and extension programs tailored to the needs of local farmers can improve their knowledge and skills in adopting more sustainable agricultural practices (Salman, D, Yassi, A, & Bahsar, E, 2023). In addition, efforts need to be made to improve farmers' access to capital, either through bank credit or alternative financing schemes. The development of farmer groups and cooperatives can also strengthen farmers' social networks and improve their ability to negotiate with related parties, such as traders and rice millers (Fahly, A. P, Fauzi, A, Juanda, B, & Rustiadi, E, 2024); (Phuong, L. T. H, Khanh, H. L. P, & Beckman, M, 2024).

More comprehensive policy interventions are needed to address the challenges faced by rice farmers in this region. The government and related institutions need to develop policies that support the diversification of agricultural production, the development of local markets, and the enhancement of added value of agricultural products. In this way, farmers can increase their income and food security amidst climate change and market price fluctuations.

b. Social Capital

Social capital is an intangible asset owned by a community, consisting of a network of social relationships, norms, beliefs, and shared values. This social network allows individuals to interact with each other, share information, and work together to achieve common goals. Strong norms and beliefs form the basis for effective cooperation, while shared values provide guidance in social behavior. In the context of agriculture, social capital plays an important role in facilitating farmers' access to resources, information, and social support needed to increase productivity and adapt to environmental changes.

The results of field research show that social capital has a strong correlation with the adaptive capacity of rice farmers. Farmers who are members of farmer groups with high social capital tend to be more successful in adopting sustainable agricultural practices. This is because they have better access to the latest agricultural information, new

e-ISSN 2655-853X
https://doi.org/10.37637/ab.v8i2.2264

technologies, and support from fellow farmers. In addition, strong norms of cooperation and trust allow them to share risks and overcome challenges together. In contrast, farmers with low social capital often have difficulty in accessing information and resources, and face obstacles in collaborating.

Increasing social capital is a strategic step to increase the adaptive capacity of rice farmers in Prafi District. By strengthening social networks, norms of cooperation, and trust between farmers, a conducive environment for innovation and adoption of better agricultural practices will be created. In addition, high social capital can also increase farmers' resilience to climate change, price fluctuations, and natural disasters. Emphasizes that efforts to build and strengthen social capital need to be an integral part of agricultural development programs in the area (Vicarelli, M, Georgescu, A, & Sudmeier-Rieux, K, 2024).

c. Access to Resources

The results of field research show that access to various resources is crucial in determining the success of rice farmers in adapting to rice price fluctuations. Farmers who have better access to market information, capital, technology, markets, and knowledge tend to be better able to make the right decisions in dealing with price changes. For example, farmers with good access to information can find out which rice varieties are more resistant to climate change and have higher selling prices. Meanwhile, farmers with sufficient access to capital can invest in modern agricultural technology that increases productivity and production efficiency.

The results of the study also illustrate that several policies need to be taken to support the adaptation of lowland rice farmers. First, the government needs to increase farmers' access to market information through intensive agricultural extension and the use of information technology. Second, efforts need to be made to increase farmers' access to capital, either through people's business credit programs or partnerships with financial institutions. Third, the government needs to encourage the adoption of appropriate agricultural technology through demonstration programs and the provision of subsidies. In addition, the development of market infrastructure and strengthening farmer institutions are also important to support the sustainability of rice farming businesses. Access to adequate resources is the key to the success of lowland rice farmers in adapting to market dynamics. Targeted policies can help farmers overcome the obstacles they face and increase their productivity and income (Leunda Martiarena, M, et al., 2025).

d. Adaptation Strategy

Adaptation strategy is an active response of farmers to environmental and market changes, with the aim of increasing the resilience and sustainability of rice farming. This farmer adaptation strategy refers to efforts made by farmers to overcome environmental challenges and changes, especially in this case the fluctuation of rice prices. This adaptation strategy includes various actions, ranging from changes in cropping patterns, selection of rice varieties that are more resistant to climate change and disease, to diversification of farming businesses (Azril, H, et al., 2024). To identify the determinants that influence farmers' decisions to adopt adaptation strategies to price dynamics, a logistic regression analysis was conducted. The results, which show statistically significant variables, are presented in Table 1.

Table 1 shows the results of logistic regression analysis aimed at identifying factors that influence the decisions of rice farmers in Prafi District in adopting adaptation strategies to the dynamics of changes in rice prices. Explanation of Table 1 is described in the following paragraphs.

e-ISSN 2655-853X
https://doi.org/10.37637/ab.v8i2.2264

Table 1. Analysis of Adaptation of Lowland Rice Farmers to the Dynamics of Rice Price Changes in Prafi District, Manokwari Regency in 2025

Variable	Odds Ratio	Standard Error	Significance
Literacy Level	6.958***	577	***
Trust in Others	3.972***	585	***
Adaptation Strategy	6.970***	507	***
Participation in Groups	2.525**	483	**
Family Size	1.610***	174	***
Age	1.070***	26	***
Rice Price Volatility	1.234*	98	*
Access to Market Information	1.567**	123	**
Diverse Marketing Strategies	1.890***	154	***

1. Literacy Level, Trust in Others, and Adaptation Strategy: These three variables showed a highly significant and positive relationship with the adoption decision. Regression analysis showed that Literacy Level (6.958), Known Adaptation Strategies (6.970), and Trust in Others (3.972). Literacy and Knowledge are not just theories. Better literate farmers actively seek and understand crucial technical information. One farmer shared his experience: "I used to just follow my neighbors, sir. Now that I can read, I know the correct dosage of fertilizer from the packaging, not just spreading it. The results are better and the cost of fertilizer is more efficient." This quote shows how literacy directly translates into more efficient and profitable farming practices. Trust is social currency. In an environment where information can be inaccurate and the risk of failure is high, trust becomes the main filter before farmers dare to try new things. This trust is not abstract, but tied to a specific figure. "I dared to try the Inpari 32 variety because the information came from the head of our farmer group who has proven to be honest. If it was only from an extension worker who rarely comes or a seller at the market, we would hesitate. We are afraid of impure seeds."This explains why trust in others has such a big influence; innovations spread through trusted social networks, not just through formal channels.

2. Vital Role of Local Institutions and Access to Information Group Participation (2.525) and Access to Market Information (1.567) also proved significant. In-depth interviews on Farmer Groups as Collective Fortresses. Farmers who are active in groups have a stronger bargaining position and faster access to information. "On our own, we are easily manipulated by middlemen. In a group, we can exchange price information, and sometimes even sell together to get a higher price. If there is a pest problem, we can also get the solution faster from our friends." Participation in groups directly reduces individual vulnerability and facilitates the adoption of shared strategies. Market Information as a Negotiating Weapon. Access to price information, often through simple technology such as WhatsApp groups, changes the power dynamics between farmers and buyers. "Now we have a WhatsApp group, so we know what the price is in the city (Manokwari). If a middleman here bids too low, we can hold back. In the past, we didn't know anything, we just gave in to the price." This shows how access to information practically empowers farmers to get fairer prices, which is a direct adaptation to price volatility. 3. Economic Pressure Drives Diversification, Choice to Diversify Marketing Strategies (1.890) and farm diversification is not just an option, but a survival strategy born out of economic pressure. This is a direct response to the initial finding that profit margins from rice are very thin. One farmer explained: "If you rely on rice alone, it is not enough, especially

e-ISSN 2655-853X
https://doi.org/10.37637/ab.v8i2.2264

if the price drops. That's why I plant chilies and water spinach on part of the land. The proceeds from vegetables can be used for children's school fees and daily kitchen needs. So, if the price of rice is bad, the family can still eat." This narrative clearly links external economic pressures with strategic decisions at the individual level to diversify income sources as a safety net.

Based on the logistic regression analysis that has been conducted, it can be concluded that rice farmers in Prafi District need to adopt multidimensional adaptation strategies. Effective adaptation strategies include increasing agricultural literacy, strengthening social networks through farmer groups, diversifying farming businesses, increasing access to market information, and using appropriate agricultural technology. By increasing knowledge and skills, farmers can make better decisions in dealing with changes in rice prices. In addition, by collaborating with other farmers and utilizing technology, farmers can access broader market information, increase productivity, and reduce the risk of losses due to price fluctuations (Alvar-Beltrán, Jorge, & Gianluca Franceschini, 2024); (Girik Allo, A, Satiawan, E, & Arsyad, L. A, 2019).

Income Diversification

Based on the analysis results, rice farmers in Prafi District have shown various adaptation patterns in dealing with the dynamics of changes in rice prices. These adaptation patterns include: changes in planting strategies, income diversification, and adoption of new technologies. Changes in planting strategies are one of the farmers' responses to price fluctuations. One interesting adaptation pattern is the integration of rice cultivation with horticultural crops. Farmers in Prafi District have begun to allocate part of their land to grow vegetables such as chilies, tomatoes, or leafy vegetables. By growing vegetables, farmers have a more stable source of additional income. Vegetable prices tend to be more volatile than rice, so they can reduce the risk of losses when there is a decline in rice production.

Diversification of income is also a strategic choice for many farmers. They have started to develop side businesses such as livestock, fisheries, or agro-industrial businesses to reduce dependence on income from rice. The adoption of new technologies such as the use of more effective and efficient agricultural machinery or even the use of market information via mobile devices, shows that farmers in Prafi District are increasingly open to innovation.

These three adaptation patterns are interrelated and mutually reinforcing. Changes in planting strategies, for example, can be more effective if supported by the use of new technologies such as superior varieties or the right fertilizers. Likewise, income diversification can make it easier for farmers to adopt new technologies because of the additional sources of income. Overall, the adaptation patterns shown by farmers in Prafi District reflect their efforts to increase resilience and competitiveness in facing dynamic market challenges. In order for this adaptation pattern to be more effective, it needs to be supported by various efforts, such as:

- Providing access to accurate and up-to-date market information.
- Improving the quality of agricultural extension.
- Developing agricultural infrastructure.
- Facilitating access to credit and capital.
- Strengthening farmer institutions.

With adequate support, it is hoped that the adaptation patterns that have been carried out by farmers can continue to develop and contribute to improving farmer welfare and food security in the region.

Use of New Technology

The use of new technology is a significant internal factor in increasing the adaptive capacity of rice farmers in Prafi District, especially in dealing with changes in rice prices. Modern agricultural technologies, such as hand tractors, rice transplanters, and mini combine harvesters, can play an

e-ISSN 2655-853X
https://doi.org/10.37637/ab.v8i2.2264

important role in increasing the efficiency and productivity of farming businesses.

The results of the field study show that farmers in Prafi District have a strong desire to implement modern agricultural technology. They realize that the use of agricultural tools and machinery (alsintan) can help increase productivity and reduce production costs. With technology such as hand tractors and rice transplanters, the process of tilling and planting can be done faster and more efficiently, reducing dependence on manual labor which is often expensive and limited.

The application of technology such as mini combine harvesters can reduce crop losses and speed up the harvesting process. This not only increases productivity but also reduces labor costs and the time required for harvesting. By reducing production costs, according to farmers can be more resilient in facing fluctuations in rice prices, because profit margins can be increased even if the market price of rice decreases (Wahyudi, 2023). Respondent farmers hope for support from the government in the form of assistance or subsidies to obtain modern agricultural machinery. This support can be in the form of extension programs, training, and financial assistance or subsidies for purchasing equipment. The government can play an important role in facilitating access to this technology, which can ultimately improve farmer welfare and the sustainability of the agricultural sector in Prafi District.

Changes in Cultivation Practices

In facing the challenges of declining production due to climate change, limited irrigation water flow, and pest and disease attacks, rice farmers in Prafi District have adopted significant changes in their cultivation practices. One of the main strategies implemented is crop diversification. By diverting part of their rice fields to grow vegetables such as kale, chili, tomatoes, eggplant, cucumber, and corn, farmers can reduce their dependence on rice and utilize the land more optimally. This diversification not only helps reduce production risks but also provides additional sources of income that can improve farmers' welfare, especially when rice prices are low or yields are declining (Mkondiwa, M & Urfels, A, 2024).

In addition to diversification, farmers in Prafi District also implement the practice of fallow, which is leaving the land unplanted for 1-2 months. This fallow period aims to break the life cycle of pests and diseases, thereby reducing infestation in the next planting season. This practice also provides an opportunity for the soil to restore its fertility, which can have a positive impact on future harvests. Thus, the implementation of fallow is an important strategy in sustainable land management.

This change in cultivation practices reflects the flexibility and adaptability of farmers in Prafi District. However, to ensure the success of this strategy, support from the government and related institutions is essential. Extension and training on appropriate cultivation techniques and pest and disease management can help farmers optimize their practices. With the right support, this strategy not only increases farmers' resilience to environmental and market challenges but also improves their overall well-being (Samui, S, et al., 2024).

Adaptation Attitude and Impact on Farmers' Socio-Economic

The adaptation attitude of rice farmers in Prafi District is a manifestation of their ability to respond dynamically to increasingly complex environmental changes. Faced with challenges such as climate change, pest and disease attacks, and fluctuations in rice prices, farmers have shown flexibility in changing their farming practices. Innovation is key to this adaptation, reflected in the adoption of superior rice varieties, the application of modern agricultural technology, and the diversification of farming businesses. In addition, farmers have also shown awareness of the importance of sustainable resource management. This can

e-ISSN 2655-853X
https://doi.org/10.37637/ab.v8i2.2264

be seen from their efforts in implementing crop rotation, the use of organic fertilizers, and water conservation. This adaptive attitude not only has an impact on the individual level, but also on the community level. Adaptive farmers tend to be more active in seeking information, collaborating with fellow farmers, and being involved in community development activities. Thus, this adaptive attitude not only increases farmers' productivity and income, but also strengthens food security and the local economy in Prafi District.

Table 2 above shows the heterogeneity of the level of adaptation of rice farmers in Prafi District in responding to rice price fluctuations. Farmers with a "High" adaptation attitude (42.2%) are likely to be those who have a good level of literacy, are active in farmer groups and have strong social trust, as identified by the regression model. In contrast, the "Low" group (31.1%) are those who are isolated from information networks and institutional support. Therefore, policy interventions cannot be evenly distributed. Capacity building efforts should focus on the low and medium level farmer groups, by strengthening the key factors driving adaptation: strengthening farmer groups, facilitating access to digestible market information, and building trust-based extension programs. By integrating quantitative and qualitative data, we not only know what works, but also why and how it works in the real context of farmers' lives in the Prafi Sub-district.

Table 2. Respondent Farmers' Adaptation Attitudes to Changes in Rice Prices

Adaptive Attitude	Amount (people)	Percentage (%)	Information
Low	14	31.1	• Highly dependent on traditional production methods, lack of access to market information, have limited capital to invest in technology • Have tried several adaptation strategies, such as crop diversification, use of organic fertilizers, or seeking alternative markets, but not yet optimally • Tend to be more innovative, proactive, and open to change. Most likely, these farmers have adopted modern agricultural technology, have good access to market information, and are able to build collaborative networks with other parties.
Medium	12	26.7	
Large	19	42.2	
Total	45	100.0	

The results of interviews and field observations show that rice farmers in Prafi District have demonstrated resilience in facing the challenges of climate change, pest and disease attacks, and fluctuations in rice prices. The results of the study revealed that farmers have developed various adaptation strategies to maintain the sustainability of their farming businesses. One common strategy is income diversification through the integration of rice cultivation with horticultural crops. By planting vegetables, farmers not only obtain additional sources of income but also reduce the risk of losses due to fluctuations in rice prices (Dam, T. H. T, et al., 2021). In addition, farmers also adopt more modern agricultural technologies such as the use of superior varieties, drip irrigation systems, and organic fertilizers. The use of this technology aims to increase productivity, efficiency, and plant resistance to environmental disturbances (Rozi, F, et al.,

e-ISSN 2655-853X
https://doi.org/10.37637/ab.v8i2.2264

2025).

The implementation of adaptation strategies has had a positive impact on the socio- economic aspects of rice farmers in Prafi District. Income diversification has improved farmers' welfare and reduced their dependence on one commodity. The stability of production maintained through the use of technology and sustainable agricultural practices has provided income certainty for farmers. In addition, adaptation strategies have also contributed to increasing food security at the household and community levels. However, the success of implementing this adaptation strategy is greatly influenced by several factors, such as access to information, availability of capital, and government policy support. The implementation of adaptation strategies has had a positive impact on the socio-economic aspects of rice farmers in Prafi District. Income diversification has improved farmers' welfare and reduced their dependence on one commodity. The stability of production maintained through the use of technology and sustainable agricultural practices has provided income certainty for farmers. In addition, adaptation strategies have also contributed to increasing food security at the household and community levels. However, the success of implementing this adaptation strategy is greatly influenced by several factors, such as access to information, availability of capital, and government policy support.

The adaptation strategy carried out by rice farmers in Prafi District is a proactive response to the challenges of environmental and market changes. With the support of appropriate policies, this adaptation strategy can continue to be developed and improved so that it can make a significant contribution to improving farmer welfare and food security in the region.

CONCLUSION

The dynamics of adaptation of rice farmers in Manokwari Regency in responding to rice price fluctuations show the ability to adapt through various strategies, such as business diversification, application of agricultural technology innovation, and changes in planting patterns. This adaptation process is influenced by the level of farmers' understanding of market conditions and their ability to manage existing resources. Actors that influence farmers' adaptation decisions can be categorized into external and internal factors external. Factors include government policies, institutional support, and uncertain market conditions, while internal factors include social capital, experience, and access to information and resources. Fluctuations in rice prices have a significant impact on the socio-economic aspects of farmers' lives, including income, welfare, and family economic stability. In an unstable price situation, many farmers experience economic pressure that can affect their daily lives.

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