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PROBABILITY OF USING SUPERIOR RICE VARIETY IN FARMING ON TIDAL SWAMPLAND OF BARITO KUALA REGENCY, INDONESIA

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ABSTRACT
Barito Kuala Regency makes a major contribution to South Kalimantan's rice production, which accounts for more than 20%. However, data shows that in the last three years, rice production in the area declined significantly, which was around 15% respectively. Therefore, it needs special attention so that production in the coming years will increase to fulfill the need of rice as a staple food of people. This study aimed to analyze the determinant and the probability of using superior varieties in rice farming on tidal land of Barito Kuala Regency. Inferential analysis of logistic regression approach is used. The results showed that simultaneously the fifth predictor factors influenced the adoption of superior variety as the response variable. However, partially, there were only three predictor factors that influence the application of superior variety which were production of the variety, availability of markets for grain produced, and farmer's experience, while the factors of migrant status and land area had no significant effect. Furthermore, the production variable (X_1) had an OR of 7.263, meaning that the production of superior variety tended to be applied by farmers at 7.26 times. Variable X_2 (Market) showed an OR of 9.115, meaning when there was a guarantee for superior variety output to be marketed then the probability of using superior variety was 9.12 times applied by farmers. Farmers who had a lot of experience ($X_{5.2}$) in rice farming (over 20 years) had a tendency of 5.27 times to apply superior variety to their rice farming compared to their counterpart.

KEY WORDS
Probability, Superior variety, rice farming, tidal swamps.

South Kalimantan is one of the national rice productions outside Java and Sumatra, which contributes to rice production in 2020 around 2.10% of rice production in Indonesia) (BPS, 2021). However, when it compared to the production of the previous year (2019), rice production in South Kalimantan decreased significantly by 192,555.16 tons (14.34%) which is the second highest decreased nationally, after the South Sulawesi Province of 345,701.99 tons of dry husk. This condition is quite alarming considering that South Kalimantan is one of the main contributors to the national rice supply outside Java.

Barito Kuala Regency is the highest of rice production in South Kalimantan Province which contributes 20.62% of the total rice production with a total harvested area of 66,448.45 ha and production of 237,193.34 tons while productivity of 3.57 rice t ha^{-1}. As a phenomenon seen at the provincial level, it turns out that a decline in rice production also occurred in Barito Kuala Regency, where there was a substantial decrease in production, namely 47,365, 69 tons of rice (16.65%) compared to the previous year (BPS, 2021). This condition needs special attention so that rice production would be better in the coming years. On the other hand, the government is currently intensively implementing a number of programs to increase the national rice/rice production capacity so that food security, income and farmers' welfare continue to increase. This study aimed to describe the characteristics of farmers followed by analyzing their tendencies towards the application of superior varieties. In the Barito Kuala Regency, apart from local farmers, there are also farmers, most of whom come from the island of Java. In addition to descriptive analysis, this study also used inferential analysis with a logistic regression approach.

METHODS OF RESEARCH

The research was conducted in Barito Kuala District as the largest tidal area in South Kalimantan Province with Rantau Badauh District and Cerbon District as the selected locations. The data were collected, processed, and analyzed descriptively using Logistic Regression to analyze the relationship between the response variable (y) which is dichotomous and the predictor variable (x) which is polychotomous. The logistic regression function can be written as follows:

$$\pi(x) = \frac{e^{\beta 0 + \beta 1X1 + \beta 2X2 + \beta 3X3 + \beta 4X4 + \beta 5X5}}{1 + e^{\beta 0 + \beta 1X1 + \beta 2X2 + \beta 3X3 + \beta 4X4 + \beta 5X5}},$$

Then transformed into a form with a logit transformation:

$$g(x) = \ln$$
$$(\pi(x)\ 1-\pi(x)) = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \beta_3 x_3 + \beta_4 x_4 + \beta_5 x_5$$

Where the response variable and the predictor variables:

Table 1 – The variables used in the estimation

No	Variable		Remark
1.	Adoption of Superior Variety	Response	1 = Superior variety; 0 = Local variety
2.	Production	Predictor	1 = High; 0 = Low
3.	Market	Predictor	1 = Available; 0 = Not available
4.	Farmer's status	Predictor	1 = Migrant farmer; 0 = Local farmer
5.	Land	Predictor	1 = Large scale; 0 = Other
6.	Experience	Predictor	2 = Long experienced; 1 = Intermediate; 0 = New

Goodness of Fit using Hosmer and Lemeshow Test:

- Hypothesis: H_0: The model fits with the observation data;
- H_1: The model does not fit with the observation data.

Statistic Test: $\hat{C} = \sum_{k=1}^{g} \left[\frac{(o_k - n'_k \bar{\pi}_k)^2}{(n'_k \bar{\pi}_k(1-\bar{\pi}_k))} \right]$

Statistic $\hat{C}$ follows distribution of $\chi^2_{(0.05,g-2)}$ (Hosmer and Lemeshow, 2000). H_0 rejects if the *p-value* less than α (0,05), so it can be concluded that the model tested is not fit. Conversely, if the p-value is greater than or equal to α, it can be concluded that the model fits.

Simultaneous parameter estimation testing is by using the Likelihood Ratio test, with the hypothesis:

- H_0: $\beta_1 = \beta_2 = \ldots = \beta_5$ (there is no effect of the predictor variable together on response variable);
- H_1: At least there is one $\beta_i \neq 0$; i=1- 5 (at least one predictor variable influences the response variable).

Statistic test: $G = -2\ln \frac{Lo}{Lp} = -2[\ln (L_0 - \ln (L_p)]$, where Lo is *likelihood* without predictor variable, and Lp is *likelihood* with predictor variables.

Statistic test G follows Chi-Square distribution with degrees of freedom p. H_0 is rejected if the p-value < α (0.05), meaning that by including the predictor variable in it can be concluded that there is at least one variable that influences the response variable.

Parameter testing partially using the Wald test, with the hypothesis:

- H_0: $\beta_i=0; i=1–5$, (there is no effect of the j-th predictor variable on the variable response);
- H_1: $\beta_i \neq 0$; i=1-5, (there is influence from the predictor variable i to the response variable).

Statistic test: $W = \left(\frac{\hat{\beta}_i}{SE(\hat{\beta}_i)}\right)^2$, where $\hat{\beta}_i$ is β_i estimator; $SE(\hat{\beta}_i)$ is *standard error* from $\hat{\beta}_i$.

Chi-Square distribution with degree of freedom 1 (Agresti, 1990), Ho is rejected if the p-value is less than α (0.05), which means that the predictor variable βi partially affects the response variable.

The Odds ratio is a comparison of the probability of occurrence or non-occurrence of an event is a measure to see how much the predictor variable tends to the response variable. Odds show the likelihood of an event occurring compared to the likelihood of not occurring an event (Pampel, 2000). In the logistic regression method, the value of the odds ratio can be determined, which is the ratio of the probability of an event from one group to another that indicates a tendency for an event to occur.

The logarithm of the odds when x=1 and x=0 respectively:

$$g(1) = \ln\frac{\pi(1)}{1-\pi(1)} \text{ and } g(0) = \ln\frac{\pi(0)}{1-\pi(0)}$$

RESULTS AND DISCUSSION

Age is one of the criteria that determine labor productivity. The average age of farmers in the study area was 48.02 years, where the youngest is 28 years old and the oldest was 76 years old, while the average experience in farming was 25.6 years. The average of farmer's dependents was 2.64 people with a range of 1-4 people. In terms of farmers' status, 35.71% are residents, 16.67% residents from outside the district and 47.62% immigrant from Java. Most farmers had their own land varies between 1 and 3 ha, with the average of 1.43 ha. However, there were some of the farmers (11.9%) did not own the land, so they cultivated other farmers' land using profit-sharing system. The condition of the formal education obtained by farmers in this area was mostly elementary school graduates and below, i.e., did not complete elementary school (9.52%) and completed elementary school (38.1%), completed junior high school (23.81%), high school (21.43%), and college level (7.14%).

To explain the factors influencing the probability of farmers applying high-yielding varieties in rice farming on tidal land in South Kalimantan, logistic regression was used. The stages were carried out through several statistical tests, namely model suitability, simultaneous test, partial test, and model goodness test, as well as the formation of estimation parameters and binary logistic regression models.

Goodness of Fit of the Model test was used to see the suitability of the model whether all predictor variables can be used to form the intended model. Based on the Hosmer-Lemeshow Test (Table 2), it showed that the Chi-square value was 8.074 with a significance value of 0.426 (0.426 > 0.05). This situation concluded that the null hypothesis (H_0) could not be rejected. This situation can be concluded that by using a 95% confidence level, the empirical data obtained was in accordance with the model.

Table 2 – Chi-square value at Hosmer and Lemeshow Test

Hosmer and Lemeshow Test			
Step	Chi-square	df	Sig.
1	13.274	8	.103

To measure how much the variation in the response variable (dependent) can be explained by the variation in the value of the predictor variables, the coefficient of determination, R^2 was used. This condition is seen from the value of Cox & Snell R^2 which was 0.436 and Nagelkerke R^2 which was 0.582 (Table 3). This means that 58.2.5% of the variation in the predictor variables can explain the variation in the response variable, while the remaining 47.8% was explained by other variables not included in the model.

To find out the effect of the predictor variables on the response variable simultaneously can be done by using the likelihood ratio test. In the likelihood ratio test, a model consisting of all explanatory variables will be compared with a model without explanatory variables or only consisting of constants or intercepts. Based on the Omnibus Test of Model Coefficients (Table 4), it shows that the Chi-square value was 34.386 with a significance value of 0.000

(0.000 <0.05), so H_0 was rejected. This situation leads to the conclusion that using a confidence level of 95%, the effect of all the predictor variables simultaneously had a significant effect on the response variable.

Table 3 – Determination Coefficient Cox & Snell R^2 and Nagelkerke R^2

Model Summary			
Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	50.017[a]	.424	.565

a. Estimation terminated at iteration number 20 because maximum iterations have been reached. Final solution cannot be found.

Table 4 – Omnibus Tests of Model Coefficients

Omnibus Tests of Model Coefficients				
		Chi-square	df	Sig.
Step 1	Step	34.386	6	.000
	Block	34.386	6	.000
	Model	34.386	6	.000

Partially Parameter Test was used to see the significance of the parameter $\hat{\beta}_i$ in partially influencing the response variables contained in the model. Testing the significance of the coefficient $\hat{\beta}_i$ partially using the Wald test. Data processing showed that there are three predictor variables that significantly affect the response variable, namely variable X_1 (production), X (market); and X_5 (farmers' experience). The Wald stat value for each predictor variable X_1 was 5.454 (Sig. 0.02); X_2 was 8.388 (Sig. 0.004); and $X_{5.2}$ (Sig. 0.028). Meanwhile, variables X_3 (status of farmers) and X_4 (land area) had no significant effect. The Wald stat value for X_4 was 1.349 (Sig. 245), and $X_{5.1}$ (Sig. 0.999). More clearly can be seen in Table 5.

Table 5 – Parameter estimation

Variables in the Equation						
		B	S.E.	Wald	df	Sig.
Step 1[a]	Production (1)	1.951	.824	5.603	1	.018
	Market (1)	2.196	.756	8.441	1	.004
	Farmer's status (1)	-.693	.800	.750	1	.386
	Land (1)	.221	.769	.082	1	.774
	Experience			5.447	2	.066
	Experience (1)	20.472	19477.620	.000	1	.999
	Experience (2)	1.779	.762	5.447	1	.020
	Constant	-2.392	.861	7.718	1	.005

a. Variable(s) Production entered on step 1: High yield production, High market, Migrant status, Land, Experience.

Based on the results of data processing using SPSS 24 software, logistic regression parameter estimates were obtained (Table 4), so the model can be written as follows:

$$g(x) = -2{,}392 + 1{,}951X_1 + 2{,}196\,X_2 - 0{,}693X_3 + 0{,}221X_4 + 20{,}472X_{5(1)} + 1{,}779X_{5(2)}$$

Table 6 – Odd Ratio of each predictor variables

No	Variable	Sig.	Odd Ratio
1.	X_1 (Production)	0.018*	7.034
2.	X_2 (Marker)	0.004*	8.985
3.	X_3 (Farmer's Status)	0.386	0.500
4.	X_4 (Land area)	0.774	1.247
5.	$X_{5(1)}$ (Experience 1)	0.999	777.799.606
6.	$X_{5(2)}$ (Experience 2)	0.020*	5.921

An odds ratio (OR) is a measure of association between an exposure and an outcome. The OR represents the odds that an outcome will occur given a particular exposure, compared to the odds of the outcome occurring in the absence of that exposure. In this study, the OR is a measure to see how much the predictor variable tends to the response variable.

Table 6 shows that the production variable (X_1) had an OR of 7.263. This figure means that the production of superior variety tended to be applied by farmers at 7.26 times. Variable X_2 (Market) showed an OR of 9.115, meaning when there was a guarantee for superior variety output to be marketed then the probability of using superior variety was 9.12 times applied by farmers. Farmers who had long experience ($X_{5.2}$) in rice farming (over 20 years) had a tendency of 5.27 times applying superior variety to their rice farming compared to their counterpart (less than 10 years).

CONCLUSION

The average age of farmers was 48.02 years, with a range of 28-76 years. The average farming experience was 25.6 years. The number of dependents of farmers was between 1-4 people with an average of 2.64 people. In general, the education of farmers was in the low category, namely not completing elementary school (9.52%) and completing elementary school (38.1%). The area of origin of the farmers was 35.71% local, 16.67% residents from outside the district and 47.62% immigrant from Java. The average area of land owned by farmers was 1.43 ha with an area varying between 1-3 ha, but there are also farmers who do not have their own land (11.9%); hence the profit-sharing system was used for rice cultivation.

The predictor variables of production, market, and experience have a significant effect on the response variable for the adoption of superior variety. Meanwhile the variables of migrant status and land area have no significant effect.

High production of superior variety shows a probability of 7.26 times applied by farmers. Meanwhile, the existence of a market for superior variety shows 9.12 times to be adopted, and farmers who have long experience tends to use superior variety 5.27 times compared to farmer who have less experience.

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