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Analysis of farmers' preferences in choosing horticultural crops in Gowa Regency, Indonesia: Fact finding from binary logistic regression analysis

Análisis de las preferencias de los agricultores en la elección de cultivos hortícolas en Gowa Regency, Indonesia: Resultados del análisis de regresión logística binaria

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Farmers' preferences in choosing horticultural crops.
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ABSTRACT

This study examines the preferences of farmers in choosing horticultural commodities. The number of respondents was 70 farmers selected using a random sampling technique, and the data were analyzed using binary logistic regression. The results showed that farmers' preferences in conducting horticultural farming in Tombolopao District, Gowa Regency (Indonesia), included cabbage, potato, tomato, mustard greens, onion, carrot, chilli and broccoli. The results of the binary logistic regression showed that the potato commodity was the main preference of farmers, as evidenced by a significant value in the Wald test of 0.001. The potato commodity has an odds ratio value of 0.022 with an estimated value of -3.824. This indicates a negative correlation between the potato variable and farmers' preferences. This means that probability of farmers choosing other commodities instead of potatoes is very low, at only 0.022%. This also provides evidence that the decision to grow potatoes is strongly favored, making potatoes a mainstay commodity on their farms. Evidence from the field indicates that farmers prefer potatoes due to their higher and more stable prices, greater durability, consistent market availability, and higher income compared to other crops.

Additional key words: farm planning; agricultural decision-making; potato; agriculture in Indonesia.

RESUMEN

Este estudio examina las preferencias de los agricultores al elegir productos hortícolas. El número de encuestados fue de 70 agricultores seleccionados mediante una técnica de muestreo aleatorio, y los datos se analizaron mediante regresión logística binaria. Los resultados mostraron que las preferencias de los agricultores al realizar actividades hortícolas en el distrito Tombolopao, regencia de Gowa (Indonesia), incluyeron repollo, papa, tomate, mostaza, cebolla, zanahoria, ají y brócoli. Los resultados de la regresión logística binaria mostraron que el producto de papa fue la principal preferencia de los agricultores, como lo demuestra un valor significativo en la prueba de Wald de 0,001. El producto de papa tiene un valor de la razón de odds 0,022 con un valor estimado de -3,824. Esto indica una correlación negativa entre la variable papa y las preferencias de los agricultores. Esto indica que la probabilidad de que los agricultores elijan otros productos productos en lugar de papa es muy baja, de solo 0,022%. Esto también proporciona evidencia de que la decisión de cultivar papa es fuertemente favorecida, convirtiendo las papas en un producto básico en sus explotaciones. La evidencia de campo indica que los agricultores prefieren las papas debido a sus precios más altos y estables, mayor durabilidad, disponibilidad constatnte en el mercado y mayores ingresos en comparación con otros cultivos.

Palabras clave adicionales: planificación de la finca, toma de decisiones agrícolas; papa, agricultura en Indonesia.

INTRODUCTION

One of the sectors that has received significant attention in national development is agriculture, especially in the management and utilization of strategic products, particularly those related to food and horticultural commodities (Isbah and Iyan, 2016). The development of horticultural products is essential for both the Indonesian and global populations. The large number of Indonesian consumers presents a potential opportunity for the domestic market if promotional efforts focus on increasing the consumption of horticultural products, thereby enhancing awareness, appreciation, and living standards (Pitaloka, 2017). Additionally, horticultural products are valuable commodities due to their significant contribution to national policy (Sarvina, 2019). Horticulture is the most widely practiced agricultural subsector, as evidenced by the number of farmers engaged in horticulture compared to other subsectors. According to data from the agriculture and food sector, horticulture occupies a land area of 6,449,758 ha, with 71 horticultural commodities currently cultivated (Tania *et al*., 2023). Horticultural products such as vegetables and fruits are among the most important commodities for meeting the population’s needs (Istiqomah *et al*., 2017). Notably, horticultural crops are strategic and essential as basic food sources, such as potatoes (Rumallang, 2019).

Horticultural commodities are superior suitable for development in several of Indonesia with high altitudes and tropical climates (Humaidi *et al*., 2020). Among the many technologically, economically, socially, and environmentally options are vegetables such as chillies, shallots, potatoes, cabbage and tomatoes, mustard greens, spring onions, and similar crops (Krisnohadi and Riduansyash, 2015). Based on SPH data collection and analysis in 2021, total production of horticultural crops, including vegetables, was 14,803,776 t, representing a 4.77% decrease from 2020. Five key vegetable types contributed significantly: shallots (13.54%), cabbage (9.69%), bird's eye chillies (9.37%), potatoes (9.19%), and large chillies (9.19%). In contrast, the remaining 20 species produced approximately 9.00% each, accounting for a combined total of 49.02% (Kementerian Pertanian, 2021).

South Sulawesi Province is one of Indonesia’s highland horticulture producers. Key horticultural centers include Gowa, Enrekang, Bantaeng, and Jeneponto Regencies (BPS Provinsi Sulawesi Selatan, 2021). Gowa Regency, located in southern South Sulawesi, has established horticulture as a leading agricultural activity, particularly in Tinggimoncong and Tombolopao District (Rumallang and Akbar, 2021). The most commonly cultivated commodities in Tombolopao Subdistrict are potatoes, cabbage, mustard greens, tomatoes, chillies, carrots, and leeks (Rumallang *et al*., 2023). This is supported by Tombolopao’s location at 1,500 m a.s.l., with an average temperature of 16-20°C (BPS Kabupaten Gowa, 2022).

Farmers' preferences in selecting crops significantly influence the success of their agricultural programs (Aravindakshan *et al*., 2021). Nidumolu *et al*. (2022) emphasized that such preferences help explore the impacts of crop choices on income, labor, input use, and market access, as well as the trade-offs involved in different agricultural intensification strategies.

Farmers in Tombolopao determines which commodities are to grow each season. Accurate crop selection is critical, as income depends on market prices at time of harvest (Rumallang *et al*., 2020). Although farmers often show great enthusiasm and optimism at planting, these expectations are not always met at harvest due to price fluctuations, leading to potential losses. Therefore, crop choice preferences must be aligned with economic and market realities.

In recent years, several studies in Indonesia have addressed farmers’ preferences. For example, Effendy *et al*. (2020) examined the adoption of Jajar Legowo rice planting technology in Bogor Regency. Similarly, Prayoga *et al*. (2018) analyzed preferences for superior rice varieties in Cilacap Regency. Purba *et al*. (2022) investigated farmers' attitudes and preferences toward improved rice seeds in Langkat Regency, West Sumatra. Naufal and Chofyan (2022) explored the development of Minapadi cultivation based on farmers’ preferences in Cikurutug.

Most previous studies have focused on staple food commodities. In contrast, the present study emphasizes highland vegetable farming preferences, offering a novel contribution. Additionally, the use of binary logistic regression—a tool still rarely applied in preference studies—adds further innovation to this research.

MATERIALS AND METHODS

Location and time of the research

This research was conducted in Tombolopao District, Gowa Regency, based on the consideration that the area is a center of horticultural production, especially for vegetable crops. The research was conducted over a period of four months, from January to April 2024. The data collected in the field were quantitative primary data obtained through structured interview techniques using questionnaires administered to farmers in Tombolopao District, Gowa Regency.

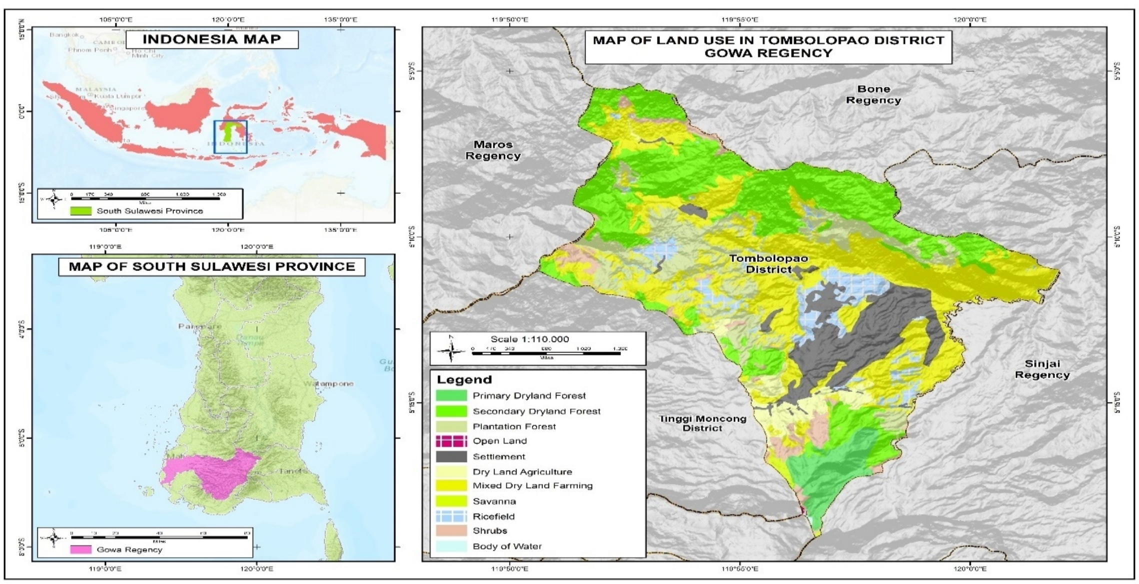

Figure 1. Map of the research location in Tombolopao District.

Tombolopao sub-district, located in Gowa Regency, South Sulawesi, Indonesia, is an important area for horticultural agriculture, particularly due to its favorable edaphoclimatic conditions. Located at an altitude of 1,500 m a.s.l., Tombolopao has a cool tropical mountain climate, with average temperatures ranging from 16 to 20°C. The area receives annual rainfall of around 2,000 to 2,500 mm, creating an ideal environment for highland horticultural crops. The soil type is mostly Andosol, which is rich in organic matter and slightly acidic, thereby increasing its suitability for the cultivation of various horticultural crops such as potatoes, cabbage, carrots, mus-

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tard greens, tomatoes, chilies, broccoli, leeks and others (Safir *et al*., 2024) (Tab. 1).

Table 1. Geographical coordinates and edaphoclimatic description of Tombolopao District, Gowa Regency, Indonesia.

Attribute	Details
Geographical coordinates	Latitude: 3.1393° S, Longitude: 119.6672° E
Altitude	1,500 meters above sea level
Temperature	Average temperature: 16-20°C (cool tropical highland)
Precipitation	Annual precipitation: Approximately 2,000-2,500 mm/year
Soil types	Predominantly Andosols, rich in organic matter, slightly acidic
Dominant production systems	Vegetable farming (potatoes, cabbage, tomatoes, etc.), focused on highland crops

Population and sample

The population in this study consisted of all farmers engaged in vegetable cultivation in Tombolopao District, Gowa Regency, totaling 703 farmers. Based on the results of the initial survey, the number of farmers actively engaged in vegetable farming represents the defined population.

This study used a simple random sampling technique by selecting 70 respondents, which corresponds to 10% of the total population. The sample size determination follows the guideline by Arikunto (2016), who states that if the population exceeds 100 individuals, then a sample of 10% can be taken.

Conceptual framework and research construction

The dependent (bound) variable in this study is farmers' preference, and the eight horticultural crops serve as the independent variables (Fig. 2).

The conceptual framework is developed to guide the researchers in collecting and analyzing field data using a binary logistic regression approach. These variables are hypothesized to influence farmers' preferences in horticultural farming in Tombolopao District, Gowa Regency.

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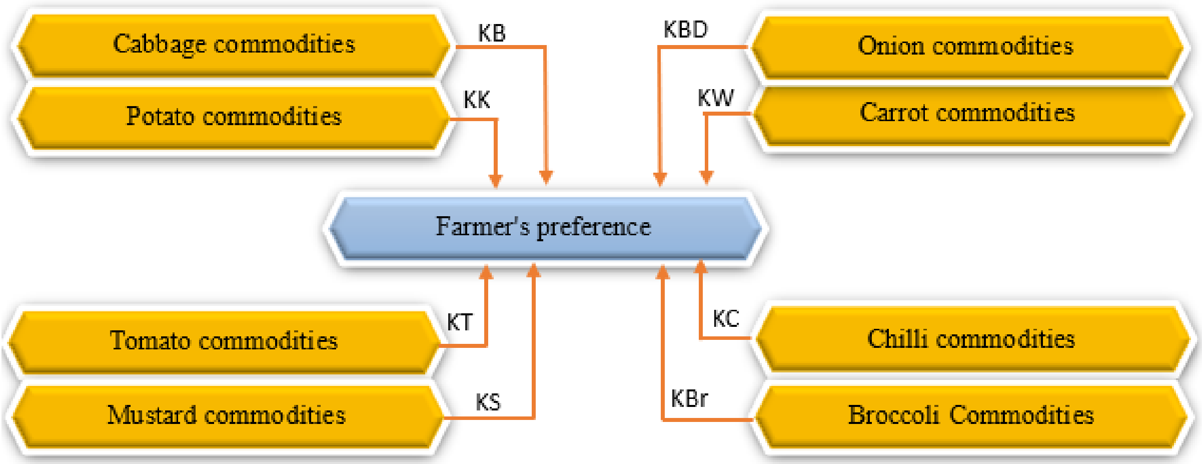

Figure 2. Conceptual framework of farmers' preference research in Gowa Regency.

Data analysis

In this study, binary logistic regression was used to analyze the factors that influencing farmers' preferences in choosing horticultural commodities. This model is useful for predicting the probability of an event occurring based on relevant independent variables.

Table 2 summarizes the main elements of the binary logistic regression model used, including the logit equation, parameter estimates, odds ratio, and statistical tests applied to evaluate model significance and goodness of fit. Each aspect is presented with its respective mathematical foundation to clearly demonstrate how the methodology supports the analysis of farmers' preferences.

Table 2. Mathematical description of binary logistic regression model.

Aspects	Description
Logistic regression model	Logistic regression models are used to predict the probability of a binary outcome
Logit equation	$g(P)=\ln\lfloor \frac{\pi(P)}{1-\pi(P)} \rfloor \beta_0+\beta_1 \beta X_1+\beta_2 X_2+\ldots\beta_n X_n$
Parameter estimation (β)	The parameter β is estimated using the Maximum Likelihood Estimation (MLE) technique
Opportunity ratio (OR)	The odds ratio indicates the relationship between the independent variable and the outcome, calculated as Exp*(βi)*
The Wald test	Test the significance of each independent variable: $W=\frac{\widehat{\beta i}}{SE}$

Likelihood ratio test (LRT)	Tests the overall model significance: $H_0 : \beta_1 = \beta_2 = \cdots = \beta_n = 0$, evaluated using the G statistic and x^2 table

Variables, measurement and data types

This study uses one dependent variable and eight independent variables to analyze farmers' preferences in choosing agricultural commodities for cultivation. The dependent variable is farmers' preference, measured dichotomously: a value of 1 is assigned if the farmer chooses to cultivate the crop, and 0 if not.

The independent variables represent eight vegetable commodities and are measured based on the frequency of selection using a categorical scale: 1 = frequently selected, 2 = sometimes selected, 3 = never selected. For data analysis, all these variables are treated dichotomously.

- The first independent variable is cabbage, indicating the frequency with which farmers choose to cultivate it.
- The second is potato, reflecting its status as a primary commodity.
- The third variable, tomato, evaluates the intensity of tomato cultivation.
- The fourth, mustard greens, denotes the frequency of mustard cultivation.
- The fifth, onion, assesses how often farmers choose onions.
- The sixth, carrot, identifies its presence among preferred crops.
- The seventh variable is chili, which examines its role in farmers' crop selection.
- Finally, the eighth is broccoli, reflecting preferences for this commodity.

Through this model, the research aims to determine the influence of each crop on farmers' decision-making and identify the trends in vegetable selection based on cultivation frequency.

RESULTS AND DISCUSSION

Respondent characteristics

The characteristics of the respondents refer to the demographic and socioeconomic attributes that define farmers and support their agricultural activities (Arita *et al*., 2022). These include age, education, number of family dependents, and farming experience (Setiyowati *et al*., 2022).

The age of the respondent farmers in the study area ranged from 20 to 61 years. According to Susanti *et al*. (2016), the productive age for farmers is between 20 and 59 years. Based on this definition, 65 respondents were within the productive age category. This suggests that age plays a critical role in the success of agricultural operations (Suresh *et al*., 2021; Akbar *et al*., 2024).

In terms of farming experience, the respondents had between 5 and 30 years of experience, indicating a strong foundation for horticultural production and informed decision making in crop selection.

The number of family dependents also plays an important role in farm labor availability. Farmers with more family dependents are more likely to rely on internal labor, reducing the need to hire external workers. In contrast, those with fewer dependents often incur labor costs. In this study, 30 farmers had 1-2 dependents, indicating limited availability of family labor (Rumallang and Akbar, 2021).

Regarding education level, respondents were classified into four categories: no schooling, elementary school, undergraduate, and postgraduate. The majority had elementary education (58 respondents), followed by those with no formal education, undergraduate, and postgraduate degrees.

Model summary and model fit evaluation

Model fit test

To assess the calibration of the logistic regression model, the Hosmer and Lemeshow (H-L) test was employed. This test evaluates how well the model's predicted probabilities match observed outcomes—whether farmers choose to engage in farming activities (preference = 1) or not (preference = 0).

The H-L test yielded a Chi-square value of 4.751 with 8 degrees of freedom and a significance level (Sig.) of 0.784. This *P*-value, being greater than 0.05, suggests that there is no statistically significant difference between observed and predicted outcomes. Therefore, the model is considered to have a good fit.

This result indicates that the model is well specified, and the predicted probabilities of farmers' preferences align with actual data. The high *P*-value (0.784) also shows that there is no major model misspecification, affirming its reliability in predicting cultivation decisions based on commodity preferences.

Cox & Snell R-square and Nagelkerke R-square test

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The logistic regression model in this study aims to identify the key factors influencing farmers' crop selection decisions. Farmers' preference was measured as a binary dependent variable: 1 = active farming decision, 0 = no farming decision.

The model's –2 Log Likelihood value is 34.510, indicating substantial improvement compared to the null model. This decrease suggests that including commodity variables significantly improves explanatory power.

Two pseudo R^2 values were used to assess model strength:

- Cox & Snell R^2 = 0.373: Approximately 37.3% of the variance in farmers' preferences is explained by the model. However, this value is conservative, as it does not reach the theoretical maximum of 1.
- Nagelkerke R^2 = 0.605: This adjusted value suggests that 60.5% of the variance in farmers' preferences is explained by the model.

These results confirm that the model is statistically robust and appropriate for analyzing decision-making patterns among farmers.

Likelihood ratio test (LRT)

The G-test (likelihood ratio test) compares the full model (with predictors) to the base model (without predictors). The Chi-square value was 32.682 with 8 degrees of freedom, and a significance value of 0.000.

Because this P-value is less than α=0.05, the test indicates that the model is statistically significant, and the eight independent variables meaningfully contribute to explaining farmers' preferences.

Partial test (test Wald)

The Wald test assesses the statistical significance of each individual parameter in the model by squaring the radio of the parameter estimate β to its standard error.

Using a significance level of α=0.05, the rule is that H_0 is rejected if $W > \chi^2(\alpha, df)$ or if the significance value is less than α. The test results are presented in table 3, showing which commodities significantly influence farmers' cultivation preferences.

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Table 3. Wald test results of the influence of independent variables on farmers' preferences.

Independent variable	B	S.E.	Wald	df	Sig.	Exp(B)
Cabbage commodities	2.135	1.299	2.701	1.000	0.100	8.459
Potato commodities	-3.824	1.103	12.010	1.000	0.001**	0.022
Tomato commodities	-1.095	1.065	1.058	1.000	0.304	0.334
Mustard commodities	-1.000	1.198	0.697	1.000	0.404	0.368
Onion commodities	-1.132	0.728	2.420	1.000	0.120	0.322
Carrot commodities	-1.364	1.210	1.271	1.000	0.260	0.256
Chilli commodities	1.363	1.114	1.496	1.000	0.221	3.907
Broccoli commodities	-0.820	1.361	0.363	1.000	0.547	0.440
Constant	11.710	4.420	7.020	1.000	0.008	121795
Dependent variable: farmers' preferences						

** Significant at 95% confidence level.

Based on the Chi-squared table calculation at a significance level α=0.05, the critical Chi-squared value is 3.841. According to the findings shown in table 3, only one independent variable exhibits a statistically significant influence on the dependent variable — the potato commodity. This observation is supported by the Wald test results, where the calculated test statistics exceeded the critical value of 3.841 and the *P*-value is less than 0.05. Therefore, H_0 is rejected and H_1 is accepted. In contrast, the other independent variables — cabbage commodity, tomato commodity, mustard commodity, onion commodity, carrot commodity, chilli commodity and broccoli commodity — do not have a statistically significant effect on farmers' preferences. Thus, H_0 is accepted and H_1 is rejected for these variables because their Wald statistics are below 3.841 and *P*-value exceed 0.05. By analyzing the regression coefficients in Equation 1, we can determine whether the independent variables have a positive or negative influence on farmers' preferences.

g(P)=

$$g(P) = \ln \lfloor \frac{\pi(P)}{1-\pi(P)} \rfloor 11{,}710 + 2{,}135\,KB - 3{,}824\,KK - 1{,}095\,KT - 1{,}000\,KS - 1{,}364\,KW - 1{,}132\,KBD + 1{,}363\,KC - 0$$

(1)

Interpretation of odds ratio

The odds ratio (OR or Exp(B)) is a quantitative measure used to evaluate the relationship between a causal factor and its effect. It helps determine whether the likelihood of an outcome differs between groups (Chen *et al*., 2010). In logistic regression, the coefficient indicates the expected change in the log odds of the variable for a one-unit increase in the predictor. According to Chen *et al*. (2010), the OR ranges from zero to infinity. The odds ratios in this study are presented in table 3. Below is the interpretation of each:

- The odds ratio for the cabbage commodity is 8.459 with a coefficient of 2.135, indicating a positive association. This suggests that farmers are 8.459 times more likely to choose a commodity other than cabbage, reflecting a tendency away from cabbage.
- The potato commodity has an odds ratio of 0.022 and a coefficient of -3.824, indicating a strong negative correlation. Farmers are very unlikely to choose another commodity over potatoes — only 2.2% probability. This highlights potatoes as the dominant farming choice. Revised to clarify the contrast between OR and farmer behavior.
- For tomato commodity, the odds ratio is 0.334 with a coefficient of -1.095, indicating a lower likelihood of choosing another commodity over tomato.
- The odds ratio for mustard commodity is 0.368, showing a similar negative relationship.
- The onion commodity has an OR of 0.322, again pointing to a negative preference for alternatives.
- For carrot commodity, the odds ratio is 0.256, reflecting low likelihood of choosing other crops, although not statistically significant.
- The chili commodity has an odds ratio of 3.907 with a positive coefficient, suggesting farmers are almost four times more likely to choose commodities other than chili. This clarified potential confusion between “preference” and “likelihood to switch”.
- Lastly, broccoli commodity has an odds ratio of 0.440, suggesting a modest negative preference.

Of the eight independent variables, six show negative correlations with farmers' preferences, and two show positive correlations. A negative correlation indicates farmers tend to stick with their current crops, while a positive correlation suggests an openness to alternative commodities. The potato commodity is the only statistically significant predictor at the 95% confidence level, reinforcing its role as the primary preference among farmers.

This aligns with findings by Rumallang *et al*. (2023) and Adawiyah *et al*. (2022), who highlight potatoes as economically profitable and stable, with consistent market demand and favorable farming conditions. Potatoes also offer a longer post-harvest shelf life, allowing farmers to store and sell them strategically. Additionally, the local climate and soil support high productivity, and farmers possess the experience and skills necessary for optimal potato cultivation (Rumallang *et al*., 2025).

Infrastructure and market access further contribute to the success of potato farming, while high consumer demand ensures market certainty for this crop.

CONCLUSION

The study found that farmers in Tombolopao District, Gowa Regency, cultivate various commodities including cabbage, potato, tomato, mustard, leek, carrot, chili, and broccoli. Binary logistic regression analysis identified potatoes as the main farming preference, evidenced by a Wald significance of 0.001 and an odds ratio of 0.022, indicating a strong negative correlation. This implies that farmers are unlikely to switch from potatoes to other crops — reinforcing the crop's economic and practical advantages.

Recommendations include introduction of high-yield, disease- and climate-resistant potato varieties; continuous training in sustainable and efficient cultivation techniques, and improved market access and distribution systems to ensure profitability and sustainability.

Conflict of interest: Tall authors declare no conflict of interest that could compromise the validity of the study.

Author's contributions: A. Rumallangg: drafted, conceptualization; A. Akbar: drafted, methods, discussion and conclusion; N. Mappa: data collectiion and processing; A. Halil: validation and interpretation. All authors approved the final manuscript.

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Open source research data repository: The dataset is available on reasonable request.

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