Determining Factors for Farmers' Decision in Crop Selection (Case Study: Post-Harvest Tobacco Cropping Pattern and Red Chili Cropping Pattern in Jember Regency)

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Abstract: - This research aims to analyze the determining factors in the selection of planting patterns for post-harvest tobacco and red chili. The study was conducted in the Ambulu District and Wuluhan District, Jember Regency, Indonesia, as both areas are centers for post-harvest tobacco and red chili cultivation. The research utilized a sample size of 50 respondents from the Ambulu District and 50 respondents from the Wuluhan District, totaling 100 respondents. The sampling technique employed was snowball sampling. Data analysis tools included binary logit regression, R/C ratio, and independent t-test. The research findings indicate that the determining variables influencing farmers' decisions in selecting planting patterns are land area, income, and farming experience. Based on financial analysis, the income of post-harvest tobacco farmers is greater than that of red chili farmers. Furthermore, there is a significant difference between the income of post-harvest tobacco farmers and red chili farmers.

Key-Words: - Determining variables, Farming patterns, Income disparity, Agricultural development, Farmers' decision.

Received: June 21, 2023. Revised: October 24, 2023. Accepted: November 26, 2023. Available online: December 22, 2023.

1 Introduction

The focal point of national development is the economic sector. Policy leadership will be the key to any successful development strategy, particularly if these efforts are to contribute to economic and social transformation, [1]. This means that the economic sector serves as the primary driver of national development. The emphasis lies on the interconnection between the economic, industrial, and agricultural sectors. This implies that the agricultural sector still plays a significant role in Indonesia's economy. The agricultural added value model shows that factors like education and skills, economic growth, government spending, non-farming business income, the number of people living in rural areas, and technology have a noticeable impact on the value generated by agriculture, [2]. This is because agriculture remains a major livelihood for a large portion of the population, contributes significantly to the gross domestic product, provides diverse food menus, supports both upstream and downstream industries, boosts farmers' income, and continues to foster entrepreneurial opportunities, as well as contributes a substantial amount of foreign exchange earnings, [3].

The development of agriculture is aimed at establishing resilient, advanced, and efficient agricultural practices. The objective of agricultural development is to increase production yield and quality, enhance the income and living standards of farmers, livestock breeders, and fishermen, expand job opportunities and entrepreneurial prospects, support industrial growth, and boost exports, [4].

While initially the focus of agricultural development was on increasing rice commodity production, now that Indonesia has achieved rice self-sufficiency, [5], it is time to explore other agricultural commodities. Among the range of food commodities, the immediate goal is to achieve self-sufficiency in horticulture and secondary crops (*palawija*), as these commodities are crucial sources of carbohydrates, particularly for achieving food self-sufficiency, [6].

In efforts to enhance agricultural production and farmers' income, the selection of crop types and planting patterns throughout the year requires careful attention and should be linked to marketing strategies, [7]. If the goal is to implement an optimal planting pattern that maximizes farmers' net income, the choice of crop types and planting patterns should be dynamically adjusted based on environmental conditions, market demand, and prices.

The selection of crop types for each year is highly important due to the dependence of crops on their environment. By understanding the land's environmental conditions, suitable crop types for that land can be determined. Typically, several types of crops are suitable for a piece of land. This offers the advantage of choosing from various crop alternatives for cultivation or engaging in intercropping. Avoiding mismatches between crops and their environment is crucial, as this can not only decrease production but also lower the quality of output, [8].

Jember Regency in East Java Province is an agrarian area dominated by the agricultural sector. This sector contributes 40% of the workforce absorption. One of the reasons is its favorable geographical conditions that support its growth and development. This is evidenced by its significant contribution to the Regional Gross Domestic Product (GDP) at 26.55%, [9].

Tobacco is a distinctive, suitable, and dominant crop in Jember Regency, [10], particularly in the broader Besuki region. Many farmers cultivate this crop, which yields high returns. In terms of cultivation timing, Indonesian tobacco can be categorized into two types: post-harvest (*na oogst*) used as raw materials for the cigar industry, and smallholder tobacco (*voor oogst*) which is tobacco for raw materials of cigarettes, [11]. Post-harvest tobacco is planted at the beginning of the dry season and harvested at the start of the rainy season, while smallholder is the opposite. The primary areas for post-harvest tobacco cultivation are: Wuluhan, Balung, Ambulu, Panti, Tempurejo, Jenggawah, Rambipuji, Puger, Patrang, Sumbersari, Ajung, and Mumbulsari Districts, [12].

Tobacco farming significantly contributes to the national economy. Furthermore, it provides a larger workforce compared to other agricultural commodities and generates higher income for farmers, [13]. However, the prospects for tobacco farming are uncertain due to regulations on "smoking bans" which are government regulations aimed at reducing tobacco consumption, and the uncertain prospects for tobacco farming could be influenced by the impact of these policies on the tobacco market and the livelihoods of farmers.

Understanding the relationship between crop pattern selection and profitability is a crucial aspect of agricultural management. This study aims to provide scientific information on: (1) the determining variables of crop pattern selection, and (2) the income difference between post-harvest tobacco planting patterns compared to non-post-harvest tobacco planting patterns. As a comparative benchmark, horticultural crops with the highest economic value, specifically red chili peppers, were chosen, based on the findings of, [14], which indicated that red chili pepper cultivation had the highest spread across 19 out of 31 districts. Moreover, according to, [15], this large red chili cultivation could yield higher income compared to other horticultural crops.

2 Methods

This research was conducted in the Ambulu and Wuluhan Districts of Jember Regency, Indonesia. The selection of these research locations was deliberate, taking into consideration that these two areas have different cropping patterns. Some farmers adopt the post-harvest tobacco planting pattern, while others follow the red chili pepper planting pattern. According to, [16], both Ambulu and Wuluhan Districts are centers for post-harvest tobacco as well as red chili pepper cultivation in Jember Regency. Farmers plant post-harvest tobacco and red chili peppers in the second planting season. Therefore, in the research locations, there are two planting patterns: rice -> post-harvest tobacco -> corn; and rice -> red chili peppers -> corn. Rice and corn farming efforts are assumed to yield the same results, so only the comparison between post-harvest tobacco and red chili peppers is analyzed. Economically, these crops are key income sources for local farmers and boost the regional economy. Post-harvest tobacco is a traditional cash crop, supporting many households. In addition, red chili peppers have gained popularity, contributing to local income and the food industry.

Socially, these crops hold cultural significance, shaping community identities. Tobacco farming is deeply rooted in local traditions, while red chili peppers are integral to local cuisine and celebrations. Environmentally, there is a growing focus on sustainable practices. While tobacco farming has raised environmental concerns, red chili pepper cultivation offers an eco-friendlier alternative. Therefore, farmers are increasingly adopting sustainable approaches.

This study employs the snowball sampling technique. Snowball sampling is a sampling method that starts with a small number of participants and then expands, [17]. The total sample size in this research consists of 100 respondents, with 50 respondents being post-harvest tobacco farmers and 50 respondents being red chili farmers. The data sources include both primary and secondary data. Primary data refers to information collected directly from the field, [18], [19] and is obtained from firsthand sources, such as individuals, typically gathered through interviews or questionnaire responses conducted by the researcher, [20]. Data collection methods involve using primary data obtained through observation, questionnaires, and interviews with farmers. Secondary data sources are official documents issued by institutions such as the Central Bureau of Statistics (BPS) and the Department of Agriculture for Food Crops, Horticulture, and Plantations. The research focuses on determining the variables that influence farmers' decisions in choosing their agricultural commodities. The data analysis tools employed in this study include logistic binary regression analysis and independent t-test.

2.1 Logistic Regression Binary Analysis

Regression analysis is a technique used to test the presence or absence of an influence between one variable and another variable, expressed in the form of a regression equation, [16]. Ordinary regression analysis cannot be used to model the relationship between a binary response variable and multiple predictor variables. One approach that can be used to address this issue is logistic regression analysis.

Logistic regression is a data analysis technique that employs mathematics to uncover the relationship between two data factors. It then uses this relationship to predict the value of one factor based on the other. Predictions typically yield limited outcomes, such as yes or no, [21].

The statistical analysis used in this research is logistic regression analysis. Logistic regression analysis tests whether the probability of the dependent variable occurring can be predicted by the independent variables. Logistic regression analysis does not require a normal distribution in the independent variables, [22]. Therefore, logistic regression analysis does not necessitate classic assumption tests, such as tests for normality, heteroskedasticity, and classical assumptions on the independent variables.

The binary logistic regression equation in this study is as follows:

$$Y = a + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 X_6 + \beta_7 X_7 + \beta_8 D_8 + \beta_9 D_9 + e$$

Where:
Y = Farmer's decision probability (1 = post-harvest tobacco planting pattern, 0 = other than post-harvest tobacco planting pattern, specifically red chili planting pattern)
a = Constant
X_1 = Land area (hectares)
X_2 = Income (Rupiah)
X_3 = Capital availability (Rupiah)
X_4 = Farmer's age (years old)
X_5 = Education (years)
X_6 = Farming experience (years)
X_7 = Number of dependents (people)
D_8 = Land ownership (1 = owned, 0 = sharecropping)
D_9 = Government policy (1 = supportive, 0 = other)
β_1 through β_9 = Regression coefficients
E = Error

Logistic regression analysis includes several tests, namely: Overall Model Fit Assessment, Goodness of Fit Test, Nagelkerke's R Square (Coefficient of Determination), and Partial Test (Wald Test), [22]. Overall model fit is used to determine if all independent variables affect the dependent variable. If the p-value (sig) ≤ 0.05, then overall, the independent variables are statistically significant in explaining the dependent variable. The log-likelihood test is used to assess the model's fitness. If the log-likelihood value for block number 0 is greater than the log-likelihood value for block number 1, then the regression model is considered good. The goodness of fit test is utilized to evaluate the suitability or appropriateness of the logit model used (Nagelkerke's R Square, Hosmer, and Lemeshow's Test, and Classification Plot). Meanwhile, Odds Ratio is employed to understand the extent to which farmers' decisions are influenced by factors affecting the decision. Wald test or partial test is conducted to determine the individual effect of variables by comparing the Wald statistic value to the chi-square distribution. If the p-value (sig) $\leq$ 0.05, then the independent variable significantly affects the dependent variable.

2.2 R/C Ratio Analysis

The Return/Cost (R/C) ratio analysis in this study is used to determine the income of the post-harvest tobacco planting pattern and the red chili planting pattern. The R/C ratio measures operational efficiency, which is the comparison between business revenue (R) and total cost (TC). Farming is considered efficient (profitable) if the R/C value is greater than 1, [23], [24].

Mathematically, the R/C ratio is formulated as follows:

$$R/C = TR/TC$$

Where:
R/C = Return per Cost Ratio (total revenue / total cost)
TR = Total Revenue
TC = Total Cost

Total revenue for a company (producer) is the product of the unit price of the product and the quantity of products sold, [23], [24]. Thus, total revenue is obtained using the formula:

$$TR = P \times Q$$

Where:
TR = Total Revenue
Q = Total Quantity (Number of Products)
P = Price of the Product

Cost from the perspective of a producer or supplier encompasses all expenses incurred by the producer to produce a product. To calculate the total cost expended, the following mathematical formula is used, [3], [25]:

$$TC = TFC + TVC$$

Where:
TC = Total Cost
TVC = Total Variable Cost
TFC = Total Fixed Cost

2.3 Independent t-test

The independent t-test is employed to determine the difference in income between post-harvest tobacco farmers and red chili farmers using the SPSS software application. The population variances of income from the post-harvest tobacco planting pattern and the red chili planting pattern can be assessed through the significance (sig) value in Levene's test, [22]. If the sig value is > 0.05, then the population variances are assumed to be equal (equal variances assumed). Conversely, if the sig value is $\leq$ 0.05, then the variances are assumed to be different (equal variances not assumed). Thus, the research hypotheses are as follows:

H_0: There is no significant difference in income between post-harvest tobacco farmers and red chili farmers.
H_1: There is a significant difference in income between post-harvest tobacco farmers and red chili farmers.

3 Results and Discussion

3.1 Factors Influencing Farmers' Decision in Choosing Planting Patterns

Farmers' decisions in choosing planting patterns are influenced by various factors. The factors strongly suspected to affect farmers' decisions in selecting planting patterns in this study are analyzed using a binary logistic regression model. This analysis aims to examine the likelihood of variables such as land area, income, capital, farmer's age, education, farming experience, number of family dependents, land ownership, and perception of government policy affecting farmers' decisions, coded as (1) if farmers choose the post-harvest tobacco planting pattern and (0) if farmers do not choose the post-harvest tobacco planting pattern (red chili planting pattern). The results of this analysis can be seen in Table 1.

Based on the Omnibus Test of Model Coefficients which is used to assess whether the combined set of independent variables has a statistically significant influence on farmers' decisions regarding planting patterns, with a significance value of 0.000 < 0.05, it can be concluded that collectively, the examined independent variables are capable of influencing farmers' decisions in selecting planting patterns and can be included in the model. Meanwhile, from the results of the log-likelihood test, it is observed that the log-likelihood value for block number 0 (83.167) is higher than the log-likelihood value for block number 1 (26.138), indicating that the logistic regression model being used is good.

The Nagelkerke R Square (R^2) value obtained is quite high at 0.807. This demonstrates that 80.7% of farmers' willingness or decisions in selecting planting patterns can be explained by factors such as land area, income, capital, farmer's age, education, farming experience, number of family dependents, land ownership, and government policy, while the remaining 19.3% is influenced by other factors outside the model.

Table 1. Results of Logit Analysis on Factors Influencing Farmers' Decisions

Variable	B	S.E	Wald	Sig.	Exp (B)
Land area (X_1)	-22.339	9.086	6.046	.004*)	.200
Income (X_2)	.000	.000	6.491	.001*)	1.000
Capital availability (X_3)	.000	.000	.039	.743	1.000
Farmer's age (X_4)	-.126	.067	.151	.037*)	1.026
Education (X_5)	-.300	.259	1.345	.246	.700
Farming experience (X_6)	-.255	.096	7.047	.008*)	.750
Number of dependents (X_7)	1.331	.692	3.701	.054	3.784
Land ownership (D_8)	.922	2.064	.200	.655	2.514
Government policy (D_9)	-1.639	2.104	.607	.436	.194
Constant	1.366	5.729	.054	.816	3.802
Omnibus Test of Model Coefficients				.000	
Chi-Square Count					57.051
Chi-Square Table					18.307
Chi-Square Table					3.841
-2 Log Likelihood Block Number =0					83,167
-2 Log Likelihood Block Number =1					26,138
Hosmer and Lemeshow Test				.975	
Nagelkerge R Square					.807
Overall Percentage					92.2

The accuracy of the predictive model can be concluded based on the Overall Percentage Model value, which is 92.2%. This leads to the conclusion that the logistic regression model being used is good as it surpasses the 80% threshold. In the Hosmer and Lemeshow Test, the significance value of the model is 0.975, where this value is greater than 0.05. Hence, it can be stated that the used model is capable of explaining or fitting the data.

Land area (X_1) significantly influences farmers' decisions in selecting planting patterns. This is because, according to the farmers, a larger cultivated land area leads to greater production opportunities. These findings are in line with previous research, [26], [27], [28], which state that land area significantly affects farmers' decisions. A larger land area encourages farmers to engage in farming activities, resulting in higher production yields.

Income (X_2) significantly affects farmers' decisions in selecting planting patterns. This is due to the respondents' belief that the post-harvest tobacco planting pattern provides higher economic value or income compared to other planting patterns. This aligns with the research findings by, [29], indicating that post-harvest tobacco farming can yield a net profit of 141.59 million Rupiah per hectare. In contrast, red chili cultivation is reported to yield the highest profits in Jember Regency, [15]; however, according to, [30], the net profit per hectare for red chili cultivation is only 126.68 million Rupiah. Under the assumption of ceteris paribus, meaning the same planting seasons (season 1 for rice and season 3 for corn) yield equal farming results.

The variable of capital availability (X_3) does not significantly influence farmers' decisions in selecting planting patterns. This is because farmers' capital is not only in the form of cash but also includes natural resources. [24], states that farming capital can consist of land, agricultural tools/materials, and credit/cash. Farmers possess capital in the form of agricultural machinery (farm equipment) and leftover fertilizer from previous seasons. These findings are consistent with research by, [31], which shows that key determinants that affect the selection of cropping patterns include the farmer's age, proximity of the farmland to the farmer's home, distance from the farmland to processing facilities, and the maturity of the crops.

Farmer's age (X_4) does not significantly affect farmers' decisions in selecting planting patterns. This is because, according to the farmers, both post-harvest tobacco and red chili planting patterns entail similar risks. Additionally, the ability to engage in farming activities is not solely dependent on age but also the skills, diligence, and determination of the farmers themselves. These findings align with research by, [32], which indicates that age is not a significant consideration for farmers in their farming activities. Both young and elderly farmers are equally capable of engaging in farming effectively.

Education (X_5) does not significantly influence decisions in selecting planting patterns. This is due to the relatively uniform and limited variability in farmers' education levels in the research area, which suggests minimal impact on planting pattern choices. Respondent farmers engaged in post-harvest tobacco farming are not heavily reliant on high levels of education but rather on traditional knowledge passed down through generations and shared experiences with other farmers in their community. These findings are consistent with research by, [26], [33].

Farming experience (X_6) significantly influences farmers' decisions in selecting planting patterns. This is because, for the most part, farmers in the research location rely solely on their experience when making choices and cultivating their crops. Additionally, farmers with more experience tend to make farming decisions more quickly. This contrasts with previous research, such as the findings of, [32].

The number of family dependents (X_7) does not significantly affect farmers' decisions in selecting planting patterns. This is because, according to the farmers, seeking input from their children as family dependents is unnecessary in their farming activities. Farmers only discuss and decide with their spouses when choosing farming commodities. The presence of family dependents or the number of family members only affects the availability of labor within the family. This aligns with the viewpoint of, [31], stating that farmers' decision-making has little to no significant impact on planting pattern choices.

The dummy variable of land ownership (D_8) does not significantly affect farmers' decisions in selecting planting patterns. This is because farmers in the research area tend to focus on commercial aspects, choosing crops that offer the highest income potential, regardless of land ownership status. These findings are in line with the results of previous research, [29], [30], which state that Tembakau Na Oogst farming provides higher profits compared to horticulture, [15]. After selecting the commodity, according to, [3], farmers tend to maximize their production capacity by efficiently managing their farming practices in terms of techniques and resource utilization.

The dummy variable of government policy (D_9) does not significantly affect farmers' decisions in selecting planting patterns. Farmers in their farming activities do not consider the policy restrictions on tobacco circulation. Post-harvest tobacco farmers do not take this government policy into account. According to the respondent farmers, whether or not there is a policy restricting tobacco circulation, they will still engage in tobacco farming. This is because, besides their proficiency in growing tobacco, they also believe that tobacco has historically been a flagship commodity and continues to yield satisfactory results. The land of post-harvest tobacco farmers is of the highest class (Class A). While it can be used for other crops, tobacco is still perceived as the best-performing commodity.

3.2 Farmers' Probability of Choosing the Post-Harvest Tobacco Planting Pattern

According to the logistic regression analysis results, the magnitude of the independent variables' influence can be determined, where the significant determinant factors are land area, income, and farming experience. These probabilities are indicated by the Exp(B) values in Table 1.

The Exp(B) value for the land area variable is found to be 0.200, indicating that for every 1-hectare increase in land area, the likelihood of farmers adopting the post-harvest tobacco planting pattern increases by 20%, assuming all other factors remain constant. This result aligns with the research hypothesis, suggesting that as the farming area expands, the likelihood of higher production increases. This is presumed to impact farmers' inclination to engage in farming. These findings correspond with previous studies, [26], [34], indicating that a larger farming area leads to a greater number of crops cultivated by farmers, potentially resulting in increased production.

The income variable provides farmers with a likelihood of 1.000 toward their decision, indicating that every 1 Indonesian Rupiah increase in income raises the likelihood of farmers engaging in farming by 100%, assuming all other factors remain constant. This research result aligns with the hypothesis that higher farmer income leads to a stronger inclination to engage in farming. This occurs because when farmers earn more, they see farming as financially rewarding and sustainable. With improved financial stability, they invest in better seeds, equipment, and expansion, making farming more attractive and profitable. Increased income also helps them address challenges like weather or pests, strengthening their commitment to farming as a viable profession. This also corresponds with the research of, [35], which states that farmers' decisions in farming take into consideration the potential for higher income from farming activities.

The farming experience variable offers farmers a likelihood of 0.750 toward their decision, indicating that each additional year of farming experience increases the likelihood of farmers engaging in farming by 75.0%, assuming all other factors remain constant. This result aligns with the research hypothesis that longer farming experience enhances farmers' willingness to engage in farming. This research finding also corresponds with the study by, [36], suggesting that farmers with more extensive experience tend to make quicker and more accurate decisions due to their enhanced farming skills and abilities.

3.3 Difference in Income between Post-Harvest Tobacco Farmers and Red Chili Farmers

Financial analysis of post-harvest tobacco and red chili farming using the R/C ratio can be observed in Table 2. Based on Table 2, it is clear that there is a notable income difference of 42.26% between the income of post-harvest tobacco farmers and non-tobacco (red chili) farmers. This difference is attributed to the fact that post-harvest tobacco farming tends to generate higher income compared to red chili farming.

Table 2. Analysis of Post-Harvest Tobacco and Red Chili Farming

Farming Classification	Unit	Post-Harvest Tobacco	Red Chili
Total Farming Costs (average)	Rp	27,042,469	53,532,193
Farming Revenues (average)	Rp	168,633,671	180,210,264
Farming Income (average)	Rp	141,591,202	126,678,071
R/C *ratio*	-	6.24	3.37

The research location is known for its post-harvest tobacco cultivation and is strictly not allowed to be directly adjacent to horticultural crops. This is because post-harvest tobacco cultivation requires dry land, while horticultural crops require sufficient water availability. Therefore, post-harvest tobacco crops must be separated from horticultural crops, allowing for income differences among farmers with the same land area. The strict separation between post-harvest tobacco cultivation, requiring dry land, and horticultural crops, which depend on ample water supply, is enforced due to their differing land and water requirements, preventing direct adjacency to maintain crop quality and yield, leading to income disparities among farmers with similar land sizes in the region. To determine the income disparity between post-harvest tobacco farmers and post-harvest farmers, an independent sample t-test is used for analysis. The results of this analysis are presented in Table 3.

Table 3. Results of Independent Sample T-test Analysis of Farm Income

Farm Income	Levene's Test for quality of variances (Sig.)	t-test for Equality of Mean (Sig.)
Equal Variances Assumed	.001*	.003
Equal Variances Not Assumed		.004*
Mean of Post-Harvest Tobacco Farm	141,591,202	
Mean of Red Chili Farm	126,678,071	

The population variances of income between post-harvest tobacco farmers and red chili farmers can be observed in Levene's test for quality of variances, where the significance value is 0.001 < 0.05, indicating that the population variances of income for post-harvest tobacco farmers and red chili farmers differ significantly. The significant income disparity among farmers can be seen from the unequal variances not assumed in the t-test for equality of means, where the significance value is 0.004 < 0.05, indicating a significant difference between the income of post-harvest tobacco farmers and red chili farmers. Although both post-harvest tobacco and red chili crops are suitable for cultivation in the location, it turns out that post-harvest tobacco remains a high-value economic crop. This result aligns with previous studies, [29], [30], which state that the post-harvest tobacco commodity tends to have high-income levels, and only a few commodities can match such income levels, even though post-harvest tobacco carries high risks as well.

4 Conclusion

The results of this study indicate that the determining variables for farmers' decisions in choosing planting patterns are land area, income, and farming experience. In financial analysis, the income of post-harvest tobacco farmers is higher than that of red chili farmers. In addition, there is a significant difference in income between post-harvest tobacco farmers and red chili farmers.

The study's findings provide valuable recommendations for both the government and farmers to enhance the agricultural sector. For the government, it is crucial to design targeted policies that support increased income opportunities for farmers, considering factors like land area, income levels, and farming experience. These policies should encompass better access to agricultural resources, education, training programs, and improved market access. Such measures can empower farmers to diversify their crops, adopt modern farming techniques, and explore value-added agricultural activities. Additionally, bolstering rural infrastructure and facilitating market access can further enhance their profitability.

Farmers, on the other hand, should focus on income-enhancing strategies tailored to their resources and expertise. This includes diversifying crops, optimizing financial management, staying updated on agricultural advancements, conducting market research, collaborating with experts and peers, and effectively managing risks. The incorporation of environmental considerations and sustainable practices is also essential. By combining government support with informed decision-making, both parties can work together to develop more effective crop selection and planting strategies, ultimately contributing to a more resilient and profitable agricultural landscape.

Acknowledgement:
The authors would like to thank the Directorate of Research, Technology, and Community Service from the Ministry of Education, Culture, Research, and Technology of the Republic of Indonesia, which provided research grants, namely Higher Education Excellence Basic Research (Penelitian Dasar Unggulan Perguruan Tinggi/PDUPT) in 2022-2024.

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Contribution of Individual Authors to the Creation of a Scientific Article (Ghostwriting Policy)

The authors equally contributed to the present research, at all stages from the formulation of the problem to the final findings and solution.

Sources of Funding for Research Presented in a Scientific Article or Scientific Article Itself

This research was funded by the Directorate of Research, Technology, and Community Service, the Ministry of Education, Culture, Research, and Technology of the Republic of Indonesia through research grants, namely Higher Education Excellence Basic Research (Penelitian Dasar Unggulan Perguruan Tinggi/PDUPT) in 2022-2024.

Conflict of Interest

The authors have no conflicts of interest to declare.