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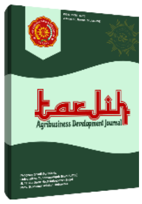

Rice Farming Productivity Amid Seasonal Changes: A Case Study of Kaloling Village, Sinjai

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ABSTRACT

Seasonal variability has become a major constraint for rice farming in rainfed and simple-irrigated areas. This study aimed to analyze the effect of seasonal changes on rice farming productivity in Kaloling Village, East Sinjai District, Sinjai Regency. Seasonal change was measured using three indicators: planting time shift, water availability condition, and increasing pest attack, while productivity was measured through land, labor, capital, technology adoption, and planting intensity indicators. The study employed a quantitative descriptive-associative approach. The population consisted of 411 members of 12 farmer groups, and 41 respondents were selected using proportionate sampling. Data were collected through observation, questionnaires, interviews, and documentation, and analyzed using multiple linear regression. The results showed that planting time shift had a negative and significant effect on rice farming productivity ($t = -7.723$; $p < 0.001$), water availability condition had a positive and significant effect and became the dominant factor ($t = 8.086$; $p < 0.001$), and increasing pest attack had a negative and significant effect ($t = -2.203$; $p = 0.034$). Simultaneously, the three variables significantly affected rice farming productivity ($F = 23.444$; $p < 0.001$), with an R-square value of 0.655. These findings indicate that adaptive strategies should prioritize water management, synchronized planting calendars, and integrated pest control to sustain rice productivity under seasonal uncertainty

Keywords: *Farmer adaptation, Pest attack, Rice productivity, Seasonal variability, Water management*

INTRODUCTION

The agricultural sector plays a strategic role in food provision, labor absorption, and the improvement of rural welfare. Rice is one of Indonesia's most important food commodities because the majority of the population depends on rice as a staple food. Therefore, maintaining rice farming productivity is a crucial concern, particularly in areas where farming systems still depend strongly on seasonal patterns and water availability.

Seasonal change has become one of the major challenges for rice farming. Shifts in the onset of the rainy season, changes in the duration of the dry season, rainfall variability, and increasing temperature and humidity can alter planting schedules, disrupt water availability, and intensify pest development. These conditions make rice cultivation increasingly uncertain, especially in rainfed fields and simple-irrigated areas that are vulnerable to both drought and waterlogging.

Kaloling Village, East Sinjai District, Sinjai Regency is a rice-producing area in which agricultural activities are strongly influenced by seasonal water availability. Local productivity data show that rice productivity in Kaloling Village fluctuated from 46.36 quintals/ha in 2021 to 45.87 quintals/ha in 2022, then increased to 49.56 quintals/ha in 2023, 49.84 quintals/ha in 2024, and 51.52 quintals/ha in 2025. Although

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productivity tended to increase, annual variation indicates that external factors, including seasonal uncertainty, remain important to examine.

Previous studies have examined the influence of rainfall, land area, input use, and farm efficiency on rice production. However, studies that specifically analyze seasonal change through farmer-perceived indicators such as planting time shifts, water availability conditions, and increasing pest attacks at the village level remain limited. Since farmers make production decisions within local contexts, village-level empirical evidence is needed to formulate more precise adaptation strategies.

Table 1. Rice productivity in Kaloling Village, 2021-2025

Year	Productivity (quintals/ha)
2021	46.36
2022	45.87
2023	49.56
2024	49.84
2025	51.52

Source: Agricultural Extension Office of East Sinjai District, processed (2025).

This study aims to analyze the effect of seasonal change on rice farming productivity in Kaloling Village, East Sinjai District, Sinjai Regency. The novelty of this study lies in the use of seasonal change indicators that are closely related to farmers' experience, namely planting time shifts, water availability conditions, and increasing pest attacks, and in testing their influence on rice farming productivity in a local agribusiness context.

RESEARCH METHODS

This research was conducted in Kaloling Village, East Sinjai District, Sinjai Regency from January to June 2026. The location was selected purposively because most residents of Kaloling Village work as rice farmers and face seasonal uncertainty, particularly in relation to planting schedules and water availability. The study employed a quantitative approach with descriptive and causal-associative methods. Primary data were collected through field observation, questionnaires distributed to rice farmers, and interviews with supporting informants. Secondary data were obtained from the Central Bureau of Statistics, the Meteorology, Climatology, and Geophysics Agency, the Food Crops, Horticulture, and Plantation Office of Sinjai Regency, and village government documents.

The research population consisted of 411 members of 12 farmer groups in Kaloling Village. The sample was determined using proportionate sampling by taking 10% of members from each farmer group, resulting in 41 respondents. The questionnaire used a four-point Likert scale ranging from strongly disagree to strongly agree.

The independent variables were seasonal change indicators consisting of planting time shift (X1), water availability condition (X2), and increasing pest attack (X3). The dependent variable was rice farming productivity (Y), measured through indicators of land productivity, labor productivity, capital productivity, technology adoption, and planting intensity. In the questionnaire, the water-related items were treated as farmers' perceived water availability condition; therefore, a higher score reflects a more favorable ability to maintain water availability rather than a worsening water constraint. Data were analyzed using validity tests, reliability tests, classical assumption tests, and multiple linear regression. The regression model used in this study is presented as follows:

$$Y = alpha + b1X1 + b2X2 + b3X3 + e$$

where Y represents rice farming productivity; alpha is the constant; b1, b2, and b3 are regression coefficients; X1 represents planting time shift; X2 represents water availability condition; X3 represents increasing pest attack; and e is the error term. Hypotheses were tested using the t-test for partial effects, the F-test for simultaneous effects, and the coefficient of determination to assess the explanatory power of the model. The significance level used was 5%.

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RESULT AND DISCUSSION

Respondent Characteristics

The characteristics of respondents indicate that most farmers were in the productive age group. The largest age group was 40-49 years old, consisting of 16 respondents or 39.0%, followed by the 30-39 age group with 14 respondents or 34.1%. Male respondents accounted for 27 people or 65.9%, while female respondents accounted for 14 people or 34.1%. The dominant education level was senior high school, with 17 respondents or 41.4%. In terms of farming experience, most respondents had 5-10 years of farming experience, consisting of 15 respondents or 36.6%, followed by 11-20 years with 14 respondents or 34.2%. These conditions show that respondents had sufficient practical experience and productive capacity to evaluate the influence of seasonal change on rice farming activities.

Table 2. Characteristics of respondents

Characteristic	Category	Frequency	Percentage (%)
Age	30-39 years	14	34.1
	40-49 years	16	39.0
	50-59 years	6	14.7
	60-69 years	2	4.9
	70-79 years	3	7.3
Sex	Male	27	65.9
	Female	14	34.1
Education	Elementary school	9	22.0
	Junior high school	8	19.6
	Senior high school	17	41.4
	Bachelor degree	7	17.0
Farming experience	5-10 years	15	36.6
	11-20 years	14	34.2
	21-30 years	7	17.0
	31-40 years	5	12.2

Source: Primary Data processed, 2026.

Validity, Reliability, and Classical Assumption Tests

Validity testing was conducted by comparing the calculated r-values with the r-table value at df = 39 and a 5% significance level, which produced an r-table value of 0.308. All items for planting time shift, water availability condition, increasing pest attack, and rice farming productivity had calculated r-values greater than 0.308, indicating that all items were valid. Reliability testing showed that Cronbach's Alpha values for all variables were greater than 0.60, indicating that the instruments were reliable.

Table 3. Validity and reliability test summary

Variable	Validity range (r count)	Cronbach's Alpha	Decision
Planting time shift (X1)	0.745-0.885	0.892	Valid and reliable
Water availability condition (X2)	0.418-0.852	0.807	Valid and reliable
Increasing pest attack (X3)	0.546-0.869	0.821	Valid and reliable
Rice farming productivity (Y)	0.406-0.827	0.754	Valid and reliable

Source: Primary data processed using SPSS (2026).

The classical assumption tests confirmed that the data met the requirements for regression analysis. The Kolmogorov-Smirnov normality test produced an Asymp. Sig. value of 0.200, which is greater than 0.05, indicating normally distributed residuals. The tolerance values for X1, X2, and X3 were 0.306, 0.292, and 0.873, respectively, while the VIF values were 3.264, 3.423, and 1.145. Since all tolerance values were above 0.10 and all VIF values were below 10, the model was free from multicollinearity. The heteroscedasticity test produced significance values of 0.874 for X1, 0.088 for X2, and 0.130 for X3. These values were greater than 0.05, indicating that the model was free from heteroscedasticity.

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Table 4. Classical assumption test summary

Test	Indicator	Value	Decision
Normality	Asymp. Sig.	0.200	Normal
Multicollinearity X1	Tolerance/VIF	0.306/3.264	No multicollinearity
Multicollinearity X2	Tolerance/VIF	0.292/3.423	No multicollinearity
Multicollinearity X3	Tolerance/VIF	0.873/1.145	No multicollinearity
Heteroscedasticity X1	Sig.	0.874	No heteroscedasticity
Heteroscedasticity X2	Sig.	0.088	No heteroscedasticity
Heteroscedasticity X3	Sig.	0.130	No heteroscedasticity

Source: Primary data processed using SPSS (2026).

Multiple Linear Regression Analysis

The multiple linear regression analysis showed that the model explained the relationship between planting time shifts, water availability conditions, increasing pest attacks, and rice farming productivity. The regression equation obtained was:

$$Y = 50.205 - 4.185X1 + 6.235X2 - 0.823X3$$

The regression coefficient of X1 was -4.185, indicating a negative relationship between planting time shifts and rice farming productivity. Empirically, the greater the shift in planting time perceived by farmers, the lower the rice farming productivity tends to be. This occurs because changes in planting time may disrupt the suitability between plant growth phases, water availability, and weather conditions. Rice planted outside the appropriate seasonal window is more likely to experience water shortage during vegetative growth or grain filling, resulting in lower yield.

The regression coefficient of X2 was 6.235, and its t-value was the highest among the independent variables, indicating that water availability condition was the dominant factor in the model. This result emphasizes that water availability is a central issue for rice productivity in Kaloling Village. In rainfed and simple-irrigated fields, water deficit during the dry season or excess water during periods of high rainfall can affect land preparation, crop growth, flowering, and grain filling. Therefore, water stability and water management are key strategies for adapting to seasonal uncertainty.

The regression coefficient of X3 was -0.823, indicating that increasing pest attack had a negative relationship with productivity. Changes in temperature, humidity, and seasonal regularity can make pest cycles more difficult to predict. Unsynchronized planting patterns may also facilitate the movement of pests from one plot to another. Uncontrolled pest attacks can damage leaves, stems, and panicles, ultimately reducing rice productivity.

Table 5. Multiple linear regression results

Variable	B	Std. Error	Beta	t	Sig.
Constant	50.205	8.237	-	6.095	0.000
Planting time shift (X1)	-4.185	0.542	-1.347	-7.723	0.000
Water availability condition (X2)	6.235	0.771	1.444	8.086	0.000
Increasing pest attack (X3)	-0.823	0.374	-0.228	-2.203	0.034

Source: Primary data processed using SPSS (2026).

Table 6. Simultaneous test and coefficient of determination

Model indicator	Value	Decision
F count	23.444	Significant
Sig. F	0.000	Significant at 5% level
R	0.809	Strong relationship
R Square	0.655	65.5% of variation explained by the model
Adjusted R Square	0.627	Adjusted explanatory power of 62.7%
Std. Error of the Estimate	5.168	-

Source: Primary data processed using SPSS (2026).

The simultaneous test produced an F value of 23.444 with a significance value of 0.000. Thus, planting time shift, water availability condition, and increasing pest attack jointly had a significant effect on rice farming productivity. The R-square value of 0.655 indicates that 65.5% of the variation in rice farming productivity can be explained by these three variables, while the remaining 34.5% is influenced by factors outside the model, such as seed quality, cultivation techniques, access to capital, fertilization, and farmers' managerial capacity.

Discussion

The negative effect of planting time shift on productivity shows that the accuracy of the planting calendar is essential for rice farming. Many farmers in Kaloling Village still depend on rainfall and simple irrigation. When the onset of the rainy season changes, farmers must delay or accelerate planting. Inappropriate adjustment may cause plants to enter critical growth stages when water is not sufficiently available. This finding is consistent with previous studies showing that seasonal shifts can disrupt planting calendars and reduce rice production, especially in farming systems dependent on rainfall (Chaniago, 2022; Pramasani and Soelistyono, 2018).

The dominance of water availability condition indicates that the main issue faced by farmers is not merely seasonal change in general, but the capacity of the production system to provide water when crops need it. Adequate water availability supports photosynthesis, nutrient uptake, tillering, flowering, and grain filling. Conversely, drought and waterlogging reduce crop performance. This finding underlines the importance of irrigation rehabilitation, water pumping, water storage facilities, and water-saving technologies as village-level adaptation policies.

Increasing pest attack also had a significant influence on productivity. Seasonal change can make pest dynamics more difficult to anticipate because temperature and humidity patterns change. Unsynchronized planting can also increase the likelihood of pest movement across fields. Therefore, pest management must be strengthened collectively through farmer groups, including field monitoring, synchronized planting, and integrated pest management.

The findings provide policy implications that seasonal adaptation strategies for rice farming in Kaloling Village should prioritize three directions: developing planting calendars based on local climate information, improving water infrastructure and governance, and strengthening integrated pest management. Village governments, agricultural extension officers, and farmer groups need to establish stronger coordination systems so that farmers have adequate information and facilities to respond to seasonal uncertainty.

CONCLUSION

Seasonal change affects rice farming productivity in Kaloling Village, East Sinjai District, Sinjai Regency. Planting time shift has a negative and significant effect on productivity, indicating that inappropriate planting time due to seasonal uncertainty can reduce farm output. Water availability condition has a significant effect and is the most dominant factor, showing that the sustainability of rice productivity strongly depends on stable water provision and effective water management. Increasing pest attack also has a negative and significant effect on productivity. Simultaneously, the three indicators of seasonal change explain 65.5% of the variation in rice farming productivity. The implication of this study is the need to strengthen adaptive planting calendars, rehabilitate and develop irrigation infrastructure, utilize water pumping and water storage technologies, and implement farmer group-based integrated pest management.

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